The Thai Journal of Orthopaedic Surgery

The Official Journal of the Royal College of Orthopaedic Surgeons of Thailand

The Official Journal of Thai Hip & Knee Society
The Official Journal of Spine Society of Thailand
The Official Journal of Thai Orthopaedic Society for Sports Medicine
The Official Journal of Thai Musculoskeletal Tumor Society
The Official Journal of Thailand Orthopaedic Trauma
The Official Journal of Thai Society for Hand Surgery of RCOST
The Official Journal of Pediatric Orthopaedic Society
The Official Journal of Thailand Orthopaedic Foot and Ankle Society
The Official Journal of Metabolic Bone Disorder and Orthogeriatrics

ISSN 0125-7552

Volume 40 / Number 3-4 July-October 2016

The Thai Journal *Of* Orthopaedic Surgery

The Official Journal of the Royal College of Orthopaedic Surgeons of Thailand

The Official Journal of Thai Hip & Knee Society
The Official Journal of Spine Society of Thailand
The Official Journal of Thai Orthopaedic Society for Sports Medicine
The Official Journal of Thai Musculoskeletal Tumor Society
The Official Journal of Thailand Orthopaedic Trauma
The Official Journal of Thai Society for Hand Surgery of RCOST
The Official Journal of Pediatric Orthopaedic Society
The Official Journal of Thailand Orthopaedic Foot and Ankle Society
The Official Journal of Metabolic Bone Disorder and Orthogeriatrics

ISSN 0125-7552

Volume 40 / Number 3-4 July-October 2016

The Council Members of the Royal College of Orthopaedic Surgeons of Thailand (RCOST) 2014-2016

President	**Sukit Saengnipanthkul, MD**
Immediate Past President	**Thavat Prasartritha, MD**
President Elect	**Banchong Mahaisavariya, MD**
1st Vice-President	**Manoj Chantarasorn, MD**
2nd Vice-President	**Kanyika Chanmiprasas, MD**
Registrar	**Thana Turajane, MD**
Treasurer	**Pornpavit Sriphirom, MD**
Secretary General	**Charlee Sumettavanich, MD**
Assistant Secretary General	**Saradej Khuangsirikul, MD**
Promotion	**Thipachart Bunyaratabandhu, MD**
Council Members	**Pornchai Mulpruek, MD**
	Sumroeng Neti, MD
	Pijaya Nagavajara, MD
	Aree Tanavalee, MD
	Warat Tassanawipas, MD
	Wanchai Sirisereewan, MD
	Kitiwan Vipulakorn, MD
	Keerati Chareancholvanich, MD
	Vera Sathira-Angkura, MD
	Chanyut Suphachatwong, MD
	Theerachai Apivatthakakul, MD
	Thammanoon Srisa-Arn, MD
	Somkid Lertsinudom, MD
	Werayudth Chaopricha, MD
Advisory Board	**Samak Bukkanasen, MD**
	Natee Rukpollamuang, MD
	Direk Israngkul, MD
	Suprija Mokkhavesa, MD
	Charoen Chotigavanich, MD
	Pongsak Vathana, MD
	Prasit Gonggetyai, MD
	Chaithavat Ngarmukos, MD
	Thamrongrat Keokarn, MD
	Suthorn Bavonratanavech, MD
	Wichien Laohacharoensombat, MD
	Saranatra Waikakul, MD
	Adisorn Patradul, MD

The Thai Journal of Orthopaedic Surgery

Current Editorial Board (2015-2016)

Editorial office address: The Royal College of Orthopaedic Surgeons of Thailand
4 th Floor, Royal Golden Jubilee Building, 2 Soi Soonvijai, New Petchburi Road, Bangkapi, Huay Khwang, Bangkok 10310
E-mail: secretariat@rcost.or.th
Telephone: +66 2 7165436-7
The Journal is free online at http://www.rcost.or.th, http://thailand.digitaljournals.org/index.php/JRCOST

สมาชิกดีเด่น
ราชวิทยาลัยแพทย์ออร์โธปิดิกส์แห่งประเทศไทย

สมาชิกดีเด่น สาขาบริการ
ผศ.นพ. วิศิษฏ์ วามวาณิชย์
Assistant Prof. Visit Vamvanij

หน้าที่การงานปัจจุบัน: ผู้อำนวยการโรงพยาบาลศิริราช

สถานที่ทำงาน: โรงพยาบาลศิริราช คณะแพทยศาสตร์ศิริราชพยาบาล

ประวัติการศึกษา การฝึกอบรมและดูงาน

ระดับการศึกษา	คุณวุฒิ	สถานศึกษา	ปีที่สำเร็จการศึกษา
ปริญญาตรี	แพทยศาสตรบัณฑิต	คณะแพทยศาสตร์ศิริราชพยาบาล	๒๕๓๐
ปริญญาเอก	ว.ว.ศัลยศาสตร์ออร์โธปิดิกส์	คณะแพทยศาสตร์ศิริราชพยาบาล	๒๕๓๖
หลังปริญญาเอก	Clinical Fellow in Spine Surgery Special Spine Fellow in Orthopaedic Surgery.	ภาควิชาศัลยศาสตร์ออร์โธปิดิคส์และกายภาพบำบัด State University of New York, Health Science Center at Syracuse,USA.	๒๕๓๖ – ๒๕๓๗ ๒๕๓๘ – ๒๕๔๐
อื่น ๆ	อบรมหลักสูตรพัฒนาคุณภาพ ๑. Mini MPA ๒. Mini MBA (CEO 2) ๓ อบรมผู้บริหารหลักสูตรพัฒนาผู้บริหารสถาบันผลิตแพทย์แห่งประเทศไทย (กสพท. รุ่น ๕) ๔.Master of Business Administration (Executive) ๕. The Executive Program Strategy and Innovation for Business in Asia. ๖.Hospital Management Executive Program.	คณะแพทยศาสตร์ศิริราชพยาบาล Assumption Business Administration College (ABAC) สถาบันผลิตแพทย์แห่งประเทศไทย Sasin Chulalongkorn University. CMMU-SLOAN School of Management, MIT, USA. Singapore Management University.	 ๒๒ ก.พ.-๘ เม.ย. ๒๕๔๘ ๒๒ มี.ค-๒๘ เม.ย. ๒๕๔๗ ๒๕๕๔ – ๒๕๕๖ ๒๕๕๕ ๒๕๕๖

หัวข้อ	รายละเอียด	
ตำแหน่งปัจจุบัน	ผู้อำนวยการโรงพยาบาลศิริราช	พ.ศ.2556 – ปัจจุบัน
ผลงานในอดีต	รองคณบดีฝ่ายทรัพยากรกายภาพและสิ่งแวดล้อม	พ.ศ.2554-2556
	รองคณบดีฝ่ายทรัพย์สินและระบบสนับสนุน	พ.ศ.2551-2554
	รองผู้อำนวยการโรงพยาบาลศิริราช	พ.ศ.2546-2551
	ผู้อำนวยการโรงพยาบาลโพธิ์ชัย จ.ร้อยเอ็ด	พ.ศ.2532-2533
ผลงานด้านบุคคล	1. บุคลากรดีเด่น Quality person of the year 2008 ของคณะแพทยศาสตร์ศิริราชพยาบาล 2. รางวัลมหาวิทยาลัยมหิดล สาขาการบริการ ประจำปีการศึกษา 2558	
ผลงานด้านออร์โธปิดิกส์	● วิทยากร / ประธานร่วม ในการประชุมวิชาการ Operative Couse และ Basic Spine Couse ของ Spine Section of RCOST ● บทความทางวิชาการ 7 บทความ (ตามเอกสารแนบ)	
ผลงานด้านบริหาร	● กรรมการดำเนินการพัฒนาศิริราชสู่ความเป็นเลิศในเอเชียอาคเนย์ (สถาบันการแพทย์สยามินทราธิราช) ● เข้าร่วมโครงการแก้ไขปัญหาการจราจร ระบบระบายน้ำ และ การเชื่อมต่อระบบขนส่งมวลชนบริเวณโดยรอบโรงพยาบาลศิริราช ● นำโรงพยาบาลศิริราชผ่านการรับรองคุณภาพขั้นก้าวหน้า Advance HA จาก สถาบันรับรองคุณภาสถานพยาบาล (องการมหาชน) เป็นโรงพยาบาลแรกของประเทศไทย ● นำโรงพยาบาลศิริราชเข้ารับรางวัล Golden Awards จาก Thailand Lean Awards 2015 จัดโดย สมาคมส่งเสริมเทคโนโลยี (ไทย-ญี่ปุ่น)	

ผลงานดีเด่น

ปีงบประมาณ	ชนิด/ประเภท	ผลงาน/กิจกรรมหรือการปฏิบัติที่ได้รับการยกย่อง
๒๕๕๖ - ปัจจุบัน	วิทยากร	HA National forum ครั้งที่ ๑๔,๑๕,๑๖ หัวข้อบรรยายเกี่ยวกับการบริหารองค์กร การบริหารคุณภาพ การจัดการสิ่งแวดล้อม ระบบสนับสนุน
๒๕๕๗	วิทยากร	World Healthcare Asia @2012, Singapore
๒๕๕๘	รางวัลการบริหารจัดการ	Golden Award Thailand Lean Award 2015 จัดโดยสมาคมส่งเสริมเทคโนโลยีไทย – ญี่ปุ่น
๒๕๕๗	การรับรองคุณภาพโรงพยาบาล	นำโรงพยาบาลศิริราชผ่านการรับรองมาตรฐานคุณภาพขั้นก้าวหน้า (Advanced HA) โดย สรพ. เป็นโรงพยาบาลแรกของประเทศ
๒๕๕๖ - ๒๕๕๗	รางวัลเกียรติยศด้านบริการทางการแพทย์	Best medical performance award จัดโดย บริษัท อลิอันซ์-อยุธยา จำกัด
๒๕๕๙	การรับรองคุณภาพโรงพยาบาล	นำโรงพยาบาลศิริราช ผ่านการรับรองคุณภาพมาตรฐานเฉพาะโรค วันที่ ๙ มีนาคา ๒๐๑๖ รับกิตติกรรมประกาศ 17th HA National Forum คุณภาพในทุกลมหายใจ – Enjoy Quality Every Movement - การดูแลผู้ป่วยผ่าตัดเปลี่ยนข้อเข่าเทียม - การดูแลรักษาผู้ป่วยผ่าตัดปลูกถ่ายอวัยวะตับ

งานบริการวิชาการ

- วิทยากรบรรยาย Panel Discussion:Leadership Experience of Key driver and AHA Journey HA National Forum วันที่ ๗ มกราคม ๒๕๕๙ โรงแรมนารายณ์
- วิทยากรบรรยาย การประชุมวิชาการศิริราช "BCM"
- Moderator:Video Session II การประชุม The 4th Combined Meeting of Spinal and Paediatric Sections of WPOA ,The 21st Annual Meeting of the Royal College of Orthopaedic Surgeons of Thakland and The Thai Orthopaedic Association ในวันที่ ๑ ตุลาคม ๒๕๔๒ ณ Royal Cliff Beach Resort พัทยา จังหวัดชลบุรี
- Moderator:Lucheon Lecture VII การประชุม The 4th Conbined Meeting of Spine and Paediatric Sections of WPOA, The 21st Annual Meeting of the Royal College of Orthopaedic Surgeons of Thailand and The Thai Orthopaedic Association ในวันที่ ๒๓ ตุลาคม ๒๕๔๒ ณ Royal Cliff Beach Resort พัทยา จังหวัดชลบุรี
- Co-Chairperson:Session II: Free Paper II การประชุม Combined Meetion 20th Annual ASEAN Orthopaedic Association, 22nd Annual Meeting of the Royal College of Orthopaedic Surgeons of Thailand in Association with SICOT ๒๑ ตุลาคม ๒๕๔๓ ณ Royal Cliff Beach Resort พัทยา จังหวัดชลบุรี
- ประธานร่วม การประชุมปฏิบัติการเรื่อง Degenerative disease of the spine จัดโดย Spine Section Of the Royal College of Orthopaedic Surgeons of Thailand ร่วมกับภาควิชาออร์โธปิดิกส์ คณะแพทยศาสตร์มหาวิทยาลัยเชียงใหม่ ๒๔ มกราคม ๒๕๔๔
- Moderator:Symposium "Update in Spinal Surgery" การประชุม 111 Years Anniversary of the Medical School Faculty of Medicine Siriraj Hospital วันที่ ๘ มีนาคม ๒๕๔๔ ห้องอทิตยาธรกิติคุณ ตึกสยามินทร์ ชั้น ๗
- วิทยากรบรรยายเรื่อง "Cervical spindylotic myelopathy" วันที่ ๒๒ เมษายน ๒๕๔๒ ณ ห้องประชุมดิษฐศักดิ์ศรี ชั้น ๒ ตึก ๓๓ ปี โรงพยาบาลเลิศสิน
- วิทยากรบรรยายเรื่อง "Traumatic Problem in Paediatric Spine" การประชุมอบรมทางวิชาการ Paediatric Orthopaedics Review Course ๑๙๙๙ โดยราชวิทยาลัยแพทย์ออร์โธปิดิกส์แห่งประเทศไทย วันที่ ๘ พฤษภาคม ๒๕๔๒ ณ ห้องประชุม บุรพรัตน์ อาคารคุ้มเกล้า โรงพยาบาลภูมิพลอดุยเดช
- วิทยากรบรรยายเรื่อง "Approach to C-spine Injuries" การประชุม The 4th Spine Operative Course of RCOST (Spinal Injures) วันที่ ๑๗ กุมภาพันธ์ ๒๕๔๓ ณ ห้องประชุม ชั้น ๔ ตึกอำนวยการ โรงพยาบาลนครปฐม
- วิทยากรบรรยายเรื่อง "Complications in Cervical Spine Surgery" การจัดประชุมเชิงปฏิบัติการเรื่อง "Degenerative Disease of The Spine" วันที่ ๔๒-๒๕ มกราคม ๒๕๔๔ ณ ภาควิชาออร์โธปิดิกส์ คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่
- วิทยากรบรรยายเรื่อง "กระดูกสันหลังหัก" เนื่องในวันครบรอบ ๘๐ ปี การก่อตั้งแพทยสมาคมแห่งประเทศไทย วันที่ ๒๘ ตุลาคม ๒๕๔๔ ณ ห้องประชุม R6 IMPACT เมืองทองธานี กรุงเทพมหานคร

- เป็นกรรมการในคณะอนุกรรมการฝ่ายวิชาการ และเข้าร่วมเป็นกรรมการจัดการประชุม The 4th Combined Meeting of Spinal and Pediatric Sections of WPOA,The 21st Annual Meeting of the Royal College of Orthopaedic Surgeons of Thailand and The Thai Orthopaedic Association ระหว่างวันที่ ๒๐-๒๓ ตุลาคม ๒๕๔๒
- เป็นอนุกรรมการสาขาวิชาย่อย Spine ในราชวิทยาลัยแพทย์ออร์โธปิดิกส์แห่งประเทศไทย วันที่ ๑๐ พฤษภาคม ๒๕๔๔
- เป็นเลขาธิการ ในกรรมการจัดการบรรยาย "Instructional Course Lecture in Spinal Disorders" ประจำปี ๒๕๔๔ วันที่ ๑๓ กันยายน ๒๕๔๔ ณ อาคารเฉลิมพระบารมี ๕๐ ปี ซอยศูนย์วิจัย ถนนเพชรบุรีตัดใหม่
- กรรมการวิชาการ คณะที่ ๖๔๖ มาตรฐานวัสดุอุปกรณ์ที่ฝังในทางศัลยกรรม วันที่ ๗ กันยายน ๒๕๔๔

ผลงานทางวิชาการ

เอกสารประกอบการสอน

- วิดีทัศน์ประกอบการสอน เรื่อง Casting and bandging ร่วมกับ รศ.นพ.สุรินทร์ ธนพิพัฒนศิริ รศ.นพ.วิทเชษฐ พิชัยศักดิ์, ผศ.นพ.ปรีชา รักษ์พลเมือง สำหรับบรรยายวิชา SIOR ๕๑๑ ศรอธ ๕๑๑ หลักสูตรแพทยศาสตรบัณฑิต คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล นักศึกษาแพทย์ ชั้นปีที่ ๕ ปีการศึกษา ๒๕๔๒-๒๕๔๔
- สื่อการสอนโดยใช้คอมพิวเตอร์ช่วย (Computer Assisted Instruction) เรื่อง Thoracolumbar Fracture Dislocation สำหรับการบรรยายวิชา SIOR ๕๑๑ ศรอธ ๕๑๑ หลักสูตรแพทยศาสตรบัณฑิต คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล นักศึกษาแพทย์ชั้นปีที่ ๕ ปีการศึกษา ๒๕๔๔

ตำรา

- ตำรากระดูกหักและข้อเคลื่อนบริเวณข้อศอกและแขนส่วนปลาย (Fracture and Dislocations around the Elbow and Forearm) ผู้ช่วยศาสตราจารย์นายแพทย์วิศิษฏ์ วามวาณิชย์
- ตำราโรคติดเชื้อของกระดูกและข้อ (Bone and Joint Infection) ศาสตราจารย์เกียรติคุณนายแพทย์นที รักษ์พลเมือง/ผู้ช่วยศาสตราจารย์นายแพทย์วิศิษฏ์ วามวาณิชย์

งานวิจัย

- **Visit Vamvanij,** Bruce E. Rerdrickson, Joshua M.Thrope, Michael E. Stadnick, Hansen A.Yuan. Surgical Treatment of Internal Disc Disruption:An Outcome Study of Four Fusion Techinque. J Spine Disorders ๑๙๙๘;๓๗๕-๘๒.
- Vamvanij V. Taweebanjongsilp T, Luksanapruksa P. Predictive factors for vertebroplasty in osteoporotic vertebral compression fractures. Siriraj Med J ๒๐๑๕;๖๗:๒๘๐-๒๘๔.
- Vamvanij V. Ruangchainikom M, Thanapipatsiri S, Pichaisak W. The outcomes of combined posterior instrumentation and anterior radical debridement with fusion for multilevel spinal tuberculosis. J Med Assoc Thai ๒๐๑๔; ๙๗ (Suppl ๙): S ๕๐-๕.
- Foead A, Thanapipatsiri S, Pichaisak W, Vamvanij V. Osteoporotic compression fracture of spine Treated with posterior instrumentation and transpedicular bone grafting. Malays Orthop J ๒๐๑๒;๖ (Suppl.๙): ๖-๑๐. Chawalparit O, Churojana A, Chiewvit P, Thanapipatsiri S, Vamvanij V, Charnchaowanish P. The Limited protocol MRI in diagnosis of lumbar disc herniation. J Med Assoc Thai ๒๐๐๖;๘๙:๑๘๒-๑๘๙.

งานวิจัยที่นำเสนอต่อที่ประชุมวิชาการ (Abstract)

- Combined Anterior Fusion with Posterior Instrumentation for the Treatment of Tuberculous Spondylitis การประชุม The Centenary Celebrations of the Birth of Her Royal Highness Princess Srinagarindra The Princess Mother" วันอังคารที่ ๗ มีนาคม ๒๕๔๓ ณ ห้อง ๘๐๑๐ ตึกสยามินทร์ ชั้น ๘ โรงพยาบาลศิริราช
- Role of Spinal Instrumentation in the Management of Degenerative Lumbosacral Disorders การประชุม Combined Meeting, 20th Annual ASEAN Orthopaedic Association, 22nd Annual Meeting of The Royal College of Orthopaedic Surgeons of Thailand in Association with SICOT วันที่ ๒๑ ตุลาคม ๒๕๔๓ ณ ห้อง Orchid A โรงแรม Royal Cliff Beach Resort พัทยา จังหวัดชลบุรี

บทความทางวิชาการ

1. Vamvanij V, Ruangchainikom M, Thanapipatsiri S, Pichaisak W. The outcomes of combined posterior instrumentation and anterior radical debridement with fusion for multilevel spinal tuberculosis. J Med Assoc Thai. 2014 Sep;97 Suppl 9:S50-5.
2. Chuckpaiwong B, Vamvanij V, Asavamongkolkul A, Limwongse C, Thanapipatsiri S, Kaewpornsawan K, Kulthanan T. Medical Utilization Review by Indicators ORTHOPAEDICS in Orthopaedic. Siriraj Med J 2006;58(3):720 – 724.
3. Chawalparit O, Churojana A, Chiewvit P, Thanapipatsir S, Vamvanij V, Charnchaowanish P. The limited protocol MRI in diagnosis of lumbar disc herniation. J Med Assoc Thai. 2006 Feb;89(2):182-9.
4. Vamvanij V, Ferrara LA, Hai Y, Zhao J, Kolata R, Yuan HA. Quantitative changes in spinal canal dimensions using interbody distraction for spondylolisthesis. Spine (Phila Pa 1976). 2001 Feb 1;26(3):E13-8.
5. Vamvanij V, Fredrickson BE, Thorpe JM, Stadnick ME, Yuan HA. Surgical treatment of internal disc disruption: an outcome study of four fusion techniques.J Spinal Disord. 1998 Oct;11(5):375-82.

รางวัลดีเด่นที่เคยได้รับ

- รางวัลการบริหารจัดการ Golden Award from Thailand Lean Award 2015 จัดโดย สมาคมส่งเสริมเทคโนโลยีไทย – ญี่ปุ่น
- การรับรองคุณภาพโรงพยาบาล นำโรงพยาบาลศิริราชผ่านการรับรองมาตรฐานคุณภาพขั้นก้าวหน้า (Advanced HA) โดย สรพ. เป็นโรงพยาบาลแรกของประเทศ พ.ศ.๒๕๕๗
- รางวัลเกียรติยศด้านบริการทางการแพทย์ Best Medical Performance Award (2012-2014) จัดโดย บริษัท อลิอันซ์ – อยุธยา จำกัด
- รางวัลมหาวิทยาลัยมหิดล สาขาการบริการประจำปี ๒๕๕๘

สมาชิกดีเด่น สาขาวิชาการ

ศ. นพ. อภิชาต อัศวมงคลกุล

Dr. Apichat Asavamongkolkul

หน้าที่การงานปัจจุบัน

รองคณบดีฝ่ายบริหาร คณะแพทยศาสตร์ศิริราชพยาบาล

ประธานคณะกรรมการดำเนินการโครงการเยาวชนรางวัลสมเด็จเจ้าฟ้ามหิดล

สถานที่ทำงาน ภาควิชาศัลยศาสตร์ออร์โธปิดิคส์และกายภาพบำบัด คณะแพทยศาสตร์ศิริราชพยาบาล

ประวัติการศึกษา การฝึกอบรมและดูงาน

ระดับการศึกษา	คุณวุฒิ	สถานศึกษา	ปีที่สำเร็จการศึกษา
ปริญญาตรี	แพทยศาสตรบัณฑิต	คณะแพทยศาสตร์ศิริราชพยาบาล	๒๕๓๐
ประกาศนียบัตรชั้นสูงทางวิทยาศาสตร์การแพทย์คลินิก	ศัลยศาสตร์ออร์โธปิดิกส์ฯ	คณะแพทยศาสตร์ศิริราชพยาบาล	๒๕๓๔
ปริญญาเอก	ว.ว.ศัลยศาสตร์ออร์โธปิดิกส์	คณะแพทยศาสตร์ศิริราชพยาบาล	๒๕๓๖
หลังปริญญาเอก	Certification of Orthopaedic Fellow in Oncology Certification of Orthopaedic Fellow in Oncology	คณะแพทยศาสตร์ศิริราชพยาบาล University of California, Los Angeles (UCLA)	๒๕๓๗ ๒๕๔๑
อนุมัติบัตร	เวชศาสตร์ครอบครัว	แพทยสภา	๒๕๔๕

ประวัติการทำงาน

หัวข้อ	รายละเอียด
ตำแหน่งปัจจุบัน	๑. รองคณบดีฝ่ายบริหาร คณะแพทยศาสตร์ศิริราชพยาบาล พ.ศ.๒๕๕๘ – ปัจจุบัน ๒. ประธานคณะกรรมการดำเนินการโครงการเยาวชนรางวัลสมเด็จเจ้าฟ้ามหิดล พ.ศ.๒๕๕๑ – ปัจจุบัน ๓. กองบรรณาธิการตำรา “ออร์โธปิดิกส์ปัญญาวัตร 1” ราชวิทยาลัยแพทย์ออร์โธปิดิกส์แห่งประเทศไทย ๔. กองบรรณาธิการวารสาร Journal of Orthopaedic Surgery (Hong Kong) ๕. กองบรรณาธิการวารสารราชวิทยาลัยแพทย์ออร์โธปิดิกส์แห่งประเทศไทย
ตำแหน่งในอดีต	๑. รองคณบดีฝ่ายบริหาร คณะแพทยศาสตร์ศิริราชพยาบาล พ.ศ.๒๕๕๐ – ๒๕๕๔ ๒. รองหัวหน้าภาควิชาฝ่ายบริหาร พ.ศ.๒๕๕๔ – ๒๕๕๘ ๓. ประธานอนุสาขาเนื้องอกกระดูกและเนื้อเยื่อเกี่ยวพันราชวิทยาลัยแพทย์ออร์โธปิดิกส์แห่งประเทศไทย พ.ศ.๒๕๕๒ – ๒๕๕๕ ๔. รองเลขานุการกรรมการบริหารราชวิทยาลัยฯ พ.ศ.๒๕๔๘ – ๒๕๕๑ ๕. รองประธานฝ่ายวิชาการ การประชุม The 18th Biennial Congress of Asia Pacific Orthopaedic Association (APOA) And the 36th Annual Meeting of the Royal College of Orthopaedic Surgery of Thailand (RCOST) พ.ศ.๒๕๕๗
ผลงานด้านบุคคล	๑. ชนะเลิศรางวัลที่ 1 การประกวดการนำเสนอผลการทำวิจัยของแพทย์ประจำบ้าน เรื่อง Biomechanic Study of the Effect of Lateral Compression Force on Stability of Pelvic Ring:Comparing between Intact Anterior Column an Posterior Column ในการประชุมวิชาการประจำปี SICOT Pre-Congress และสมาคมออร์โธปิดิกส์แห่งประเทศไทย พ.ศ.๒๕๓๖ ๒. รางวัลอาจารย์ที่ปรึกษาดีเด่น มหาวิทยาลัยมหิดล พ.ศ.๒๕๔๖ ๓. ได้รับการแต่งตั้งให้ดำรงตำแหน่ง “ศาสตราจารย์” เมื่อ วันที่ ๒๖ พฤษภาคม ๒๕๕๗
ผลงานด้านออร์โธปิดิกส์	๑. รางวัลชมเชยจากสภาวิจัยแห่งชาติ พ.ศ.๒๕๔๖ จาก สิ่งประดิษฐ์คิดค้นเรื่อง “Knee Model for Arthrocentesis Simulation” ได้รับสิทธิบัตรการประดิษฐ์ หมายเลข ๐๘๒๔๒๔ ๒. International Advisory Board Committee, Asia Pacific Musculokeletal Tumor Society, 2002-present ๓. ได้รับเชิญเป็นวิทยากรบรรยาย สาธิตการผ่าตัดและประธาน ดำเนินการอภิปรายในการประชุมวิชาการ รวมถึงสถาบัน ต่างๆ ทั้งภายในและต่างประเทศจำนวนกว่า ๒๐๐ ครั้ง
ผลงานด้านวิชาการ	๑. รางวัลตำรา “ดีเด่น” ศิริราช-มหิดล ประจำปี ๒๕๕๗ คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล ๒. รางวัลมหาวิทยาลัยมหิดล สาขาการแต่งตำรา ประจำปี ๒๕๕๗ ๓. มีผลงานตีพิมพ์ในวารสารจำนวน ๖๒ ฉบับ โดยเป็นผลงานในวารสารวิชาการระดับนานาชาติ จำนวน ๓๖ ฉบับ ๔. มีผลงานการนิพนธ์ในตำรา จำนวน ๓๔ บท โดยรับเป็นบรรณาธิการในตำรา ๒ เล่ม

ผลงานดีเด่น

ประธาน/ประธานร่วม การประชุมวิชาการ

1. รับเชิญเป็นประธานร่วมในการประชุมวิชาการ The 20th Annual ASEAN Orthopaedic Association, the 22nd Annual Meeting of The Royal College of Orthopaedic Surgeons of Thailand in Association with SICOT วันที่ 22 ตุลาคม พ.ศ. 2543
2. รับเชิญเป็นประธานร่วมในการประชุมวิชาการ The 25th Annual Meeting of The Royal College of Orthopaedic Surgeons of Thailand (RCOST) วันที่ 23 ตุลาคม พ.ศ. 2546
3. รับเชิญเป็นประธานร่วมในการเสนอผลงานทางวิชาการในการประชุมฟื้นฟูวิชาการประจำปี ครั้งที่ 44 คณะแพทยศาสตร์ศิริราชพยาบาล เมื่อวันที่ 18 มีนาคม พ.ศ. 2547
4. รับเชิญเป็นผู้ดำเนินการอภิปรายในการประชุมวิชาการ Instructional CourseLecture: Musculoskeletal Tumors ในการประชุม The 2nd ASEAN-AAOS Instructional Course and the Combined Meeting of the 24th AOA Annual Meeting and the 26th Annual Meeting of the Royal College of Orthopaedic Surgeons of Thailand (RCOST) วันที่ 13 ตุลาคม พ.ศ.2547
5. รับเชิญเป็นผู้ดำเนินการอภิปรายในการประชุมวิชาการในการประชุม “Protecting the GI Mucosa from Acid and NSAIDs-related Complications” บริษัท AstraZeneca ณ โรงแรมไอยราปารค์ จังหวัดอุทัยธานี เมื่อวันที่ 18 กันยายน พ.ศ.2548
6. รับเชิญเป็น Scientific Program Coordinator ในการประชุม the Sixth Meeting of Asia Pacific Musculoskeletal Tumor Society จังหวัดเชียงใหม่ กรุงเทพฯ วันที่18-20 พ.ศ.2549
7. รับเชิญเป็นผู้ดำเนินการอภิปรายในการประชุมวิชาการในการประชุม “How to Avoid GI Complications in NSAID Users” บริษัท AstraZeneca ณ คีรี-มายารีสอร์ต จังหวัดนครราชสีมา เมื่อวันที่ 10 มิถุนายน พ.ศ.2549
8. รับเชิญเป็นผู้ดำเนินการอภิปรายในการประชุมวิชาการในการประชุม “Evidence based Management of Bone Metastasis” บริษัท Novartis ณ ห้องประชุมพจมาน ทักษิณ โรงพยาบาลพระมงกฎเกล้า จังหวัดกรุงเทพ ฯ เมื่อวันที่ 26 สิงหาคม พ.ศ.2549
9. รับเชิญเป็นผู้ดำเนินการอภิปราย Luncheon Symposium “ COX-2 Inhibitors and Pain Management” ร่วมกับบริษัท Pfizer (Thailand) ในการประชุมวิชาการ Instructional Course Lecture: Musculoskeletal Tumors ในการประชุม The 3rd ASEAN-AAOS Instructional Course and the 28th Annual Meeting of the Royal College of Orthopaedic Surgeons of Thailand (RCOST) วันที่ 20 ตุลาคม พ.ศ. 2549
10. รับเชิญเป็นผู้ดำเนินการอภิปราย RCOST Symposium “ Advances in Limb Sparing Surgery” ในการประชุมวิชาการ Instructional Course Lecture: Musculoskeletal Tumors ในการประชุม The 3rd ASEAN-AAOS Instructional Course and the 28th Annual Meeting of the Royal College of Orthopaedic Surgeons of Thailand (RCOST) วันที่ 21 ตุลาคม พ.ศ. 2549
11. รับเชิญเป็นผู้ดำเนินการอภิปรายในการประชุมวิชาการในการประชุม “Evidence based Management of Bone Metastasis” บริษัท Novartis ณ โรงพยาบาลศรีนครินทร์ จังหวัดขอนแก่น เมื่อวันที่ 17 พฤศจิกายน พ.ศ.2549

12. รับเชิญเป็นผู้ดำเนินการอภิปรายในการประชุมวิชาการในการประชุม “Principle use of Bisphosphonate” บริษัท Roche ในการประชุมวิชาการ the 29th Annual Meeting of the Royal College of Orthopaedic Surgeons of Thailand (RCOST) and the Meeting of Bone and Joint Decade (BJD) and Asian Federation of Sports Medicine (10th AFSM) วันที่ 19 ตุลาคม พ.ศ.2550
13. รับเชิญเป็นผู้ดำเนินการอภิปรายในการประชุมวิชาการในการประชุม “Optimal Way of Balancing Risks and Benefit of NSAIDs” บริษัทแอส-ตร้าเซนเนก้า ในการประชุมวิชาการ the 29th Annual Meeting of the Royal College of Orthopaedic Surgeons of Thailand (RCOST) and the Meeting of Bone and Joint Decade (BJD) and Asian Federation of Sports Medicine (10th AFSM) วันที่ 21 ตุลาคม พ.ศ.2550
14. รับเชิญเป็นประธานการนำเสนอผลงานทางวิชาการในหัวข้อเรื่อง “Metastatic Bone Tumors” ในการประชุมวิชาการ The 7th Asia Pacific Musculoskeleta l Tumor Society Meeting (APMSTS), Beijing International Convention Center นครปักกิ่ง ประเทศสาธารณรัฐประชาชนจีน วันที่ 26 กันยายน พ.ศ.2551
15. รับเชิญเป็นผู้ดำเนินการอภิปราย RCOST Symposium “Lump and Bump: How to Stay Out of Trouble” ในการประชุมวิชาการ The 30th Annual Meeting of the Royal College of Orthopaedic Surgeons of Thailand (RCOST) วันที่ 23 ตุลาคม พ.ศ.2551
16. รับเชิญเป็นประธานร่วม Tumor Symposium ในการประชุมวิชาการ The Combined Meeting of the 6th SICOT/SIROT International Conference and the 31st Annual Meeting of the Royal College of Orthopaedic Surgeons of Thailand วันที่ 31 ตุลาคม พ.ศ.2552

การมีผลงานตีพิมพ์ในวารสาร

1. Saengwichian S, Janthong S, Amornmetrajit K, Rojananin J, **Asavamongkolkul A**. Bioplastic. Siriraj Hosp Gaz 1991; 43: 862-866.
2. **Asavamongkolkul A**, Pipithkul S, Chotigavanich C. Fibrodysplasia ossificans progressiva: Report of a case and a review of the literature. J Thai Orthop Assoc 1994; 19: 54-61.
3. **Asavamongkolkul A**, Waikakul S, Chotigavanich C. Fibrodysplasia ossificans progressiva: A report of 3 cases. J Asean Orthop Assoc 1996; 10: 39-43.**
4. **Asavamongkolkul A**, Waikakul S, Chotigavanich C. Aggressive fibromatosis: A report of 10 cases and review of literature. J Thai Orthop Assoc 1996; 21: 72-77.
5. Malikao S, **Asavamongkolkul A**, Mahaisavariya B, Songcharoen P. The anatomical study of superficial radial nerve and extensor tendon of the hand in Thai people. J Thai Orthop Assoc 1996; 21: 137-145.
6. **Asavamongkolkul A**. Biopsy of musculoskeletal tumors. J Thai Orthop Assoc 1996; 21: 153-155.
7. Waikakul S, **Asavamongkolkul A**, Chotigavanich C. Bone tumour around the hip and pelvis. J Orthop Surg 1996; 4: 73-80.**
8. **Asavamongkolkul A**. The Staging and Surgery of Musculoskeletal Bone Tumors. J Thai Orthop Assoc 1998; 23: 59-64.
9. **Asavamongkolkul A**, Eckardt JJ, Eilber FR et al. Endoprosthetic reconstruction for malignant upper extremity tumors. Clin Orthop 1999; 360: 207-220.**

10. Eckardt JJ, Kabo M, Kelly CM, Ward WG, **Asavamongkolkul A**, Wirganowicz, PZ et al. Expandable endoprosthesis reconstruction in skeletally immature patients with tumors. Clin Orthop 2000; 373: 51-61.**
11. Harnroongroj T, **Asavamongkolkul A**, Chareancholvanich K. Reconstruction of the pelvic brim and its role in the reduction accuracy of displaced T-shaped acetabular fracture. J Med Assoc Thai 2000; 83: 483-493.**
12. **Asavamongkolkul A**, Jiranantakan T, Waikakul S, Phompitaksa K, Muangsomboon S. Malignant peripheral nerve sheath tumor with neurofibromatosis type 1: A 2-case report and review of literature. J Med Assoc Thai 2001; 84: 285-293.**
13. **Asavamongkolkul A**, Ruangsetakit C. False aneurysm of the brachial artery in supracondylar fracture treated with Kirschner wire fixation: A case report. Injury 2001; 32: 256-57.**
14. Waikakul S, **Asavamongkolkul A**, Penkitti P. Soparat K. Alendronate in metastasis bone Diseases. Thai J Orthop Surg 2001; 26: 52-6.
15. Chiewvit S, **Asavamongkolkul A**, Benjarassamerote S, Suntornpong N, Akewanlop C, Ratanawichitrasin S. The correlation between 99mTc MIBI scintigraphy alteration ratio and the tumor necrosis in primary bone and soft tissue malignant tumor. Thai J Orthop Surg 2001; 26: 74-8.
16. **Asavamongkolkul A**, Waikakul S, Chiewit P, Suntornpong N, Benjarassamerote S. The surgical management of sacrococcygeal chordoma. Thai J Orthop Surg 2001; 26: 79-86.
17. Waikakul S, **Asavamongkolkul A**, Kojaranon N, Benjarassamerote S, Muangsomboon S. Bone needle biopsy set: A local made at Siriraj Hospital. Thai J Orthop Surg 2001; 26: 96-9.
18. Chanchairujira K, Chung CB, Kwon ST, Chiewvit P, **Asavamongkolkul A**, Resnick DL. MR imaging features in 12 patients with chronic subacromial/subdeltoid bursitis with rice bodies: Rheumatoid arthritis and tuberculosis with emphasis on differentiating features. Radiology 2001. 221 (suupl): 523-4.**
19. Peungjesada S, Churojana A, Chiewvit P, Benjarassamerote S, **Asavamongkolkul A**. Malignant schwannoma in neurofibromatosis 1. Asean J Radio 2002; 3: 51-8.**
20. **Asavamongkolkul A**. The Siriraj musculoskeletal tumor board. Siriraj Hosp Gaz 2002; 54: 729-31.
21. Waikakul S, Vanadurongwan B, Chumtup W, **Asavamongkolkul A**, Chotivichit A, Rojanawanich V. A knee model for arthrocentesis simulation. J Med Assoc Thai 2003; 86: 282-7.**
22. **Asavamongkolkul A**, Pongkunakorn A, Harnroongroj T. Stability of Subchondral Bone Defect Reconstruction at Distal Femur: Comparison between Polymethylmethacrylate Alone and Steinmann Pin Reinforcement of Polymethymethacrylate. J Med Assoc Thai 2003; 86: 626-633.**
23. Chainamnan W, Churojana A, Lektrakul N, **Asavamongkolkul A**, Muangsomboone S, Phimolsarnti R, Wiakakul S. Giant cell tumor of the bone: Radiographic evaluation. Siriraj Hosp Gaz 2003; 55: 139-51.

24. Cannon CP, Eckardt JJ, Kabo JM, Ward WG Sr, Kelly CM, Wirganowicz PZ, **Asavamongkolkul A**, Nieves R, Eilber FR. Custom cross-pin fixation of 32 tumor endoprostheses stems. Clin Orthop 2003; 417: 285-92.**
25. **Asavamongkolkul A**, Lektrakul N, Suntornpong N, Akewanlop C, Ruangsetakit C, Benjarassamerote S. Deadly soft tissue sarcoma: Curable using a multidisciplinary approach. Siriraj Hosp Gaz 2003; 55: 324-35.
26. Wongkajornsilp A, Sangsuriyong S, Hongeng S, Waikakul S, **Asavamongkolkul A**, Huabprasert S. Effective osteosarcoma cytolysis using cytokine-induced killer cells pre-inoculated with tumor RNA-pulsed dendritic cells. J Orthop Research 2005; 23: 1460-6.**
27. Wongkajornsilp A, Sangsuriyong S, Hongeng S, Waikakul S, **Asavamongkolkul A**, Huabprasert S. Dose-dependent autogenic osteosarcoma cytolysis using cytokine-induced killer cells pre-inoculated with tumor RNA-pulsed dendritic ceslls. Siriraj Med J 2005; 57 (supplement): 24.
28. Thamrongsombatsakul S, Kulthanan T, **Asavamongkolkul A**, Kaewpornsawan K, Thanapipatsiri S, Vamvanij V, et al. Medical utilization review by indicators “ORTHOPAEDICS" in orthopaedic inpatients under universal coverage policy in Siriraj Hospital. Siriraj Med J 2005; 57 (supplement): 32.
29. Sutthiruangwong P, Thanakit V, **Asavamongkolkul A**. Angiomatoid fibrous histiocytoma with pain in a child. J Med Assoc Thai 2005; 88:1453-7.**
30. **Asavamongkolkul A**, Phimolsarnti R, Kiatsevee K, Waikakul S. Periacetabular limb-salvage surgery for malignant bone tumors. J Orthop Surgery (Hong Kong) 2005; 13: 273-9.**
31. Kiatisevi P, **Asavamongkolkul A**, Phimolsarnti R, Waikakul S, Benjarassamerote S. The outcomes and prognostic factors of patients with soft-tissue sarcoma. J Med Assoc Thai 2006; 89: 334-42.**
32. **Asavamongkolkul A**, Waikakul S, Phimolsarnti R, Kiatisevi P, Wangsaturaka P. The outcomes of endoprosthetic reconstruction for malignant bone and soft-tissue tumors: Siriraj experience. Siriraj Med J 2006; 58 (supplement): 4.
33. Waikakul S, **Asavamongkolkul A**. Wide resection of sacral malignant tumor via posterior approach. Siriraj Med J 2006; 58 (supplement): 10.
34. Wangsaturaka P, **Asavamongkolkul A**, Waikakul S, Phimolsarnti R. The results of surgical management of bone metastasis involving the periacetabular area. Siriraj Med J 2006; 58 (supplement): 14.
35. Chuckpaiwong B, Vamvanij V, **Asavamongkolkul A**, Limwongse C, Thanapipatsiri S, Kaewpornsawan K, Kulthanan T. Medical utilization review by indicators “ORTHOPAEDICS”. Siriaj Med J 2006; 58: 720-4.
36. **Asavamongkolkul A**. Osteosarcoma: An update management. Siriraj Med J 2006; 58: 989-94.
37. Kantaputra PN, Limwongse C, Koolvisoot A, **Asavamongkolkul A**, Tayavitit S. New syndrome: A newly recognized polyosteolysis/hyperostosis syndrome. Am J Med Genet Part A 2006: 140A; 2640-5.**

38. Rungpolmaung L, Akewanlop C, Benjarassamerote S, O-chareanrat P, Mahasitiwat P, **Asavamongkolkul A**. Falling can be a serious problem for the elderly. Siriraj Med J 2006; 58: 916-21.
39. Eamsobhana P, **Asavamongkolkul A**. Intralesional excision compared with en bloc resection for giant-cell tumors of bone at proximal tibia and distal femur. Siriraj Med J 2007; 59 (supplement): 25.
40. **Asavamongkolkul A**, Waikakul S, Phimolsarnti R, Kiatisevi P, Wangsaturaka P. Endoprosthetic reconstruction for malignant bone and soft-tissue tumors. J Med Assoc Thai 2007; 90: 706-17.**
41. Wangsaturaka P, **Asavamongkolkul A**, Waikakul S, Phimolsarnti R. The results of surgical management of bone metastasis involving the periacetabular area: Siriraj Experience. J Med Assoc Thai 2007; 90: 1006-13.**
42. **Asavamongkolkul A**, Keerasuntornpong A, Kuakoolwongse C. Pyogenic sacroiliitis and adult respiratory distress syndrome. J Orthop Surgery (Hong Kong) 2007; 15: 226-9.**
43. Jantanayingyong J, **Asavamongkolkul A**, Phimolsarnti R, Muangsomboon S, Lektrakul N, Waikakul S. Use of warm sterile saline for local treatment in giant cell tumor of bone. Siriraj Med J 2008; 60 (supplement): 53
44. Munkhonpornpaiboon S, **Asavamongkolkul A**, Benjarasameeroj S, Muangsomboon S. The accuracy of frozen section with open biopsy in musculoskeletal tumors. Siriraj Med J 2008; 60 (supplement): 55.
45. Chandhanayingyong C, **Asavamongkolkul A**, Lektrakul N, Muangsomboon S. The management of sacral schwannoma: Report of four cases and review of literature. Sarcoma 2008; **
46. **Asavamongkolkul A**, Waikakul S, Phimolsarnti R, Kiatisevi P. Functional outcome following excision of a tumour and reconstruction of the distal radius. Int Orthop 2009; 33: 203-9.**
47. Asavamongkolkul A. The management of musculoskeletal oncololgy in Thailand: Past, present and future. J Jpn Orthop Assoc 2009; 83: S828.**
48. Lertwanich P, Wunnasinthop S, Tharmviboonsri T, **Asavamongkolkul A**, Kulthanan T. Medical Services during the 24th Summer Universiade. Siriraj Med J 2011; 63: 8-11.**
49. Takeuchi A, Tsuchiya H, Niu X, Ueda T, Jeon DG, Wang EH, **Asavamongkolkul A**, Kusuzaki K, Sakayama K, Kang YK. The prognostic factors of recurrent GCT: a cooperative study by the Eastern Asian Musculoskeletal Oncology Group. J Orthop Sci 2011; 16: 196-202. **
50. **Asavamongkolkul A**, Waikakul S. Wide resection of sacral chordoma Via a posterior approach. Int Orthop 2011, Online First™, 28 October 2011**
51. Chanchairujira K, Jiranantanakorn T, Phimolsarnti R, **Asavamongkolkul A**, Waikakul S. Factors of local recurrence of giant cell tumor of long bone after treatment: Plain radiographs, pathology and surgical procedures. J Med Assoc Thai 2011; 94: 1230-7**
52. **Asavamongkolkul A**, Waikakul S. Using polypropylene mesh graft for soft-tissue reconstruction in internal hemipelvectomy: a case report. World J Surg Oncol 2012; 10: 124.**

53. **Asavamongkolkul A**, Eamsobhana P, Waikakul S, Phimolsarnti R. The outcome of treatment of giant cell tumor of bone around the knee. J Med Assoc Thai 2012; 95 (suppl. 9): S122-8.**
54. **Asavamongkolkul A**, Thanakarasombat S. Treatment of bone tumors in the femoral trochanteric area. J Med Assoc Thai 2012; 95 (suppl. 9):S129-37.**
55. **Asavamongkolkul A**, Harnroongroj T, Suteeraporn R, Sudjai N, Harnroongroj T. The second fracture of the same clavicle: Prevalence and fracture configurations. J Med Assoc Thai 2012; 95: 1524-7.**
56. Attatippaholkun W, Wikainapakul K, Suwannathon L, **Asavamongkolkul A**, Tansakul S. Selenium levels in osteosarcoma and healthy subjects. Thai Cancer J 2013; 33: 21-7.
57. Joo MW, Shin SH, Kang YK, Kawai A, Kim HS, **Asavamongkolkul A**, et al. Osteosarcoma in Asian populations over the age of 40 years: A multicenter study. Ann Surg Oncol. 2015 Feb 13. [Epub ahead of print]**
58. **Asavamongkokul A**, Chotiyarnwonga P, Tirawanchai N, Waikakul S. Heat shock protein 70 expression in giant cell tumor of bone and its clinical application. Surgical Science 2015; 6: 26-34.**
59. **Asavamongkolkul A**. Current Trends of Musculoskeletal Oncology inThailand. The Central Japan Journal of Orthopaedic Surgery and Traumatology 2015; 58: S34.**
60. Pimolsanti R, Wongkajornsilpa A, Chotiyarnwong P, **Asavamongkolkul A**, Waikakul S. Effects of thermoablation with or without caffeine on giant cell tumour of bone.J Orthop Surg (Hong Kong) 2015; 23: 95-9.**
61. Waikakul S, **Asavamongkolkul A**, Phimolsarnti R. Use of warm Ringer's lactate solution in the management of locally advanced giant cell tumor of bone. Int J Clin Oncol 2015: DOI 10.1007/s10147-015-0856-x**

****International journal, peer-review journal, Medline journal citation**

ผลงานวิจัยที่เสร็จสิ้นแล้วและได้ตีพิมพ์ในวารสาร

1. Asavamongkolkul A., Waikakul S. Using distraction osteogenesis as a limb salvage surgery in primary bone tumors. Proceedings of the Third Meeting of the Asia Pacific Musculoskeletal Tumor Society, Hong Kong, 2000, p.106.
2. Eckardt JJ, Kabo M, Kelly CM, Ward WG, Asavamongkolkul A, Wirganowicz, PZ et al. Expandable endoprosthesis reconstruction in skeletally immature patients with tumors. Clin Orthop 2000; 373: 51-61.
3. Harnroongroj T, Asavamongkolkul A, Chareancholvanich K. Reconstruction of the pelvic brim and its role in the reduction accuracy of displaced T -shaped acetabular fracture. J Med Assoc Thai 2000; 83: 483-493.
4. Asavamongkolkul A, Jiranantakan T, Waikakul S, Phompitaksa K, Muangsomboon S. Malignant peripheral nerve sheath tumor with neurofibromatosis type 1: A 2-case report and review of literature. J Med Assoc Thai 2001; 84: 285-293.
5. Asavamongkolkul A, Ruangsetakit C. False aneurysm of the brachial artery in supracondylar fracture treated with Kirschner wire fixation: A case report. Injury 2001; 32: 256-57.

6. Waikakul S, Asavamongkolkul A, Penkitti P. Soparat K. Alendronate in metastasis bone diseases. Thai J Orthop Surg 2001; 26: 52-6.
7. Chiewvit S, Asavamongkolkul A, Benjarassamerote S, Suntompong N, Akewanlop C, Ratanawichitrasin S. The correlation between 99 mTc MIBI scintigraphy alteration ratio and the tumor necrosis in primary bone and soft tissue malignant tumor. Thai J Orthop Surg 2001; 26: 74-8.
8. Asavamongkolkul A, Waikakul S, Chiewit P, Suntompong N, Benjarassamerote S. The surgical management of sacrococcygeal chordoma. Thai J Orthop Surg 2001; 26: 79-86.
9. Waikakul S, Asavamongkolkul A, Kojaranon N, Benjarassiimerote S, Muangsomboon S. Bone needle biopsy set: A local made at Siriraj Hospital. Thai J Orthop Surg 2001; 26: 96- 9.
10. Asavamongkolkul A, Saranatra W. Internal hemipelvectomy without reconstruction in children with Ewing's sarcoma: Report of two cases: Proceedings of the Eleventh International Symposium on Limb Salvage (ISOLS), Birmingham, 2001, p. 173-4.
11. Asavamongkolkul A., Pongkunakorn A., Harnroongroj T. Biomechanical study the axial compression force on stability of subchondral bone defect reconstruction at distal femur : comparing between polymethylmethacrylate (PMMA) alone and Steinmann pin reinforcement of PMMA: An experiment controlled trial. In the process of journal review of Journal of Thai Med Association
12. Peungjesada s, Churojana A, Chiewvit P, Benjarassamerote S, Asavamongkolkul A. Malignant schwannoma in neurofibromatosis 1. Asean J Radio 2002: 3, 51-8.
13. Asavamongkolkul A, Pimolsanti R, Kiatisevi P, Waikakul S: The management of periacetabular malignant bone tumors: : Proceedings of The Fifth Meeting of The Asia Pacific Musculoskeletal Tumor Society (APMSTS), Izmir, Turkey, 2004, P. 18
14. Asavamongkolkul A, Kiatisevi P, Waikakul S, Pimolsanti R, Benjarassamerote S: The outcomes and prognostic factors in 104 patients with soft tissue sarcoma: Proceedings of The Fifth Meeting of The Asia Pacific Musculoskeletal Tumor Society (APMSTS), Izmir, Turkey, 2004, P. 22-23.

สมาชิกดีเด่น สาขาบริหาร

นพ.พีระพงษ์ สายเชื้อ

Dr. Pirapong Saicheua

ตำแหน่งปัจจุบัน ปลัดกรุงเทพมหานคร

ประวัติการศึกษา

คุณวุฒิ	**ปี พ.ศ.ที่จบ**	**ชื่อสถานศึกษา**
1. วิทยาศาสตร์บัณฑิต (วิทยาศาสตร์การแพทย์)	พ.ศ.2521	มหาวิทยาลัยเชียงใหม่
2. แพทยศาสตรบัณฑิต	พ.ศ.2523	มหาวิทยาลัยเชียงใหม่
3. ศิลปศาสตรบัณฑิต สาขาสารนิเทศศาสตร์	พ.ศ.2537	มหาวิทยาลัยสุโขทัยธรรมาธิราช
4. สาธารณสุขมูลฐานมหาบัณฑิต (หลักสูตรนานาชาติ) รุ่น 12	พ.ศ.2541	สถาบันพัฒนาการสาธารณสุขอาเซียน มหิดล
5. หลักสูตรการป้องกันราชอาณาจักร ภาครัฐร่วมเอกชน รุ่นที่ 21 (ปรอ.21/วปอ.2551)	พ.ศ.2551	สถาบันวิชาการป้องกันประเทศ

คุณวุฒิและการฝึกอบรม	**ปี พ.ศ.**	**หน่วยงานที่จัดอบรม**
1. วุฒิบัตรการบริหารงานโรงพยาบาล รุ่น 22	พ.ศ.2530	คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล
2. Certificate in Hospital Administration	พ.ศ.2539	Japan National Institute of Health Service Management
3. วุฒิบัตรการบริหารการแพทย์และสาธารณสุขระดับสูง รุ่น 4	พ.ศ.2539	สถาบันพัฒนาข้าราชการกรุงเทพมหานคร
4. วุฒิบัตรนักบริหารระดับอาวุโส รุ่น 16	พ.ศ.2541	สถาบันพัฒนาข้าราชการกรุงเทพมหานคร
5. หลักสูตรกรรมการบริษัท รุ่นที่ 130	พ.ศ.2553	สมาคมส่งเสริมสถาบันกรรมการบริษัทไทย
6. หลักสูตรประกาศนียบัตรด้านการเงิน	พ.ศ.2553	สมาคมส่งเสริมสถาบันกรรมการบริษัทไทย

คุณวุฒิและการฝึกอบรม

7.	หลักสูตรนักบริหารยุติธรรมทางปกครอง ระดับสูง รุ่น 2	พ.ศ.2554 วิทยาลัยการยุติธรรมทางปกครอง
8.	หลักสูตรนักบริหารยุทธศาสตร์การป้องกันและปราบปรามการทุจริต ระดับสูง รุ่น 4	พ.ศ.2556 สำนักงานคณะกรรมการป้องกันและปราบปรามการทุจริตในภาครัฐ
9.	หลักสูตรผู้บริหารระดับสูงภาครัฐ เอกชน "มหานคร 3"	พ.ศ.2557 มหาวิทยาลัยนวมินทราธิราช
10.	Metropolitan Planning Strategy Program	พ.ศ.2557 มหาวิทยาลัยควีนส์แลนด์ นครบริสเบน ออสเตรเลีย

ประสบการณ์ทำงาน

ปี พ.ศ.	ตำแหน่ง / หน่วยงาน
พ.ศ.2558	ปลัดกรุงเทพมหานคร
พ.ศ.2552	รองปลัดกรุงเทพมหานคร
พ.ศ.2551	ผู้อำนวยการสำนักการแพทย์
พ.ศ.2548	รองผู้อำนวยการสำนักการแพทย์
พ.ศ.2546	ผู้อำนวยการโรงพยาบาลเจริญกรุงประชารักษ์
พ.ศ.2542	ผู้อำนวยการโรงพยาบาลหลวงพ่อทวีศักดิ์ ชุตินฺธโรอุทิศ
พ.ศ.2525	ศัลยแพทย์ โรงพยาบาลค่ายกาญจนบุรี ช่วยราชการกองพลที่ 9 กองทัพบก

เครื่องราชอิสริยาภรณ์

ปี พ.ศ.	เครื่องราชอิสริยาภรณ์
พ.ศ.2530	ตริตาภรณ์มงกุฎไทย (ราชกิจจาฯ เล่ม ๑๐๔ ตอน ๒๕๖ วันที่ ๙ ธ.ค. ๒๕๓๐)
พ.ศ.2532	ตริตาภรณ์ช้างเผือก (ราชกิจจาฯ เล่ม ๑๐๗ ตอน ๖๔ วันที่ ๒๓ เม.ย. ๒๕๓๓)
พ.ศ.2534	ทวีติยาภรณ์มงกุฎไทย (ราชกิจจาฯ เล่ม ๑๐๙ ตอน ๗๖ วันที่ ๑๐ มิ.ย. ๒๕๓๕)
พ.ศ.2538	ทวีติยาภรณ์ช้างเผือก (ราชกิจจาฯ เล่ม ๑๑๓ ตอน ๔๒ วันที่ ๑๕ มี.ค. ๒๕๓๙)
พ.ศ.2544	ประถมาภรณ์มงกุฎไทย (ราชกิจจาฯ เล่ม ๑๑๘ ตอน ๒๒ข วันที่ ๔ ธ.ค. ๒๕๔๔)
พ.ศ.2547	ประถมาภรณ์ช้างเผือก (ราชกิจจาฯ เล่ม ๑๒๒ ตอน ๑๑ข วันที่ ๒๓ ก.ค. ๒๕๔๘)
พ.ศ. 2550	เหรียญจักรพรรดิมาลา
พ.ศ.2552	มหาวชิรมงกุฎ (ราชกิจจาฯ เล่ม 126 ตอน 16ข วันที่ 4 ธ.ค.2552)
พ.ศ.2557	มหาปรมาภรณ์ช้างเผือก (ราชกิจจาฯ เล่ม 131 ตอน 27ข วันที่ 3 ธ.ค.2557)
พ.ศ. 2558	เหรียญลูกเสือสดุดีชั้น 1 ประจำปี 2554 – 2555

ประวัติรางวัลเกียรติคุณดีเด่น

- ได้รับรางวัลบุคคลที่มีผลงานดีเด่นในด้านการส่งเสริม สนับสนุน บริหารจัดการ การป้องกันและแก้ไขปัญหายาเสพติด ประจำปี 2554 จากมูลนิธิป้องกันและปราบปรามยาเสพติด สำนักงานป้องกันและปราบปรามยาเสพติด กระทรวงยุติธรรม

- ได้รับคัดเลือกให้เป็นนักศึกษาเก่ามหาวิทยาลัยเชียงใหม่ดีเด่น ประจำปี 2558 สาขาบริหารรัฐกิจ จากมหาวิทยาลัยเชียงใหม่
- ได้รับรางวัล “มหิดลทยากร” ประจำปี 2558 จากสมาคมศิษย์เก่ามหาวิทยาลัยมหิดลในพระบรมราชูปถัมภ์

ประสบการณ์/การปฏิบัติราชการพิเศษ

1. ปฏิบัติหน้าที่ในฐานะหัวหน้ากลุ่มภารกิจด้านยุทธศาสตร์และการสาธารณสุข รับผิดชอบหน่วยงานและส่วนราชการ ดังนี้
    1.1 สำนักปลัดกรุงเทพมหานคร (สถาบันพัฒนาข้าราชการกรุงเทพมหานคร และกองการต่างประเทศ)
    1.2 สำนักยุทธศาสตร์และประเมินผล
    1.3 สำนักการแพทย์
    1.4 สำนักอนามัย
    1.5 สำนักงานเขตกลุ่มกรุงเทพใต้ ประกอบด้วย สำนักงานเขตปทุมวัน สำนักงานเขตสาทร สำนักงานเขตยานนาวา สำนักงานเขตวัฒนา สำนักงานเขตสวนหลวง สำนักงานเขตบางรัก สำนักงานเขตบางคอแหลมสำนักงานเขตคลองเตย สำนักงานเขตพระโขนง และสำนักงานเขตบางนา
2. ปฏิบัติหน้าที่ผู้อำนวยการศูนย์อำนวยการป้องกันและแก้ไขปัญหายาเสพติดกรุงเทพมหานคร (ศอ.ปส.กทม.)
3. รองประธานกรรมการคณะกรรมการบริหารการป้องกันและแก้ไขปัญหายาเสพติดกรุงเทพมหานคร
4. คณะกรรมการบริหารสำนักงานศูนย์อำนวยการพลังแผ่นดินเอาชนะยาเสพติดกรุงเทพมหานคร
5. ประธานคณะกรรมการจริยธรรมการวิจัยในคนกรุงเทพมหานคร
6. ประธานคณะกรรมการพัฒนากฎหมายด้านสาธารณสุขและสิ่งแวดล้อมของกรุงเทพมหานคร
7. ผู้แทนข้าราชการกรุงเทพมหานครสามัญ ในคณะกรรมการข้าราชการกรุงเทพมหานครและบุคลากรกรุงเทพมหานคร (พ.ศ.2554 – 2558)
8. ประธานคณะกรรมการหลักประกันสุขภาพกรุงเทพมหานคร
9. คณะกรรมการบริหารโครงการภายใต้ความร่วมมือระหว่างกรุงเทพมหานคร และศูนย์ความร่วมมือไทย-สหรัฐด้านสาธารณสุข
10. คณะกรรมการบริหารแพทยสมาคมแห่งประเทศไทยในพระบรมราชูปถัมภ์
11. คณะกรรมการอำนวยการโครงการเครือข่ายสุขภาพมารดาและทารกเพื่อครอบครัวไทย ในพระราชูปถัมภ์สมเด็จพระบรมโอรสาธิราช สยามมกุฎราชกุมาร
12. คณะกรรมการการแพทย์ กองทุนเงินทดแทน กระทรวงแรงงาน
13. คณะอนุกรรมการเพื่อทบทวนและจัดทำแผนการกระจายอำนาจให้แก่องค์กรปกครองส่วนท้องถิ่นและแผนปฏิบัติการกำหนดขั้นตอนการกระจายอำนาจให้แก่องค์กรปกครองส่วนท้องถิ่น (ผู้แทนกรุงเทพมหานคร)

The Thai Journal of Orthopaedic Surgery Volume 40 Number 3-4 July-October 2016

Contents

สารบัญ

Editorial: A Message from the Associate Editor

In memoriam, it is with heartfelt sadness that we note the passing last year of Dr.Vinai Parkpian, MD, Emeritus Professor at Faculty of Medicine, Chulalongkorn University and King Chulalongkorn Memorial Hospital where he spent more than five decades of his medical career. Recognized as one of the nation's foremost specialists in Orthopaedics, Dr. Vinai Parkpian served as the past president of the Thai Orthopaedic Association (TOA) and the Royal College of Orthopaedic Surgeons of Thailand (RCOST) and made extraordinary contributions to patient care, medical education, and orthopaedic research. He was a leading personality of Thai and international orthopaedic community, a great scientist, an impressive researcher, a prominent teacher, a fine surgeon, and a remarkable mentor to us all. Dr.Vinai Parkpian's energy and enthusiasm for endless learning in science and medicine touched the lives of everyone who knew him. He will always remain in our hearts as an unforgettable teacher, a true friend and a perfect example of great surgeon and outstanding man. May our memories of him be a continuing source of inspiration.

Over the past four years, it has been a great honour and an immense pleasure to serve as Associate Editor of The Thai Journal of Orthopaedic Surgery. It was a unique and exciting experience for me to contribute to our scientific community in this post and to interact with the many able people. As yet, we have had 40 volumes, which have included numerous published original articles, reviews, case reports, etc. Our journal has gone from strength to strength and I am pleased to state that we appear to have overcome our initial difficulties in so much that the journal now continues to prosper. As you are aware, we are successfully put The Thai Journal of Orthopaedic Surgery into the Thai Journal Citation Index (TCI), indicating that our journal has been indexed by TCI which is a citation database. As you will appreciate, all of this has taken a tremendous amount of time, contribution, and effort. I have to tell you that four years is a long time to be Associate Editor. As such, I think it is now appropriate that I pass on the torch to someone who can bring new ideas, energy, and perspectives to our journal.

I also take the occasion of the close of my service to thank the members of the Editorial Board and peer reviewers of the journal for their faithful service and numerous reviews. I would like to express my sincere appreciation to Professor Thavat Prasartritha and Professor Sukit Saengnipanthkul, Associate Professor Pongsak Yuktanandana, and Professor Aree Tanavalee for providing me with the opportunity to work as Associate Editor. Especially, I would also like to extend my gratitude to those whose help and understanding made my time on The Thai Journal of Orthopaedic Surgery so enjoyable. My personal thanks go to all the authors who submitted manuscripts for consideration for publication, referees, members, and readers for their hard work, interest, and support for the journal over the years.

Last but not least, I would like to thank our entire editorial office staff, particularly Jutamas Chearanaya and previously Supawinee Pattanasoon, who have worked tirelessly as the managing editor over all these years. Without this, the journal would undoubtedly not have been what it is today. Added to that, I am grateful to Aunchalee Juntee to handle the administrative details and contribute, in many ways, to the success of our publications; this is much appreciated.

Sittisak Honsawek, MD
Associate Editor,
The Thai Journal of Orthopaedic Surgery

Should we use conventional or functional performance measures for evaluation of immediate outcomes after TKA?

Chavarin Amarase, MD, Aree Tanavalee, MD, Pathomporn Veerasethsiri, MD,

Srihatach Ngamukos, MD

Department of Orthopaedics, Faculty of Medicine, Chulalongkorn University, Pathumwan, Bangkok, Thailand

Background*: Recently, evaluation of outcomes following total knee arthroplasty (TKA) in the immediate postoperative period (≤ 12 weeks) has been frequently reported for efficiency of new surgical approaches or new pain management protocols. Several functional performance measures have been added to those of conventional tools. However, there has been no comparative evaluation of individual measures at a serial follow-up for immediate outcomes after TKA, in terms of time to significant improvement compared the preoperative period.*

Methods*: We prospectively evaluated 40 patients who had primary knee osteoarthritis and underwent uncomplicated TKA for immediate outcomes at postoperative 2nd week, 6th week, and 12th week, consecutively. All patients were evaluated for conventional outcome measures, including Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) index and SF-36, as well as functional performance measures, including Time up and go test (TUGT) and 6-min walk distance (6MWD). The improvement of individual tests at each evaluation was compared to the preoperative period.*

Results: *There were 37 females and 3 males. The patients' mean age was 70.1 years, and mean body mass index (BMI) was 27.26 kg/m^2. The majority of patients (97.5%) had ASA class I and II. At the 2nd week, several conventional measures, including WOMAC index and SF-36 provided significant improvement; however, all of the functional performance measures showed significantly worse parameters than those at the preoperative evaluation. Functional performance measures, including TUGT and 6MWD provided significant improved outcomes at the 12th week.*

Conclusion*: Conventional measures demonstrated faster outcome improvements after TKA than function performance.*

Keywords: *Total knee arthroplasty, functional performance measures, conventional measures, outcome, immediate*

The Thai Journal of Orthopaedic Surgery: 40 No.3-4: 3-9
Full text. e journal: *http://www.rcost.or.th, http://thailand.digitaljournals.org/index.php/JRCOST*

Introduction

Total knee arthroplasty (TKA) is a definite surgical treatment for late stage knee osteoarthritis (OA). The goals of TKA are pain-free surgery, good mobility, and high functional activity.[1] In the past, the patients undergoing TKA were older and sedentary,[2] however, in the present they are younger and need more activity.[3] Nowadays, many surgical approaches or surgical implants,[4,5] and new pain management protocols[6] are developed with the aim of improving the efficiency of the treatment.

Currently, there are several outcome measures following TKA which evaluate clinical signs and symptoms, functional activities, and postoperative radiographs. The outcome measures can be divided into conventional measures and functional performance measures.

The conventional measures included the patient reported outcome measures (PROMs) and the surgeon-based evaluation. The PROMs are based on patient self-evaluation that can be divided into 2 groups; 1) disease specific such as the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC),[7] the Oxford Knee Score (OKS),[8] and the Knee Injury and Osteoarthritis Outcome Score (KOOS)[9] etc. 2) general health assessment such as SF-36,[10] the EuroQol-5 dimensions (EQ5D),[11] the UCLA activity score (UCLA),[12] and visual analogue scale (VAS) for pain etc. The surgeon-based evaluations are composed of self-patient and surgeon assessments such as the Knee Society Score (KSS) clinical and function scores.[13]

The functional performance measure is based on the patient's true functional activity. The

Osteoarthritis Research Society International (OARSI)[14] has recommended 5 performance-based tests of physical function after total joint replacement including 1) the 30-s chair-stand test representing sit to stand activity, 2) 40 m fast-paced walk test representing walking short distances, 3) a stair-climb test representing stair negotiation, 4) timed up-and-go test[15] representing ambulatory transitions 5) 6-min walk test[16] representing aerobic capacity/walking long distances.

In the past, the several studies used PROMs to evaluate improvement post TKA,[17-19] but in recent years the trend of outcome measures changed to use functional performance measures.[20-22]

However, there has been no comparative evaluation of individual measures at a serial follow-up (FU) for immediate outcome (less than 12 weeks) after TKA, in terms of time to significant improvement to the preoperative period. This study aims to determine the different patterns of improvement post-TKA of each measure when comparing the immediate period to the preoperative period. The hypothesis was that the pattern of improvement of each measure is not different.

Methods

Fifty patients who had late stage primary knee osteoarthritis and underwent TKA from October 2014 to April 2015 at King Chulalongkorn Memorial Hospital were enrolled. The inclusion criteria were the patient's age between 60-80 years, BMI < 40 kg/m^2, and normal psychological status. The exclusion criteria were infected TKA, revision TKA, previous knee surgery, bilateral TKA, and patients unwilling to attend the research protocol. Ethical approval was obtained from the Ethical Review Board, Faculty of Medicine, Chulalongkorn University. Ten patients were excluded because of failure to attend the research protocol.

All Forty patients were evaluated for conventional outcome measures, including WOMAC index[7] and SF-36,[10] as well as functional performance measures, including Time up and go test (TUGT)[15] and 6-min walk distance (6MWD).[16] The conventional measures were evaluated at the preoperative period (after admission, before surgery was done), and postoperatively at 2nd week, 6th week, and 12th week. The improvement of individual measures at each evaluation was compared to the preoperative period.

Time up and go test (TUGT)[15] was the measured time that the patients took to stand up from a chair and walk 3 meters with or without gait aid. Then, he or she turned around and came back to the seat at the initial position. The high back chair with armrests was used with a seat height of 46 centimeters (18 inches) and armrest heights of 65 centimeters (26 inches).

6-min walk distance (6MWD) [16] was the measured distance that the patients could walk within 6 minutes with or without gait aid on 30 meters of solid ground with marks at 3 meter intervals.

All TKA operations were performed by one senior orthopaedist (A.T.) using a Cemented PS design (NexgenFlex, Zimmer & Vanguard, Biomet). Spinal anesthesia with morphine was administered. A tourniquet was applied at 320 mmHg. The midline longitudinal skin incision and mini-midvastus arthrotomy were performed. The distal femur was cut valgus 5 degrees with an intramedullary guide. The tibia was cut perpendicular with an extramedullary guide. The rotation of the femoral component was 3 degrees external rotation to the posterior condylar axis and parallel to the transepicondylar axis. The rotation of the tibial component was a parallel line from the posterior cruciate ligament (PCL)insertion to the mid-patellar tendon. Local joint infiltration was composed with 0.5% Marcaine 20 ml, morphine 5 mg, 0.3 ml of 1:1000 adrenaline diluted with normal saline to 40 ml, and was injected around the knee joint after the tibial and femoral components were applied. A drain was placed and removed before 24 hr postoperative. The postoperative pain was controlled with a COX-2 inhibitor (Celecoxib 400 mg OD $\geq$ 2 wk), neuropathic pain control (Pregabalin 75 OD $\geq$ 2 wk), and a pain killer (Ultracet 0.5X3 $\geq$ 2 wk). The rehabilitation protocol included start to sit bed side and range of motion exercises, and quadriceps and hamstring muscle strengthening at day 1, with start to walk with walker at day 2, and discharge at day 3.

Statistical analysis

This study was a prospective descriptive study. The qualitative data are presented as frequency and percent. The quantitative data was presented as the mean ± SD. The paired t-test was performed for each improvement of outcome measure. All reported p values were 2-tailed with a *p*-value of less than 0.5 being considered statistically significant. Data were analyzed with Stata software version 11.2.

Results

The remaining forty patients consisted of 37 women and 3 men with a mean age of 70.1 ± 7.43 years and a mean body mass index of 27.26 ± 3.79 kg/m^2. The mean preoperative alignment was varus 4.78 ± 8.42 degrees and mean postoperative alignment was valgus 5.35 ± 2.45 degrees. The majority of patients (97.5%) had ASA class I and II. (Table 1)

The majority of the conventional measures including the WOMAC index and most domains of

SF-36 showed significant improvements at the 2nd week postoperative. Meanwhile all of the functional performance measures showed significantly worse parameters than those of the preoperative evaluations. At the 12th week after surgery, all tests of conventional and functional performance measures provided significant improvement outcomes compared to the preoperative period. The data are shown in Table 2.

The conventional measures *WOMAC*

The mean preoperative WOMAC score was 50.23. There was significant improvement at the 2nd week (mean 40.13, $p < 0.001$), 6th week (mean 30.85, $p < 0.001$), and 12th week (mean 29.68, $p < 0.001$).

SF-36

At the 2nd week, some domains of SF-36 were significantly improved, including general health, physical function, and mental health, $p = 0.004$, 0.02, and 0.002, respectively. Bodily pain and role emotional were significantly improved at 6 weeks, $p = 0.002$ and 0.026, respectively. Role physical was significantly improved at the 12th week, $p = 0.001$. Vitality and social functioning were not significantly improved at the 12th week following surgery, $p = 0.073$ and 0.484.

The functional performance measures

Time up and go test (TUGT)

The mean preoperative TUGT was 18.8 seconds and was significantly improved only at the 12th week (mean 15.66 seconds, $p < 0.001$).

6-min walk distance (6MWD)

The mean preoperative 6MWD was 249.08 meters and was only significantly improved at the 12th week (mean 286.15 meters, $p = 0.001$).

Table 1 Demographic data

Variables	All patients (n=40)
Age	70.10 ± 7.43
Gender	
- Female	37 (92.50%)
- Male	3 (7.50%)
Side	
- Right	24 (60.00%)
- Left	16 (40.00%)
Height (cm)	154.19 ± 7.70
Weight (kg)	64.73 ± 9.72
BMI (kg/m^2)	27.26 ± 3.79
preop. Alignment (degrees) varus	4.78 ± 8.42
postop. Alignment (degrees) valgus	5.35 ± 2.45
preop. Arc of motoion (degrees)	113.38 ± 22.49
postop. Arc of motion (degrees)	127.38 ± 9.20
ASA	
- I	6 (15.00%)
- II	33 (82.50%)
- III	1 (2.50%)
- IV	0 (0%)
- V	0 (0%)
Diagnostic	
- HT	25 (62.50%)
- DLP	20 (50.00%)
- DM	9 (22.50%)
- Other; MR, CKD	9 (22.50%)

Table 2 Conventional and Functional performance outcome data

	Pre-op	2nd Week	6th Week	12th Week	*p*-value		
	Mean ± SD.	Mean ± SD.	Mean ± SD.	Mean ± SD.	2nd week[(a)]	6th week[(a)]	12th week[(a)]
Conventional measure							
WOMAC	50.23 ± 11.46	40.13 ± 12.03	30.85 ± 11.17	29.68 ± 14.64	<0.001*	<0.001*	<0.001*
SF-36							
General health	46.35 ± 17.15	55.94 ± 18.39	58.98 ± 17.68	59.06 ± 19.74	0.004	<0.001*	0.001
Physical function	29.34 ± 25.28	31.75 ± 19.63	44.38 ± 22.45	47.13 ± 21.45	0.02	0.001	<0.001*
Role physical	26.87 ± 32.71	20 ± 30.06	31.25 ± 37.45	52.50 ± 42.67	0.243	0.513	0.001
Bodily pain	43.81 ± 18.95	48.13 ± 20.91	55.87 ± 17.97	63.19 ± 19.04	0.266	0.002	<0.001*
Role emotional	40.83 ± 37.35	52.50 ± 36.89	56.67 ± 38.64	63.33 ± 39.80	0.09	0.026	0.003
Social functioning	40.00 ± 15.56	41.88 ± 12.52	40.31 ± 9.17	42.19 ± 10.47	0.504	0.909	0.484
Vitality	55.50 ± 19.67	58.41 ± 17.45	60.06 ± 18.45	61.38 ± 17.76	0.342	0.165	0.073
Mental health	69.20 ± 19.70	76.50 ± 14.1	75.80 ± 17.52	76.83 ± 16.68	0.002	0.026	0.003
Functional performance measure							
TUGT (seconds)	18.80 ± 6.01	32.42 ± 18.63	17.43 ± 7.21	15.66 ± 7.34	<0.001*	0.261	0.01
6MWD (meters)	249.08 ± 60.96	170.33 ± 78.12	261.41 ± 69.72	286.15 ± 71.09	<0.001*	0.292	0.001

Values presented as mean±SD. *P*-value corresponds to paired t-test[(a)]

Table 3 Improvement of each measure after TKA

Improved after TKA / Measure	2nd week	6th week	12th week
Conventional measure	WOMAC SF-36: General health SF-36: Physical function SF-36: Mental health	SF-36: Bodily pain SF-36: Role emotional	SF-36: Role physical
Functional performance measure			TUGT 6MWD

Discussion

There are several outcome measures following TKA. The conventional measures included in PROMs are simple to use[(7)], take a short time to complete[(23)], and have high internal consistency[(24)], but have limitations with representing true functional activities[(25)], and cannot evaluate psychologically-impaired patients.[(26)] The functional performance measures represent true functional activities, but have the risk of accident during the test. In this study, we used WOMAC and SF-36 from the conventional measures, and TUGT and 6MWD from the functional performance measures.

In the immediate postoperative period (≤ 12 weeks) after TKA commonly used indirect outcomes for evaluation include length of hospital stay, VAS for pain, and amount of analgesic drugs.[(27,28)] However, some studies report the clinical outcomes. Gandhi et al.[(29)] reported the improvement of WOMAC, SF-36, and TUGT after postoperative 12 weeks in 142 TKA and 58 total

hip arthroplasty (THA) patients. Stratford et al.[30] demonstrated the improvement of WOMAC, but no significant improvements of 6MWD and TUGT after postoperative 9-13 weeks in 47 knee arthroplasty and 38 hip arthroplasty patients. Mizner et al.[31] studied the outcome at 1st and 12th month after 100 unilateral TKA. They showed 6MWD, TUGT, stair climb test, and SF-36 physical component summary worsened at 1st month, however, all improved by the 12th month. In this study, we collected data at the 2nd, 6th and 12th week to show improvements in the immediate postoperative period in more detail. At the 2nd week, some of the conventional measures improved, but all of the functional performance measures were worsened. At the12th week, all tests of the conventional and functional performance measures provided significantly improved outcomes compared to the preoperative period. The data are shown in Table 3.

The strength of this study is the higher frequency of data recordings and number of measures. We collected the data three times at postoperative 2nd, 6th and 12th week which shows the improvement in more detail.

However, this study had some limitations. First, almost of the patients (92.5%) were female and may have different physiological responses from males. The improvement of functional performance might be affected by gender. Subgroup analysis should be done in the future. Second, this study had only 2 measures in each measure group. Third, the study had the small sample size. Fourth, the limited time of follow up was 12 weeks with no further correlation at longer follow ups.

Conclusion

Both conventional and functional performance measures are proper and effective to evaluate the outcome after TKA. All of measures significantly improve at the 12th week post-surgery. The conventional measures improve at the 2nd week, earlier than the functional performance measures. We concluded that the conventional measures demonstrate faster outcome improvements than functional performance in the immediate term after TKA.

References

1. Carr AJ, Robertsson O, Graves S, Price AJ, Arden NK, Judge A, et al. Knee replacement. Lancet. 2012;379(9823):1331-40.
2. Culliford DJ, Maskell J, Beard DJ, Murray DW, Price AJ, Arden NK. Temporal trends in hip and knee replacement in the United Kingdom: 1991 to 2006. J Bone Joint Surg Br. 2010;92(1):130-5.
3. Swedish Knee Arthroplasty Register. Annual report 2014, 2010, Swedish Knee Arthroplasty Register, Lund.
4. Inui H, Taketomi S, Nakamura K, Takei S, Takeda H, Tanaka S, et al. Influence of navigation system updates on total knee arthroplasty. BMC Sports Sci Med Rehabil. 2013;5:10.
5. Hofstede SN, Nouta KA, Jacobs W, van Hooff ML, Wymenga AB, Pijls BG, et al. Mobile bearing vs fixed bearing prostheses for posterior cruciate retaining total knee arthroplasty for postoperative functional status in patients with osteoarthritis and rheumatoid arthritis. Cochrane Database Syst Rev. 2015(2):CD003130.
6. Korean Knee S. Guidelines for the management of postoperative pain after total knee arthroplasty. Knee Surg Relat Res. 2012;24(4):201-7.
7. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol. 1988;15:1833-40.
8. Dawson J, Fitzpatrick R, Murray D, Carr A. Questionnaire on the perceptions of patients about total knee replacement. J Bone Joint Surg (Br). 1998;80(1):63-9.
9. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)--development of a self-administered outcome measure. J Orthop Sports Phys Ther. 1998;28(2):88-96.
10. Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992;30(6):473-83.
11. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. Ann Med. 2001;33(5):337-43.
12. Amstutz HC, Thomas BJ, Jinnah R, Kim W, Grogan T, Yale C. Treatment of primary osteoarthritis of the hip. A comparison of total joint and surface replacement arthroplasty. J Bone Joint Surg Am. 1984;66(2):228-41.
13. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. Clin Orthop Relat Res. 1989:13-4.

14. Dobson F, Hinman RS, Roos EM, Abbott JH, Stratford P, Davis AM, et al. OARSI recommended performance-based tests to assess physical function in people diagnosed with hip or knee osteoarthritis. Osteoarthritis Cartilage. 2013;21(8):1042-52.
15. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142-8.
16. Jakobsen TL, Kehlet H, Bandholm T. Reliability of the 6-min walk test after total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2013;21(11):2625-8.
17. Garcia RM, Kraay MJ, Goldberg VM. Isolated resurfacing of the previously unresurfaced patella total knee arthroplasty. J Arthroplasty. 2010;25(5):754-8.
18. Wohlrab D, Hube R, Zeh A, Hein W. Clinical and radiological results of high flex total knee arthroplasty: a 5 year follow-up. Arch Orthop Trauma Surg 2009;129(1):21-4.
19. Tanavalee A, Rojpornpradit T, Khumrak S, Ngarmukos S. The early results of gender-specific total knee arthroplasty in Thai patients. Knee. 2011;18(6):483-7.
20. Kelly MA, Finley M, Lichtman SW, Hyland MR, Edeer AO. Comparative Analysis of High-Velocity Versus Low-Velocity Exercise on Outcomes After Total Knee Arthroplasty: A Randomized Clinical Trial. J Geriatr Phys Ther. 2015.
21. Shah NA, Jain NP. Is continuous adductor canal block better than continuous femoral nerve block after total knee arthroplasty? Effect on ambulation ability, early functional recovery and pain control: a randomized controlled trial. J Arthroplasty. 2014;29(11):2224-9.
22. Chan EY, Teo YH, Assam PN, Fransen M. Functional discharge readiness and mobility following total knee arthroplasty for osteoarthritis: a comparison of analgesic techniques. Arthritis Care Res (Hoboken). 2014;66(11):1688-94.
23. Gandek B. Measurement properties of the Western Ontario and McMaster Universities Osteoarthritis Index: a systematic review. Arthritis Care Res (Hoboken).2015;67:216-29.
24. Papathanasiou G, Stasi S, Oikonomou L, Roussou I, Papageorgiou E, Chronopoulos E, et al. Clinimetric properties of WOMAC Index in Greek knee osteoarthritis patients: comparisons with both self-reported and physical performance measures. Rheumatol Int. 2015;35(1):115-23.
25. Jacobs CA, Christensen CP. Correlations between knee society function scores and functional force measures. Clin Orthop Relat Res. 2009;467(9):2414-9.
26. Giesinger JM, Kuster MS, Behrend H, Giesinger K. Association of psychological status and patient-reported physical outcome measures in joint arthroplasty: a lack of divergent validity. Health Qual Life Outcomes. 2013;11:64.
27. Mammoto T, Fujie K, Mamizuka N, Taguchi N, Hirano A, Yamazaki M, et al. Effects of postoperative administration of celecoxib on pain management in patients after total knee arthroplasty: study protocol for an open-label randomized controlled trial. Trials. 2016;17:45.
28. Harsten A, Hjartarson H, Werner MU, Toksvig-Larsen S. General anaesthesia with multimodal principles versus intrathecal analgesia with conventional principles in total knee arthroplasty: a consecutive, randomized study. J Clin Med Res. 2013;5(1):42-8.
29. Gandhi R, Tsvetkov D, Davey JR, Syed KA, Mahomed NN. Relationship between self-reported and performance-based tests in a hip and knee joint replacement population. Clin Rheumatol. 2009;28(3):253-7.
30. Stratford PW, Kennedy DM, Maly MR, Macintyre NJ. Quantifying self-report measures' overestimation of mobility scores postarthroplasty. Phys Ther. 2010;90(9):1288-96.
31. Mizner RL, Petterson SC, Clements KE, Zeni JA, Jr., Irrgang JJ, Snyder-Mackler L. Measuring functional improvement after total knee arthroplasty requires both performance-based and patient-report assessments: a longitudinal analysis of outcomes. J Arthroplasty. 2011;26(5):728-37.

ควรใช้วิธีการประเมินแบบดั้งเดิมหรือการประเมินความสามารถในการใช้งานสำหรับการประเมินผลการผ่าตัดเปลี่ยนข้อเข่าเทียมในระยะฉับพลันหลังผ่าตัด

ชวรินทร์ อมเรศ, พบ, อารี ตนาวลี, พบ, ปฐมพร วีระเศรษฐ์ศิริ, พบ, นพ. สีหธัช งามอุโฆษ, พบ

วัตถุประสงค์: *เพื่อศึกษาลักษณะการเปลี่ยนแปลงของการประเมินแต่ละชนิดในช่วงระยะฉับพลันหลังผ่าตัด (12 สัปดาห์แรก) เมื่อเทียบกับก่อนผ่าตัด*

วิธีการศึกษา: *การศึกษานี้ได้ทำการศึกษาในผู้ป่วย 40 รายที่ได้รับการวินิจฉัยโรคข้อเข่าเสื่อมแบบปฐมภูมิและได้รับการรักษาด้วยวิธีผ่าตัดเปลี่ยนข้อเข่าเทียม โดยประเมินผลลัพธ์ในระยะฉับพลันหลังผ่าตัดที่ 2 สัปดาห์ 6 สัปดาห์ และ 12 สัปดาห์หลังผ่าตัด ผู้ป่วยทุกรายได้รับการประเมินด้วยวิธีการประเมินแบบดั้งเดิม ได้แก่ WOMAC index และ SF-36 การประเมินความสามารถในการใช้งาน ได้แก่ Time up and go test (TUGT) และ 6-min walk distance (6MWD) ผลลัพธ์ที่ได้ทั้งหมดถูกนำไปเปรียบเทียบกับการประเมินก่อนผ่าตัดเพื่อดูถึงลักษณะการเปลี่ยนแปลงของแต่ละวิธีประเมิน*

ผลการศึกษา: *ในการศึกษานี้ มีผู้หญิง 37 ราย ผู้ชาย 3 ราย มีค่าเฉลี่ยอายุ 70.10 ปี ค่าเฉลี่ยของดัชนีมวลกาย 27.26 กิโลกรัม/ตารางเมตร การประเมินผลลัพธ์ที่ 2 สัปดาห์หลังผ่าตัดพบว่าการประเมินด้วยวิธีแบบดั้งเดิมหลายชนิด ได้แก่ WOMAC index และ SF-36 มีผลลัพธ์ที่ดีขึ้น ในขณะที่การประเมินความสามารถในการใช้งานทุกชนิดนั้นลดลง ความสามารถในการใช้งานเท่านั้นที่มีผลลัพธ์ที่ดีขึ้นที่การประเมินผลลัพธ์ที่ 12 สัปดาห์หลังผ่าตัด*

สรุป*: ผลลัพธ์จากการประเมินด้วยวิธีดั้งเดิมพบการพัฒนาที่ดีขึ้นได้เร็วกว่าวิธีประเมินด้วยความสามารถในการใช้งาน*

Comparison of radiographic outcomes between beta-tricalcium phosphate bone graft and autogenous bone graft in corrective osteotomy of malunited distal radius

Nuttorn Darapongsataporn, MD[1], Chairoj Uerpairojkit, MD[2]

[1]*Nan Hospital, Mueang Nan, Nan, Thailand*

[2]*Institute of Orthopaedics, Lerdsin Hospital, Bangrak, Bangkok, Thailand*

Purpose: *To compare radiographic outcomes after placement of beta-tricalcium phosphate bone grafts (BPBG) and autogenous iliac bone grafts (IBG) in corrective osteotomy of malunited distal radius fractures with volar locking plates.*

Methods: *Twenty-seven patients with malunited distal radius fractures were operated on in Lerdsin General Hospital, Bangkok. The inclusion criteria were–symptomatic malunited distal radius and unacceptable radiographic parameters. We divided patients into IBG and BPBG groups. We collected radiologic parameters at preoperative, postoperative (4th week), and the last visit. We compared radiographic parameters from both groups by unpaired t-test and calculated radiographic parameters by time sequence in each group by paired t-test. The reoperation rate in both groups was also compared by chi-squared (Fisher exact test).*

Results: *The study did not show a statistical difference in any of the radiographic parameters between the two groups. The union rate was 91.67%, 11 in 12 cases, in the IBG group while the union rate was 80%, 12 in 15 cases, in the BPBG group (p>0.05). The failure correction rate was 8.33%, 1 in 12 cases, in the IBG group while the failure correction rate was 26.67%, 4 in 15 cases, in the BPBG group (p>0.05). Six patients, 1 in the IBG and 5 in the BPBG groups, needed re-operation due to pain or failure to improve functional outcomes. The re-operation rate was 8.33% and 33% in the IBG and BPBG groups, respectively (p>0.05).*

Conclusion: *Radiographic parameters in the BPBG group were not significantly different from the IBG group. Regarding the union and re-operation rate, even though there was no statistically significant difference, there was a tendency of a lower union rate and higher re-operation rate in the BPBG group.*

Keywords: *Osteotomy, malunion distal radius fracture, beta-tricalcium phosphate bone graft, autogenous iliac bone graft*

The Thai Journal of Orthopaedic Surgery: 40 No.3-4: 11-17
Full text. e journal: *http://www.rcost.or.th, http://thailand.digitaljournals.org/index.php/JRCOST*

Introduction

Fracture of the distal radius is the most common fracture in the upper extremities. One of the most frequent complications is malunion which results in wrist weakness, pain, limited range of motion, numbness, tingling sensation, arthritis, and carpal malalignment and instability. Asymptomatic malunion of distal radius can be left untreated especially in patients with low daily activity. However, symptomatic malunion is usually subjected to corrective osteotomy. Corrective osteotomy with bone grafting and fixation is still the mainstay operation used to restore normal anatomy. Various types of osteotomy have been reported. Closing wedge osteotomy offers the advantage of bone to bone contact and more stable construction, but with the major disadvantage of shortening the radius relative to the ulna.(1) Opening wedge is the most popular technique with successful results. However, its disadvantages are potentially increased instability, risk of nonunion, and fixation failure.(1,2) Various methods of fixation in corrective osteotomy have been described such as external fixation, radio-radial fixation, standard T-plates, and fixed angle plates. The volar locking plate, one type of the fixed angle plates, is biomechanically and clinically accepted to be the best method for both dorsal and volar angulations. In general, the volar locking plate is commonly used in the treatment of acute distal radius fractures, however it can also be utilized in the treatment of malunited distal radius.(1, 3) Open wedge osteotomy can be performed on the dorsal side or volar side to create a bone defect that requires replacement of the bone-graft. Both autogenous bone graft and bone graft substitute can be used as the replacement bone graft; its advantage is load bearing capacity and stability.(4)

The iliac crest has been reported to be the most common site for bone grafting. However, the harvesting of autogenous bone grafts is associated with increased operative time and chance of complications (postoperative donor site pain, hematoma, fracture, and infection). The purpose of this study was to compare the radiographic outcomes of patients after placement of beta-tricalcium phosphate bone graft substitute and autogenous bone grafts in corrective osteotomies of malunited distal radius fractures with volar locking plates.

Materials and methods

Twenty-seven patients with malunited distal radius fractures were operated on in Lerdsin General Hospital, Bangkok. They were 13 males and 14 females. The average age was 50.53 years, range 16 to 75 years. The inclusion criteria included: (1) symptoms with pain, stiffness, grip weakness, malfunction, median nerve compression, and cosmesis (2) unacceptable radiographic parameters such as radial height <5mm, radial inclination <15°, dorsal tilt ≥15° or volar tilt ≥20°, and articular incongruity >2mm.[1,5,6] The exclusion criteria included: (1) malunion fracture associated with other conditions e.g. distal ulna fracture, scaphoid nonunion, and chronic osteomyelitis (2) incomplete data collection (3) follow-up period of less than 3 months.

All patients were operated on by the same senior staff in May 2007- December 2009. Thirteen patients were operated on the left and 14 on the right side. We divided the patients into two groups. The first group was the patients who underwent corrective osteotomy with volar locking plates and autogenous iliac bone grafts (IBG), and the second group included the patients with volar locking plates and beta-tricalcium phosphate bone grafts (BPBG). The operation was performed using the standard extra-articular osteotomy technique as suggested by Fernandez DL. However, we had modified the technique to use the volar approach since we had selected the volar locking plate as a fixation method.

After surgery, the wrist was placed in the short arm slab for 6 weeks. Gentle passive and active ranges of motion exercise were started after removal of the slab. All patients were followed up for at least 3 months. The radiographic examinations were obtained immediately, at 4 weeks, and at the final follow-up period with a mean follow-up time of 9.38 months, range 3 to 27 months.

We reviewed medical and standard anteroposterior and lateral radiographic records to collect demographic data and radiologic parameters at preoperative, postoperative (4^{th} week), and the last visit. On the antero-posterior radiographs, 3 parameters were used to evaluate the malunion: radial inclination, ulnar variance, and radial height. On the lateral radiographs, we measured 5 parameters: volar tilt, radioscaphoid angle, scapholunate angle, radiolunate angle, and capitolunate angle.[1,5,6] We used standard techniques of measurement as shown in Figures 1A and 1B. Each of the radiographic parameters was measured 3 times with an interval of 5 minutes and its average was recorded.

Statistical analysis

We compared radiographic parameters from both groups by unpaired t-test and calculated radiographic parameters by time sequence in each group by paired *t*-test. The reoperation rate in both groups was also compared by chi-squared (Fisher exact test).

Results

The study did not show a statistical difference in any radiographic parameters between the IBG group and BPBG group, as shown in Tables 1-4. We collected both clinical and radiographic results after corrective osteotomy and most of the cases showed improved symptoms. Eleven cases n the IBG group achieved union and showed satisfactory ranges of motion and cosmetic results as seen in figures 2A-2F. One of the re-operation cases in the BPBG group is demonstrated in Figure 1A-1F.

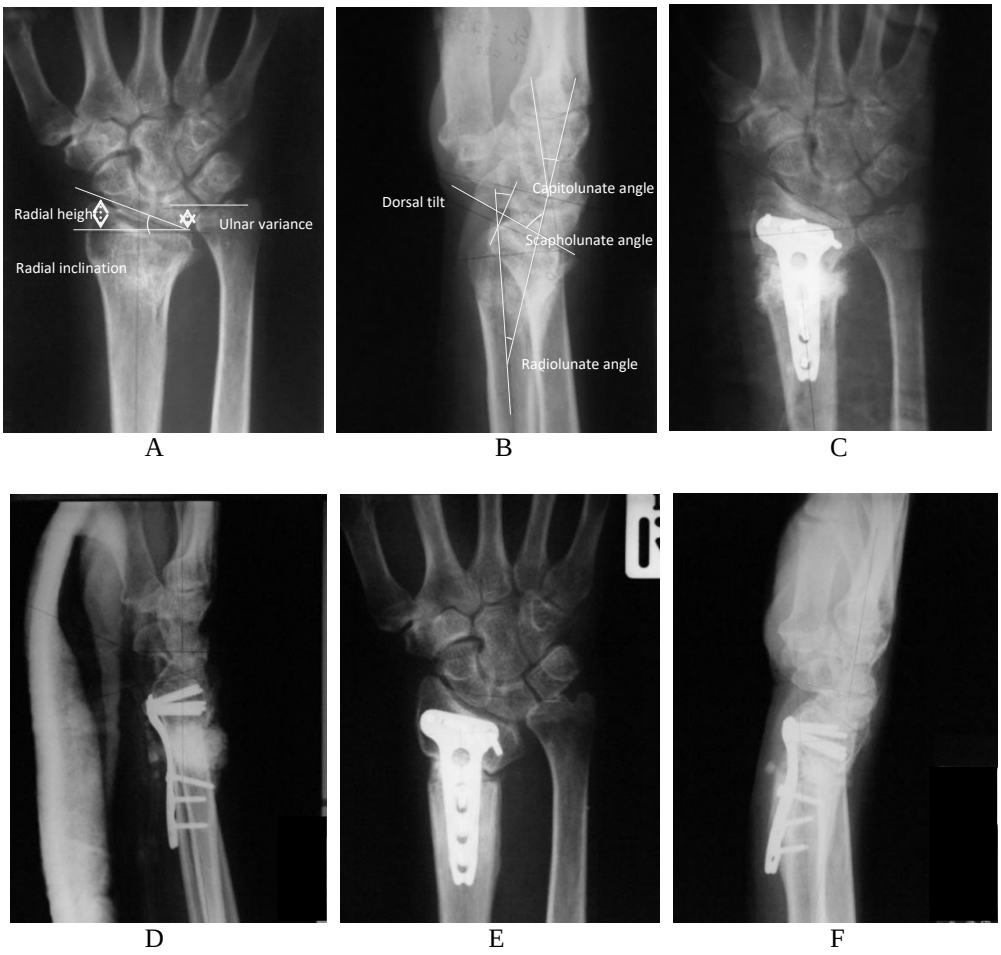

Fig. 1 Radiographs of one case in the BPBG group (A), (B) Preoperative anteroposterior view (C), (D) The 1st day postoperative anteroposterior and lateral, (E), (F) One year after operation

Table 1 Demographic data

	BPBG (N=15)	**IBG (N=12)**
Age	50.06(16-69) years	50.45(34-75) years
Male : Female	7 : 8	6 : 6
Right : Left	8 : 7	6 : 6
Year of operation		
2007	6	3
2008	9	4
2009	0	5
Follow up time	8 (3-15) months	11.27 (3-27) months

Table 2 Results of corrective osteotomy

	BPBG (N=15)	**IBG (N=12)**	***P*-Value**
Union	12	11	0.396
Failure correction	4	1	0.223
Re-operation	5	1	0.182

Table 3 Radiographic parameters for autogenous bone graft group at postoperative and last visit

Parameter	Postoperative mean (±SD)	Follow up mean (±SD)	*P*-Value
Volar tilt	4.75 (±12.19°)	-2.08 (±10.30°)	0.07
Radial inclination	15.58 (±17.07°)	23.17 (±8.96°)	0.13
Radial height (mm)	10.92 (±3.34)	11.08 (±3.63)	0.78
Ulnar variance (mm)	1.67 (±3.73)	1.75 (±3.16)	0.80
Scapholunate angle	59.25 (±9.18°)	62.92 (±4.85°)	0.32
Radiolunate angle	-3.33 (±6.21°)	-6.83 (±6.90°)	0.09
Capitolunate angle	-6.67 (±7.38°)	-10.67 (±9.88°)	0.12
Radioscaphoid angle	55.58 (±11.52°)	56.75 (± 6.92°)	0.78

Table 4 Radiographic parameters for beta-tricalcium phosphate group at postoperative and last visit

Parameters	Postoperative mean (±SD)	Follow up mean (±SD)	*P*-Value
Volar tilt	6.13 (±9.60°)	-0.13 (±17.76°)	0.11
Radial inclination	23.47 (±7.3°)	22.27 (±9.47°)	0.55
Radial height (mm)	12.34 (±3.92)	10.73 (±4.57)	0.16
Ulnar variance (mm)	1.27 (±1.87)	2.4 (±3.14)	0.14
Scapholunate angle	53.60 (±16.44°)	58.07 (±14.18°)	0.18
Radiolunate angle	1.46 (±14.06°)	2.00 (±11.66°)	0.88
Capitolunate angle	-16.80 (±16.62°)	-19.40 (±13.03°)	0.33
Radioscaphoid angle	56.67 (±10.30°)	57.73 (±15.26°)	0.81

Table 5 Comparison of mean difference of radiographic parameter

Parameters	Postoperative mean difference (95% confidence interval)	Follow up mean difference (95% confidence interval)
Volar tilt	-1.38 (-10.00,7.24)	-1.95 (-13.86,9.96)
Radial inclination	-7.88(-17.91,2.15)	-0.90(-6.40,8.28)
Radial height	-1.42(-4.35,1.52)	0.35(-2.99,3.69)
Ulnar variance	0.40(-1.87,2.67)	-0.65(-3.16,1.86)
Scapholunate angle	5.65(-5.30,16.60)	4.85(-3.99,13.69)
Radiolunate angle	-4.8(-13.81,4.21)	-8.83(-16.69,-0.97)
Capitolunate angle	10.13(-0.53,20.80)	8.73(-0.64,18.10)
Radioscaphoid angle	-1.08(-9.74,7.57)	-0.98(-10.80,8.84)

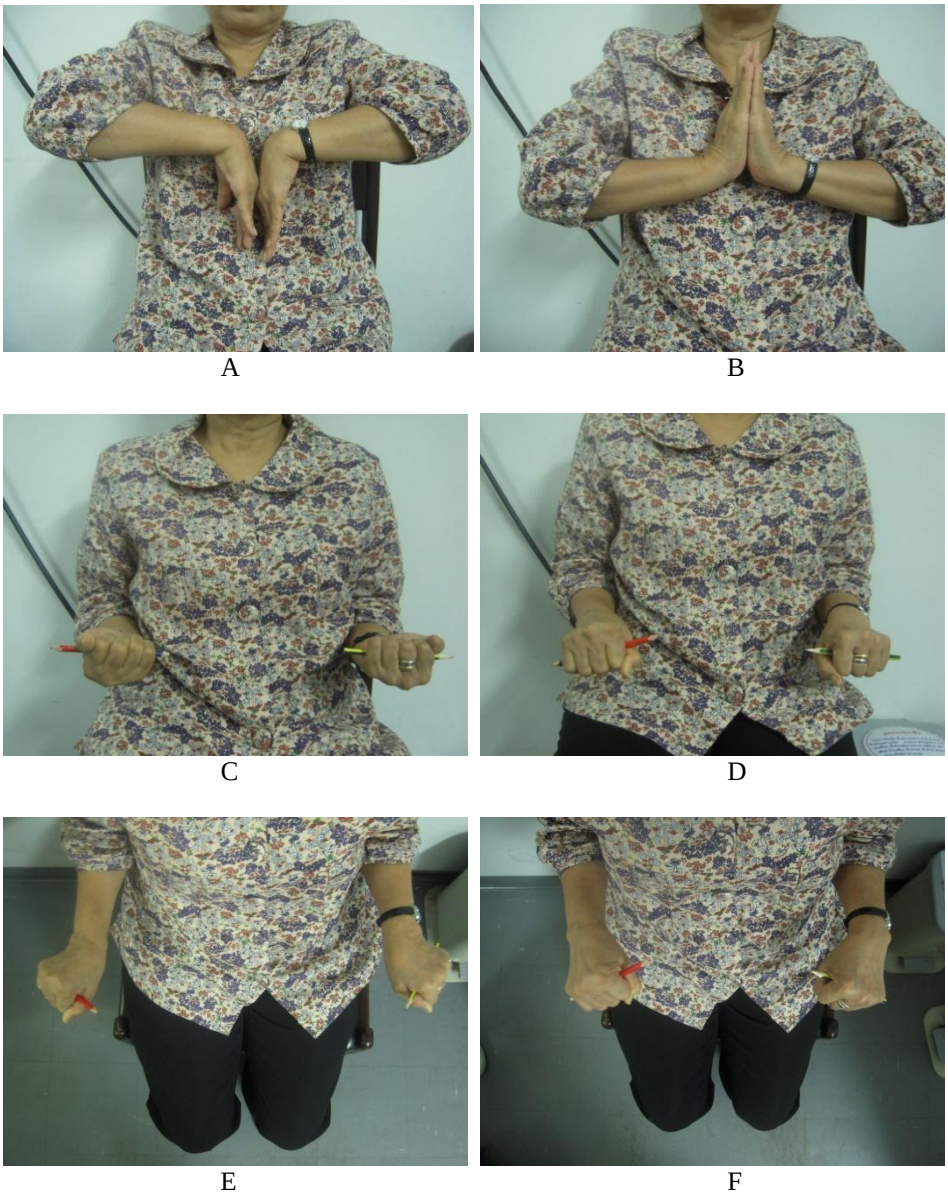

Fig. 2 Ranges of motion of one case in the autogenous bone graft group (A) Volarflexion (B) Dorsiflexion (C) Supination (D) Pronation (E) Ulnar deviation (F) Radial deviation

Discussion

Our study did not show a statistical difference in any of the radiographic parameters between the IBG group and the BPBG group. Therefore, we cannot conclude any correlation between radiographic parameter change and dorsal radiocarpal subluxation, or carpal malalignment or instability. In the previous clinical observation and biomechanical studies, it has been demonstrated that dorsal angulations of the distal radius cause wrist instability in two patterns. The first pattern is dorsal radiocarpal subluxation with maintenance of midcarpal alignment, and the second pattern is adaptive midcarpal dorsal intercalated segment instability deformity.[1]

The union rate in the BPBG group was 80% (12 in 15) while it was 91.67% (11 in 12) in the IBG group (P = 0.396). The failure correction rate in the BPBG group was 26.67% (4 in 15) while it was 8.33% (1 in 12) in the IBG group (P = 0.223). The re-operation rate in the BPBG group was 33% (5 in 15) while it was 1 in 12 (8.33%) in the IBG group (P = 0.182). Luchetti *et al.* reported successful results in a series of patients treated with carbonated hydroxyapatite instead of autogenous bone graft in the osteotomy gap.[7] Yasuda *et al.* reported a case involving the use of calcium phosphate bone cement with osteotomy and volar plating that resulted in complete radiographic union and improvement of symptoms[8]. However, some reports described the unsuccessful results. Ekrol *et*

al. reported a series of patients treated with RhBMP-7 in osteotomy and non-bridging external fixator or pi-plates that resulted in a slower bone healing rate than autogenous bone grafts.[9] Compared to the previous reports, the result of BPBG usage in our study was different from carbonated hydroxyapatite and calcium phosphate bone cement usage, but gave the same result as RhBMP-7 and BPBG usage in another study. Jakubietz *et al*. reported no difference in both clinical and radiographic results between internal fixation only and additional beta-tricalcium phosphate in comminuted intraarticular distal radius fractures.[10]

Prior to conducting the study, we had performed osteotomy using BPBG for bone graft substitute in most of the cases. After 2 years of follow-up we found, however, that there was a higher re-operation rate in patients who were operated on with BPBG as compared to those with IBG. We also collected both clinical and radiographic results after corrective osteotomy, which in most of the cases showed improvements in symptoms. However, 6 cases had to be re-operated due to pain and failure to achieve good functional outcomes. Even though there is no statistical difference of clinical and radiographic results between the two groups, the study has revealed the tendency towards a higher rate of failure in the BPBG group. The limitations of this study are that it was of retrospective design and the sample size was small in number. It is worth noting that a prospective study is beneficial and, by collecting more of both radiographic parameters and clinical outcomes, including range of motion and major symptoms, future studies will provide more conclusive results. Furthermore, as for the union time, our study is a retrospective review of the radiographs of the operated wrist. Therefore, it might be difficult to define the exact time of union at the osteotomy in association with the use of the two types of graft.

Conclusion

Radiographic parameters in the BPBG group were not significantly different from the IBG group. Compare to the previous reports, the result of BPBG usage in our study was different from carbonated hydroxyapatite and calcium phosphate bone cement usage, but gave the same result as RhBMP-7 and BPBG usage in another study. The union rate in the BPBG group was lower than the IBG group. The failure correction rate and re-operation rate in BPBG group was higher than the IBG group, however this difference in rates was not statistically significant.

References

1. Bushnell, B.D. and D.K. Bynum, Malunion of the distal radius. J Am Acad Orthop Surg, 2007. 15(1): p. 27-40.
2. Shea, K., et al., Corrective osteotomy for malunited, volarly displaced fractures of the distal end of the radius. J Bone Joint Surg Am, 1997. 79(12): p. 1816-26.
3. Smith, D.W. and M.H. Henry, Volar fixed-angle plating of the distal radius. J Am Acad Orthop Surg, 2005. 13(1): p. 28-36.
4. Khan, S.N., et al., The biology of bone grafting. J Am Acad Orthop Surg, 2005. 13(1): p. 77-86.
5. Verhaegen, F., I. Degreef, and L. De Smet, Evaluation of corrective osteotomy of the malunited distal radius on midcarpal and radiocarpal malalignment. J Hand Surg Am. 35(1): p. 57-61.
6. Graham, T.J., Surgical Correction of Malunited Fractures of the Distal Radius. J Am Acad Orthop Surg, 1997. 5(5): p. 270-281.
7. Luchetti, R., Corrective osteotomy of malunited distal radius fractures using carbonated hydroxyapatite as an alternative to autogenous bone grafting. J Hand Surg Am, 2004. 29(5): p. 825-34.
8. Yasuda, M., et al., Early corrective osteotomy for a malunited Colles' fracture using volar approach and calcium phosphate bone cement: a case report. J Hand Surg Am, 2004. 29(6): p. 1139-42.
9. Ekrol, I., et al., A comparison of RhBMP-7 (OP-1) and autogenous graft for metaphyseal defects after osteotomy of the distal radius. Injury, 2008. 39 Suppl 2: p. S73-82.
10. Jakubietz, M.G., J.G. Gruenert, and R.G. Jakubietz, The use of beta-tricalcium phosphate bone graft substitute in dorsally plated, comminuted distal radius fractures. J Orthop Surg Res. 6: p. 24.

ผลภาพถ่ายรังสีของการผ่าตัดแก้ไขกระดูก distal radius ผิดรูปโดยการใช้ beta-tricalcium phosphate เปรียบเทียบกับการใช้กระดูกเชิงกราน

ณัฐธร ดาราพงศ์สถาพร, พบ, ชัยโรจน์ เอื้อไพโรจน์กิจ, พบ

วัตถุประสงค์: *เพื่อศึกษาเปรียบเทียบภาพถ่ายรังสีที่เป็นผลจากการผ่าตัดแก้ไขกระดูก distal radius ผิดรูปโดยการใช้กระดูกเทียมชนิด beta-tricalcium phosphate เปรียบเทียบกับการใช้กระดูกเชิงกราน*

วิธีการศึกษา: *ผู้ป่วยที่มีกระดูก distal radius ผิดรูปจำนวน 27 รายในโรงพยาบาลเลิดสิน ที่มีอาการจากกระดูกผิดรูป และมีค่า parameters จากภาพถ่ายรังสีที่ผิดปกติ ที่เข้ารับการผ่าตัดแก้ไขโดยใช้กระดูกเทียมชนิด beta-tricalcium phosphate และกระดูกจากเชิงกราน โดยทำการติดตามค่า parameters จากภาพรังสีทั้งก่อนผ่าตัด หลังผ่าตัด 4 สัปดาห์ และครั้งสุดท้ายที่มาตรวจติดตามผล โดยรวบรวมผลและคำนวณโดยใช้ unpaired t-test, paired t-test และ chi-squared (Fisher exact test)*

ผลการศึกษา: *ค่า parameters จากภาพถ่ายรังสี ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของทั้งสองวิธี แต่พบว่าในกลุ่มที่ใช้กระดูกเทียมชนิด beta-tricalcium phosphate มีการติดของกระดูกหลังผ่าตัดเพียงร้อยละ 80 และในกลุ่มที่ใช้กระดูกจากเชิงกราน มีการติดของกระดูกหลังผ่าตัดถึงร้อยละ 91.67 และยังพบว่าในกลุ่มที่ใช้กระดูกเทียมชนิด beta-tricalcium phosphate มีอาการปวด และมีปัญหาจากการใช้งาน มีการสูญเสียมุมที่แก้ไขถึงร้อยละ 26.67 และต้องกลับมารับการผ่าตัดซ้ำถึงร้อยละ 33 ส่วนในกลุ่มที่ใช้กระดูกจากเชิงกราน มีการสูญเสียมุมที่แก้ไข และต้องกลับมารับการผ่าตัดซ้ำร้อยละ 8.33*

สรุป: *ค่า parameters จากภาพรังสี ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของทั้งสองวิธี แต่พบว่าในกลุ่มที่ใช้กระดูกเทียมชนิด beta-tricalcium phosphate มีอัตราการติดของกระดูกน้อยกว่า มีการสูญเสียมุมที่แก้ไขและต้องกลับมารับการผ่าตัดซ้ำมากกว่ากลุ่มที่ใช้กระดูกจากเชิงกราน แต่ก็ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติ*

Accuracy of clinical examination and magnetic resonance imaging in arthroscopic knee surgery

Somboon Wutphiriya-angkul, MD

Sawangdandin Crown prince Hospital, Sawang Daen Din, Sakon Naknon, Thailand

Background: *Diagnosis in knee injuries consist of clinical examinations and magnetic resonance imaging (MRI). The accuracy of these methods are varied. We performed a retrospective study to seek the accuracy of clinical examination and magnetic resonance imaging in arthroscopic knee surgery.*
Methods: *A total of 44 patients were selected for review. Data including sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were calculated.*
Results: *Arthroscopic examination should be kept as standard. The Lachman test is the most sensitive test to determine ACL tears, showing a sensitivity of 83% (95% confidence interval 0.64-0.99). The pivot shift test is the most specific test, showing a specificity of 85% (95% confidence interval 0.68-0.96). The McMurray test is the most sensitive test to determine meniscus tears, showing a sensitivity of 87% (95% confidence interval 0.76-0.96). The Apley test is a more specific test, showing a specificity of 86% (95% confidence interval 0.72-0.96). MRI of ACL showed a sensitivity of 96% (95% confidence interval 0.86-0.99). MRI of medial meniscus is a more sensitive test to determine meniscus tears, showing a sensitivity of 97% (95% confidence interval 0.88-0.99), MRI of lateral meniscus showed a sensitivity of 93% (95% confidence interval 0.84-0.99).*
Conclusion: *The clinical examination is an important and accurate diagnostic modality for the evaluation of knee injury. MRI is a more accurate diagnostic modality than clinical examination. It should be used when there is an uncertain indication for surgery.*

Keywords: *Clinical examination, magnetic resonance imaging, arthroscopic knee surgery*

The Thai Journal of Orthopaedic Surgery: 40 No.3-4: 19-23
Full text. e journal: *http://www.rcost.or.th, http://thailand.digitaljournals.org/index.php/JRCOST*

Introduction

The knee joint is the largest synovial joint in the body and is the most frequent source of musculoskeletal pain. Damage to the components within the knee joint usually occur as a result of injuries during sport activities or from car and motorcycle accidents. It is the numerous structures within it and their various pathologies, which result in pain and many other symptoms such as instability and restriction in range of motion[1]. Obtaining an accurate patient's history and physical examination can reveal the location of acute knee injury[2].

The anterior cruciate ligament (ACL) is an important stabilizing structure of the knee and its disruption is associated with pain and activity limitation[3]. The clinical diagnosis of an ACL injury is based upon history and physical examination findings with suspected cases confirmed by magnetic resonance imaging (MRI) or arthroscopy. Numerous clinical tests and findings have been proposed to aid in the diagnosis of ACL injuries. A popping sound, swelling and instability following high impact sport trauma along with a positive Lachman, anterior draw, or pivot shift test is the most common method of clinical diagnosis[4]. At present the diagnostic accuracy of these tests are varied. Magnetic resonance imaging (MRI) has become the gold standard for imaging soft tissue injuries of the knee[5]. However, the sensitivity of MRI for the detection of injury is not yet 100%. Sportsmen have occasionally undergone surgery with undiagnosed meniscal lesions on the basis of a normal MRI examination[6]. The sensitivity of MRI for the diagnosis of a lateral meniscus has been found to be significantly lower than that for the detection of a medial meniscus tears[7-9]. The lowest MRI sensitivity has been attributed to tears of the posterior horn of the lateral meniscus[10-12]. The presence of ACL tears are often associated with longitudinal tears of the lateral meniscus[13].

The purpose of this study is to determine the accuracy of clinical examinations and magnetic resonance imaging in arthroscopic knee surgery.

Materials and methods

A retrospectively review was conducted between 2014 and 2016 of 44 patients with arthroscopic knee surgery treated at Sawangdandin Crown Prince hospital. The inclusion criteria for this study were patients with a history of injury who underwent both MRI and arthroscopy knee surgery, patients who failed to show clinical improvement after 3 months, and those who had no

additional injury to the knee between the time of MRI/clinical diagnosis and surgery. Patients with degenerative changes, evidence of loose bodies in plain radiographs, any prior surgery for the index diagnosis, and articular surface fractures were excluded from the study.

The patients' examination included anterior drawer, pivot shift, and Lachman tests. Meniscus examination consisted of the McMurray and Apley tests. We recorded the physical examination findings for all patients.

The MRI findings were recorded by radiologist. Meniscal and ligamentous injuries were evaluated. The absence of an intrameniscal high signal was considered as a normal meniscus, while intrameniscal high signal intensity reaching the articular surface was regarded as a tear. The ACL was considered normal when it appeared as a band of fibres of low or intermediate signal intensity on both sagittal and coronal images. It was considered partially torn when it appeared fuzzy with an ill-defined outline and had abnormal signal intensity within, and as completely torn if there was disruption of all fibres, discontinuity, or avulsion from its attachment.

Arthroscopic surgery were done with complete preoperative care. A meniscus tear was diagnosed when there was discontinuity of its cartilage and we proceeded to identify according to size and shape of the tear. A complete tear of the ACL was diagnosed if the ligament was absent in the notch region, or if there was loss of ligament continuity with only ligament remnants at each end. We proceeded directly to reconstructive surgery and meniscus repair or meniscectomy in the same setting.

The data obtained from the study was analyzed using descriptive statistical methods (frequency, 95% confidence interval – percent) and the sensitivity, specificity, accuracy, positive predictive value and negative predictive value were calculated.

Results

There were 44 patients in the present study, with an average age of 25.8 years (range 14 - 40 years). The demographics data are shown in Table 1.

Table 1 Demographic data

Data	**Distribution**
Age (years): mean (SD)	25.8(5.2)
Gender (M/F)	32/12
Arthroscopic debridement	3
Meniscus repair or meniscectomy	14
ACL reconstruction	8
ACL reconstruction and meniscus repair/ meniscectomy	16
PCL reconstruction	3

The Lachman test is the most sensitive test to determine ACL tears, showing a sensitivity of 83% (95% confidence interval 0.64-0.99). The pivot shift test is the most specific test, showing a specificity of 85% (95% confidence interval 0.68-0.96). The McMurray test is the most sensitive test to determine meniscus tears, showing a sensitivity of 87% (95% confidence interval 0.76-0.96). The Apley test is a more specific test, showing a specificity of 86% (95% confidence interval 0.72-0.96), as shown in Table 2.

Table 2 Clinical examination results taking into consideration arthroscopic results as the definitive diagnosis

	Sensitivity (95% CI)	**Specificity (95% CI)**	**Positive predictive value (95% CI)**	**Negative predictive value (95% CI)**	**Accuracy (95% CI)**
Anterior drawer test	79 (58-94)	80 (61-95)	83 (65-95)	76 (54-93)	80 (60-95)
Pivot shift	75 (52-92)	85 (68-96)	86 (71-96)	74 (51-90)	80 (61-95)
Lachman	83 (64-95)	75 (53-92)	80 (62-95)	78 (56-93)	80 (59-94)
McMurray	87 (76-96)	79 (56-93)	90 (78-97)	73 (49-91)	84 (66-96)
Apley	83 (65-95)	86 (72-96)	93 (81-98)	71 (42-90)	84 (64-95)

MRI of ACL showed a sensitivity of 96% (95% confidence interval 0.86-0.99). MRI of medial meniscus is a more sensitive test for determining meniscus tears, showing a sensitivity of 97% (95% confidence interval 0.88-0.99), and MRI of lateral meniscus showing a sensitivity of 93% (95% confidence interval 0.84-0.99), as shown in Table 3.

Table 3 MRI results taking into consideration arthroscopic results as the definitive diagnosis

	Sensitivity (95% CI)	**Specificity (95% CI)**	**Positive predictive value (95% CI)**	**Negative predictive value (95% CI)**	**Accuracy (95% CI)**
Anterior cruciate ligament	96 (86-99)	95 (86-99)	96 (87-99)	95 (87-99)	95 (86-99)
Medial meniscus	97 (88-99)	93 (82-99)	97 (89-99)	93 (83-99)	95 (85-99)
Lateral meniscus	93 (84-99)	93 (81-99)	97 (86-99)	86 (78-96)	93 (82-98)

Discussion

We found that both physical examination and MRI were very sensitive and accurate in the diagnosis of ligamentous and meniscal injuries. These findings are resonant with those of Rayan et al, who conducted a correlational study on 131 patients with suspected traumatic meniscal or ACL injuries[14]. They concluded that carefully performed clinical examinations can give equal diagnosis of meniscal and ACL injuries in comparison to MRI scans and recommended that MRI be used to rule out such injuries rather than to diagnose them.

The anterior drawer test may be the least efficient tool in diagnosing ACL deficiency of the 3 methods which are most often used by practitioners as it is of unproven diagnostic value in this setting. In this study, we provided evidence that the anterior drawer test has a moderate specificity of 80% and sensitivity of 79%. Tores et al[15] put forward 3 potential cause for false-negative anterior drawer tests in acute conditions, especially in isolated ACL tears. First, hemarthrosis and reactive synovitis may preclude knee flexion to 90°, hindering performance of the test. Second, protective muscle action of the hamstrings (secondary to joint pain) provides a vector force opposite to the anterior translation of the tibia. Third, the posterior horn of the medial meniscus becomes buttressed against the posterior most margin of the medial femoral condyle and may preclude anterior translation of the tibia. Our results indicate that the Lachman test is the most sensitive method in diagnosing ACL rupture. The position of the knee during the test (20-30° of flexion) is less painful than the position of the knee during the anterior drawer test; hence, it reduces possible muscle action to protect the knee during testing[16]. The pivot shift test evaluates the combined tibiofemoral internal rotation and anterior tibia translation that occurs when the ACL is injured or deficient[17]. The pivot shift test is a complex multiplanar maneuver that incorporates 2 main components: translation (anterior subluxation of the tibial plateau followed by its reduction) and rotation (the rotation of the tibia relative to the femur)[18]. The reason for the low sensitivity may be explained by the fact that a patient with a chronic ACL deficient knee is familiar with this unpleasant phenomenon and will show protective muscle action[19].

Arthroscopic findings were used as the reference standard[20]. The sensitivity, specificity, accuracy, positive predictive value and negative predictive value of MRI were calculated in the evaluation of meniscal tears. They found the sensitivity for medial meniscus and lateral meniscus tears to be 97% and 93%, respectively. The overall accuracy for medial meniscus and lateral meniscus tears were 92% and 88%, respectively. The majority of missed meniscus tears on MRI affect the peripheral posterior horns, similar to our study. They concluded that the sensitivity for diagnosing a meniscal tear was significantly higher when the tear involved more than one-third of the meniscus of the anterior horn. The sensitivity was significantly lower for tears located in the posterior horn and for vertically oriented tears. They concluded that lateral meniscus tears are more likely to be missed if the tear involves only one third of the meniscus or is in the posterior horn. The posterior root of the lateral meniscus can be difficult to assess on MRI for multiple reasons including pulsation artefacts from the popliteal artery, volume averaging, and the magic angle effect, because of the slope of the meniscus on the tibial eminence, and the complex anatomy related to the origin of the meniscofemoral ligament[8]. The accuracy of diagnosis on injured menisci, or cruciate ligaments will depend on the quality of imaging equipment and on the skills and expertise of the radiologist and arthroscopist[21]. The decision for therapeutic arthroscopy would then depend on both clinical examination and MRI findings. The false positive rate for meniscal injuries in our study was 6.6%. In comparison, Chambers et al. reported a false positive rate of 10.5% while Sharifah et al. reported 6.2%[20,22]. Many patients presenting with an ACL tear may not have symptoms of instability and may be keen for conservative management, opting out of reconstructive surgery. In such patients, a false positive MRI finding of a torn meniscus may increase the risk of unnecessary surgery.

The strengths of our study include the standardized imaging protocol for all our knees. As all patients were from a single surgeon, the

confounding effects from varying expertise of arthroscopy are also reduced. But this study had a few limitations. It was a retrospective study and contained incomplete data on some patients. The size of the study was relatively small, and thus some findings lack statistical power.

The clinical examination is one of the most important and accurate diagnostic modalities for evaluation of knee surgery. All patients with knee injury should be subjected routinely to a thorough clinical examination to make a provisional diagnosis. It is noninvasive, easy, and available. The MRI is an accurate diagnostic modality. It can be used whenever there is an uncertain indication for arthroscopy.

References

1. Saavedra MÁ, Navarro-Zarza JE, Villaseñor-Ovies P, et al. Clinical anatomy of the knee. Reumatol Clin 2012-2013;8 Suppl 2:39-45.
2. Berfeld j, Ireland ML, Wojtys EM. Pinpointing the cause of acute knee pain. Patient care 1997; 31: 100-117.
3. Lerat JL, Moyen BL, Cladiere F, Besse JL, Abidi H. Knee instability after injury to the anterior cruciate ligament. Quantification of the Lachman test. J Bone Joint Surg Br. 2000;82:42–47.
4. Cimino F, Volk BS, Setter D. Anterior cruciate ligament injury: diagnosis, management, and prevention. Am Fam Physician. 2010;82:917–922.
5. Kocabey Y, Tetik O, Isbell WM, et al. The value of clinical examination versus magnetic resonance imaging in the diagnosis of meniscal tears and anterior cruciate ligament rupture. Arthroscopy 2004;20:696-700.
6. Makdissi M, Eriksson KO, Morris HG, et al. MRI-negative bucket-handle tears of the lateral meniscus in athletes: a case series. Knee Surg Sports Traumatol Arthrosc 2006;14:1012-6.
7. Oei EH, Nikken JJ, Verstijnen AC, et al. MR imaging of the menisci and cruciate ligaments: a systematic review. Radiology 2003;226:837-48.
8. De Smet AA, Mukherjee R.. Clinical, MRI, and arthroscopic findings associated with failure to diagnose a lateral meniscal tear on knee MRI. AJR Am J Roentgenol 2008;190:22-6.
9. De Smet AA, Graf BK.. Meniscal tears missed on MR imaging: relationship to meniscal tear patterns and anterior cruciate ligament tears. AJR Am J Roentgenol 1994;162:905-11.
10. Justice WW, Quinn SF. Error patterns in the MR imaging evaluation of menisci of the knee. Radiology1995;196:617-21.
11. Quinn SF, Brown TF. Meniscal tears diagnosed with MR imaging versus arthroscopy: how reliable a standard is arthroscopy? Radiology 1991;181:843-7.
12. Mesgarzadeh M, Moyer R, Leder DS, et al. MR imaging of the knee: expanded classification and pitfalls to interpretation of meniscal tears. Radiographics 1993;13:489-500.
13. Nikolic DK. Lateral meniscal tears and their evolution in acute injuries of the anterior cruciate ligament of the knee. Arthroscopic analysis. Knee Surg Sports Traumatol Arthrosc 1998;6:26-30.
14. Rayan F, Bhonsle S, Shukla DD. Clinical, MRI, and arthroscopic correlation in meniscal and anterior cruciate ligament injuries. Int Orthop 2009;33:129-32.
15. Torg JS, Conrad W, Kelen V. Clinical diagnosis of anterior cruciate ligament instability in the athlete. Am J Sports MED 1976;4:84-93.
16. Benjaminse A, Gokeler A, van de Schans CP. Clinical diagnosis of an anterior cruciated ligament rupture: a meta-analysis. J Orthop Sports Phys Ther 2006;36:267-88.
17. Bach BR Jr, Warren RF, Wickiewicz TL. The pivot shift phenomenon: result and description of a modified clinical test for anterior cruciate ligament insufficiency. Am J Sports Med 1988;16:571-6
18. Tanaka M, Vyas D, Moloney G , Bedi A, Pear AD, Musahl V. What does it take to have a high-grade pivot shift? Knee Surg Sports Traumatol Arthrosc 2012;20:737-42.
19. Steinbruck K, Wiehmann JC. Examination of the knee joint. The value of clinical finding in arthroscopic control. Z Orthop Ihre Grenzgeb 1988;126:289-95.
20. Sharifah MI, Lee CL, Suraya A, et al. Accuracy of MRI in the diagnosis of meniscal tears in patients with chronic ACL tears. Knee Surg Sports Traumatol Arthrosc 2015;23:826-30.
21. Esmaili Jah AA, Keyhani S, Zarei R, et al. Accuracy of MRI in comparison with clinical and arthroscopic findings in ligamentous and meniscal injuries of the knee. Acta Orthop Belg 2005;71:189-96
22. Chambers S, Cooney A, Caplan N, et al. The accuracy of magnetic resonance imaging (MRI) in detecting meniscal pathology. J R Nav Med Serv 2014;100:157-60.

ความถูกต้องของการตรวจร่างกายและการตรวจภาพถ่ายคลื่นแม่เหล็กไฟฟ้าในการผ่าตัดส่องกล้องข้อเข่า

สมบูรณ์ วุฒิพิริยะอังกูร, พบ

วัตถุประสงค์: *การวินิจฉัยอาการบาดเจ็บของข้อเข่าประกอบด้วยการตรวจร่างกายและการตรวจภาพถ่ายด้วยคลื่นแม่เหล็กไฟฟ้า ซึ่งความถูกต้องของการตรวจยังแตกต่างกัน วัตถุประสงค์ของการศึกษานี้เพื่อตรวจหาความถูกต้องของการตรวจร่างกาย และการตรวจภาพถ่ายด้วยคลื่นแม่เหล็กไฟฟ้าในการผ่าตัดส่องกล้องข้อเข่า*

วิธีการ: *การศึกษาวิจัยแบบย้อนหลัง โดยวัดความไว, ความจำเพาะ, ค่าทำนายผลบวก, ค่าทำนายผลลบและความถูกต้อง*

ผลการศึกษา: *จากผู้ป่วยจำนวน 44 ราย พบว่าการตรวจ Lachman มีความไวสูงสุดในการตรวจการบาดเจ็บของเอ็นไขว้หน้า โดยมีความไวร้อยละ 83 (95% ความเชื่อมั่น 0.64-0.99) การตรวจ pivot shift มีความจำเพาะสูงสุด โดยมีความจำเพาะร้อยละ 85 (95% ความเชื่อมั่น 0.68-0.96) การตรวจ McMurray มีความไวสูงกว่าในการตรวจการบาดเจ็บของหมอนรองข้อเข่า โดยมีความไวร้อยละ 87 (95% ความเชื่อมั่น 0.76-0.96) การตรวจ Apley มีความจำเพาะสูงกว่า โดยมีความจำเพาะร้อยละ 86 (95% ความเชื่อมั่น 0.72-0.96) การตรวจภาพถ่ายด้วยคลื่นแม่เหล็กไฟฟ้า เอ็นไขว้หน้ามีความไวร้อยละ 96 (95% ความเชื่อมั่น 0.86-0.99) หมอนรองกระดูกด้านในมีความไวสูงกว่าด้านนอก โดยความไวของ การตรวจหมอนรองข้อเข่าด้านในร้อยละ 97 (95% ความเชื่อมั่น 0.88-0.99) ส่วนความไวของ การตรวจหมอนรองข้อเข่าด้านนอกร้อยละ 93 (95% ความเชื่อมั่น 0.84-0.99)*

สรุปผลการศึกษา: *การตรวจร่างกายมีความสำคัญและถูกต้องในการวินิจฉัยการบาดเจ็บของข้อเข่า ถึงแม้ว่าการตรวจภาพถ่ายด้วยคลื่นแม่เหล็กไฟฟ้ามีความถูกต้องมากกว่า แต่ควรส่งตรวจก็ต่อเมื่อไม่แน่ใจว่าจะผ่าตัดผู้ป่วยหรือไม่*

A prospective and comparative study between pre and post intra-articular knee injection to evaluate the efficacy of sodium hyaluronate (Hyruan®III) in the treatment of knee osteoarthritis

Nara Jaruwangsanti, MD, Prakit Tienboon, MD

Department of Orthopaedics, Faculty of Medicine, Chulalongkorn University,

Pathumwan, Bangkok, Thailand

Background: *Many reports of sodium hyaluronate intra-articular injections into the knee joint show evidence of improvements of pain and function in osteoarthritis knees. Most of the injection techniques were a single dose once a week for 3 or 5 weeks according to each manufactures' recomendation. Some manufactures prepared this for one single dose, one injection.*

Purpose: *To elucidate a technique of three-in-one single doses of the intra-articular injection of sodium hyaluronate for osteoarthritis of the knee with regards to its safety and clinical outcomes between pre and post injection.*

Methods: *We combined three intra-articular injections of the high molecular weight sodium hyaluronate into a single dose to be administered as one single intra-articular injection to treat 100 osteoarthritis knees who failed the medical conservative treatment and physical therapy. The Visual Analogue Scale (VAS), Western Ontario and McMaster Universities Osteoarthritis (WOMAC) score, Knee Society score, and knee function score were the measurement methods. The mean difference between pre and post intra-articular injections in each efficacy score was compared and the safety of the injection was the main principle of evaluation.*

Results: *Ten knees were excluded due to not fulfilling the criteria. Only 90 knees were included. Using the Ahlback knee grading system, 60 knees were of grade I, 15 knees were of grade II, and 15 knees were of grade III. The average 100 mm VAS scale before injection was 44.26 and was reduced to its lowest point 7.41 at the 8^{th} month follow up($P = 0.008$), and increased to 36.85 at the 8^{th} month after treatment. WOMAC scores were reduced to their lowest point 7.51at 8^{th} month follow up ($P = 0.011$), and increased after 8 months after treatment to 36.75, therefore the VAS scale and WOMAC score decreased significantly. The average Knee Society score was 64.23 before injection and was raised to an average of 78.82 by the first month after injection ($P = 0.002$). At the 8^{th} month after injection, the value was raised up to 90.20 ($P=0.001$). The average knee function score was 60.61 before injection. But after the first month post-injection, the average score was raised to 77.22, ($P = 0.018$). At the 8^{th} month after injection, the value was 86.28($P = 0.001$), therefore the knee score and functional score increased significantly.*

Conclusion: *The combined three to one single dose (high molecular weight) sodium hyaluronate (Hyruan®III) injection yielded high potency of clinical results comparing between pre and post injection in all indicators in this study.*

Keywords: *Sodium hyaluronic acid, knee osteoarthritis, intra-articular single injection.*

The Thai Journal of Orthopaedic Surgery: 40 No.3-4: 25-34
Full text. e journal: *http://www.rcost.or.th, http://thailand.digitaljournals.org/index.php/JRCOST*

Introduction

The treatment option for knee osteoarthritis (OA) is dependent on age, sex, obesity, joint effusion, joint inflammation, knee deformities, and severity of the joint cartilage involved. The treatment principles follow the American College of Rheumatology (ACR)[1] and the European League Against Rheumatism (EULAR)[2] as standard options in general practice. Surgical treatment is the last option after failure of all conservative treatment regiments. Any surgical intervention for knee osteoarthritis must be based on the knee deformities, pathology, and the proper or corrected indication. In the early stage or gray zone of knee pathology, many conservative treatment regiments should be applied to the patients[1,2]; this depends on each patients' status or condition. Because osteoarthritis of the knee requires a long-term conservative treatment program, selection of the treatment modalities should be appropriate for each patient. Some conservative treatments such as topical gel or spray

treatments (i.e. methylsalicylate, capsaicin etc.), physical therapy, proper exercise, or intra-articular knee injections with steroids[3,4,5] or with high molecular weight sodium hyaluronate[6,7,8,9] may be another choice of treatment. Balazs[10] first proposed the idea of viscosupplementation in 1993. The FDA has approved sodium hyaluronate injections as a viscosupplementation only for knee osteoarthritis. Its clinical outcomes have been reported to be far better than placebos,[6,7,8,9,10,11,12] but when compared to many oral non-steroidal anti-inflammatory drugs, the results were not as effective as steroid injections[13,14,15,16]. Proteoglycans and link proteins facilitate binding of aggrecan to hyaluronic acid[15]. In osteoarthritis of the knee, there is decreased concentration and function[17]. Because the normal substance in healthy knees has been found to have very high viscoelasticity properties, for the treatment of knee osteoarthritis sodium hyaluronate injections will help increase the efficiency of knee lubrication, increase knee viscosity, decrease friction, shock absorption, sharing and reduce articular loading, reduce inflammation, and enhance the cartilage cell nourishment and cartilage cell apoptosis[18,19,20]. There are two methods of sodium hyaluronate preparation, cockscomb extraction (animal source) and synthetic chemical preparation (non-animal source). The non-animal source has minimal risk of contamination with animal allergens or pathogens[21]. Non- or less inflammatory reactions were reported in non-animal sourced sodium hyaluronate injections. But in the animal extracted sodium hyaluronate, painful and severe acute inflammatory reactions have been known to occur[22,23]. The concentrations and molecular weight of sodium hyaluronate preparation were also an issue with much discussion in the previous articles. Key questions included: which concentration provides the highest efficiency to improve knee pain and function? Or which molecular weight gives more effective clinical results? In general practice, a single dose of sodium hyaluronate injection is administered once a week for up to three to five weeks consecutively, depending on each regiment. However, some manufacturers combined all three or five injections into only single injection[24,25]. In this research, the selected sodium hyaluronate was a high molecular weight type, and the technique of injection was also one single injection. Even though the preparation of the sodium hyaluronate was in 3 syringes, which were recommended to be injected once a week for up to 3 weeks, we used three doses of 2 ml each and retained the syringe so it was injected into the knee joint in only one needle injection. The clinical results between pre and post injection were evaluated following the VAS (Visual Analogue Scale)[26], WOMAC score[27,28,29,30,31] (Western Ontario and McMaster Universities Osteoarthritis Index), knee society score,[32] and knee function score[32]. In addition, we verified immediate adverse drug effects on the knee with clinical examination and erythrocyte sedimentation rate at the first week follow up in every case.

Materials and methods

All the patients in this study had to meet definite inclusion and exclusion criteria.

The inclusion criteria

1. OA diagnosis following the American Rheumatism Association diagnostic criteria, 1986
2. Primary treatment following the American College of Rheumatology (ACR) and European League Against Rheumatism (EULAR)
3. Every patient is informed of the research project, research program, and accepts our method of study to the end of the program for 1 year.
4. The minimum age of the patients is 45 years old
5. 100 VAS scale and WOMAC scores before the sodium hyaluronate injection start at 30 or more
6. The entire treated knee is x-rayed in antero-posterior, lateral, and sky line view. Ahlback grading[33] is used to evaluate the severity of the knee pathology and must be in between grade 1-3

The exclusion criteria

1. Patients did not agree to the project before or during treatment program.
2. Patients could not follow the project until end of program
3. There were underling diseases such as rheumatoid arthritis, gouty arthritis and septic arthritis.
4. Patients had acute knee arthritis with joint effusion or severe inflammation

The study was conducted at the Faculty of Medicine, King Chulalongkorn University and Memorial Hospital, Bangkok, Thailand from February 2009 to October 2011 under the Chulalongkorn University ethic committee COA. No. 011/2010, IRB No. 419/52. The number of specimens was 100 osteoarthritis knees. During the research data collection, 10 knees were excluded because they did not fulfill our criteria, so there were 90 osteoarthritis knees in this study. All patients received the conservative treatment following the ACR and EULAR. The high molecular weight sodium hyaluronate (Hyruan®III) was injected in cases of conservative treatment failure. The three syringe single dose injection was administered by injecting each 2 ml. syringe of sodium hyaluronate subsequently until 3 syringe were finished. All patients were allowed to

walk normally and also advised to continue normal daily activities. The knee exercise program was advocated to improve the ligaments, muscles, and tendon strengths without giving any medication. The quadricep muscles were the main principle muscles in the strength training. One week after the injection, all patients returned to the clinic for a blood examination for erythrocyte sedimentation rate and knee examination to check knee inflammation and clinical results. Clinical knee pain and its function between pre and post injection were evaluated every month following the 100 mm VAS scale, WOMAC score, Knee society score, and functional score protocol till the 12th month follow up. The general information of the patients is shown in Table 1.

Table 1 Baseline characteristics of all patients

	Female	**Male**
Gender	73	17
average age (yrs)	65.63	64.12
Average weight Kg.	62.16	72.25
Ahlback Grade1	44	16
Ahlback Grade2	15	-
Ahlback Grade3	14	1
Ahlback Grade4	-	-
Average age (yrs)	65.34	
Average weight (kg)	63.19	
Average BMI (kg/m^2)	25.31	

Results

The erythrocyte sedimentation rate was normal in almost all of the patients. Slight ESR elevation was found in a few patients. A high ESR of over 50 was found in only one patient and it remained high along the course of treatment, but the clinical knee inflammation was not significant. This patient had a history of high ESR before the injection and she was aware of her status. For clinical knee inflammation, some patients had knee inflammation higher than the first visit or before the injection.

VAS scale, WOMAC score, knee society score, and function score were indicators to evaluate the clinical outcomes compared between pre and post 6 ml. sodium hyaluronate (Hyruan®III) injections. Statistical analysis was done using the one sample *t-test*, *P-value* and *paired t-test* between pre and post injection.

The 100 mm VAS scale analysis before the injection showed that the VAS score was in between 30-60 and 44.26 in average. After the injections, the average score gradually decreased to the lowest point of 7.41 at the 8th month. After that it increased slightly, but remained less than 10 at the 12th month. These figures are shown in Fig.1 and Table 2.

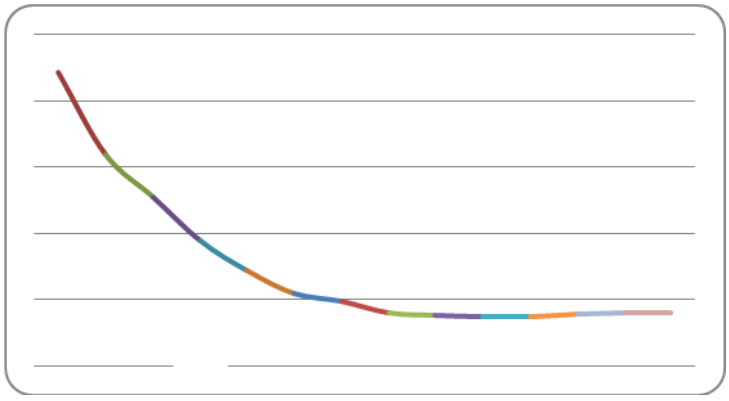

Fig. 1 The trend of Visual Analogue Scale compared between pre and post injection for every month up to 12th month

Table 2 Comparative statistical analyses of 100 mm VAS Scale between pre and post injection

100 mm VAS Scale	**N=90**	***P*-value** [a]
Average scale before injection	44.26	
Average scale after 8th months (Scale < 10, (95% confidence)	7.41	0.008
Improvement of VAS Scale after 8th month	36.85	
Paired *t*-test [b] (pre and post injection)	0.001	

[a] One-Sample t-test
[b] Paired *t*-test

Statistical analysis using the *t-test* at the 8th month of 90 subjects found the *P-value* =0.008, less than the standard value at 0.05, *Paired t-test* (pre and post injection at 8th month) = 0.001.

The WOMAC Scores were analyzed and the results are shown in Fig. 2 and Table 3. The outcome was generally the same as the VAS scale.

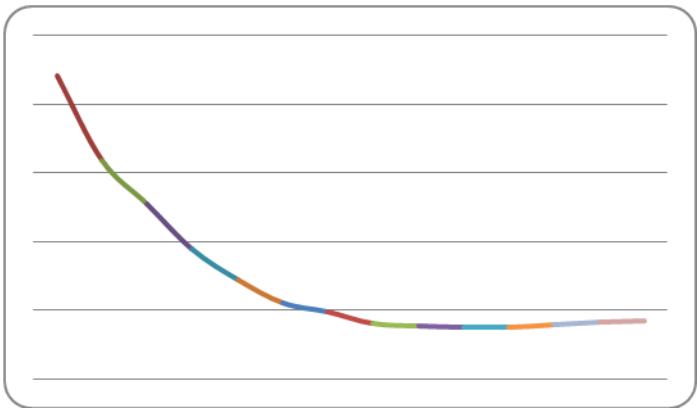

Fig. 2 The trend of WOMAC score compared between pre and post evaluated for every month up to 12th month

The trend of WOMAC scores decreased from the first month and was lowest at the 8th month, similar to the 100 mm VAS Scale.

Table 3 Statistical analysis of WOMAC scores between pre and post injection

WOMAC score	**N=90**	***P*-value**[a]
Pre-injection WOMAC score	44.26	-
Post injection WOMAC score < 10, (95% confidence)	7.51	0.011
WOMAC score improvement	36.75	-
Paired t-test[b] (pre and post injection)	0.001	-

[a] One-Sample *t*-test
[b] Paired *t*-test

Statistical analysis by *t-test* at the 8th month for 90 subjects found the *P-value* =0.011, less than the standard value at 0.05, and found *Paired t-test* (pre and post injection at 8th month) =0.001.

The average Knee Society score before injection was 64.23. The trend for the 12 months after the injections is shown in Fig. 3 and Table 4.

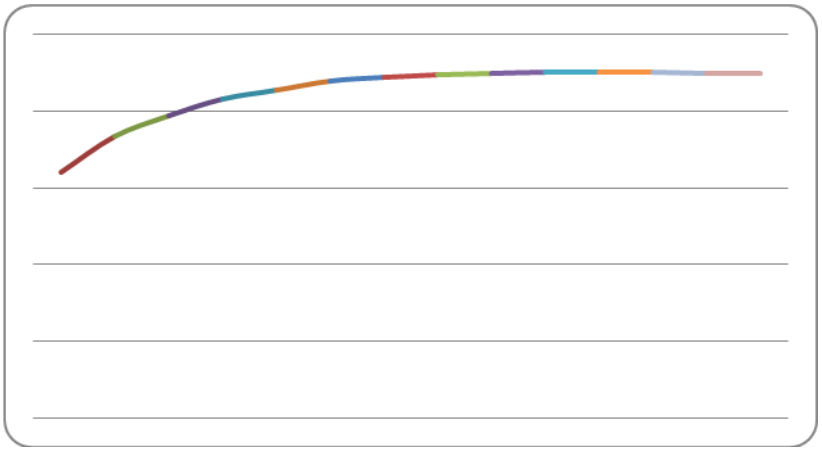

Fig. 3 The trend of Knee Society Scores compared between pre and post evaluated for every month up to 12th month

The average Knee Society score started at > 75, ($P < 0.05$) for the first month and increased to > 90, P= 0.353 at the 8th month.

Table 4 The Knee Society scores before and 12 months after injection

Knee society score value by average	**N=90**	***P*-value**
Before injection	64.23	
1st month after injection (Knee score > 75, (95% confidence)	78.82	0.002
8th month after injection (Knee score > 90, (95% confidence)	90.20	0.353
Knee society score value increase at 8th month	25.97	
Paired *t*-test [b] (pre and post injection at 8th month)	0.001	

[a] One-Sample t-test
[b] Paired t-test

Table 4 reveals that the average Knee Society score before injection was 64.23. After injection at one month it was 78.82, P=0.002 and after 8 months it was 90.20, P=0.353.

The statistical analysis found the average Knee Society score was higher than 75 at the first month and more than 90 at the 8th month. One-Sample t-test at the first month revealed *P*-value = 0.002. The standard analysis found values of knee scores were higher than 90 at the 8th month. One-Sample *t*-test at the 8th month revealed *P*-value = 0.353. Paired *t*-test (pre and post injection at the 8th month) =0.001.

The data of the average functional score before and after injection are shown in Fig. 4 and Table 5.

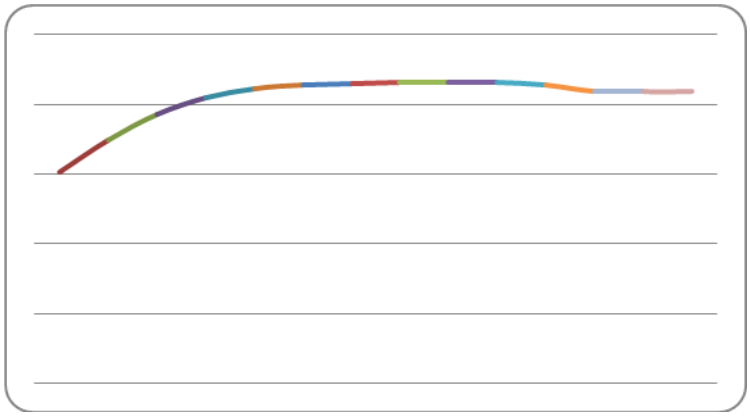

Fig. 4 Trend of the function score before and 12 months after injection

The average functional score increased from the first month and was highest at the 8th month. After that the trend decreased slightly, but was still over 85 on average. All the functional score values are shown in Table 5.

Table 5 The average functional scores before and 12 months after injection

Average Functional score	**N=90**	***P*-value [a]**
Before injection	60.61	
1th month after injection (Functional score > 75, (95% confidence)	77.22	0.018
8th month after injection (Functional score > 85, (95% confidence)	86.28	0.146
Functional score increase at 8th month	25.67	
Paired *t*-test [b] (pre and post injection at 8th month)	0.001	

[a] One-Sample *t*-test
[b] Paired *t*-test

The average functional score before injection was 60.61. At the first and 8th months post-injection, the average functional score increased to 77.22 and 86.28, respectively.

Discussion

In this research study, the researchers (clinician), data collector (research assistant) and statistics analyst individually performed their own work. The clinician treated all of the patients and assisted with progress notes recorded on every follow up visiting date as usual, but not every month. The research assistant collected all the raw data from patients every month and called them if those patients missed a period of follow up time. The data collected were 100 mm VAS scale, WOMAC score, Knee society score, and functional score protocol. The statistic analyst was the only person who analysed the entire raw dataset. To evaluate drug safety after injection, all patients were scheduled to return to the clinic after the first week to look for clinical knee inflammation and ESR. Close observation of patient who had elevated ESR or clinical knee inflammation was followed by repeated ESR tests at every follow up week until rates were considered normal. Even though 10 out of the 90 knees had elevated ESR, no one had a serious untoward reaction in this research. The reason for our very close observation after the injection was because we injected a high volume (6 ml.) at once in to the knee joint. It did not follow the company recomendation (injecting each 2 ml. refilled syringe every week for 3 weeks). We can conclude that this technique was safe and was highly effective. There have been some single injection regiments in the market. But in general practice, the recommened dosage of many sodium hyaluronate intra-articular knee injections is once a week for up to 3 or 5 weeks depending on each manufacturers' recomendation. We thought that the high volume injection concept would gain many more benefits than the standard injection regiments.This concept was, first of all, that the high volume and high concentration of the sodium hyaluronic acid would immediately reduce pain, improve knee function, and increase the viscoelasticity of the joint more than a single dose injection. Moreover, the high volume may yield more lubrication, reduce joint friction, share and reduce load transmission on the articular cartilage, and the last very important issue, it may reduce

load carrying at the pathology site. This action (high/proper volume and high concentration), in our opinion, is a very important point of the success of this paper. It improved knee function and reduced knee pain earlier, a day or a week after the injection in almost all osteoarthritis knees.

Secondly, having only one injection reduced risk of infection, reduced treatment costs and reduced patient anxiety. The aseptic technique of injection was prepared only once. So it also saved the hospital fees, the transportation payment, time to the hospital and so on.

Thirdly, apart from the function mentioned above, it nourished the articular cartilage, enhanced cartilage matrix synthesis, protected cartilage cells from apoptosis, and it was believed to reduce the inflammatory reaction of the joint. Unfortunately for this study, the period of research was quite short being only 12 months. Although there were some clinical results of patients who requested for second and third dose injection without any knee reaction, we did not have the record of such patients. It was quite interesting because some papers report the secondary reaction of knee inflammation and fibrosis[34,35,36,37]. In this paper, we only studied clinical outcomes for 12 months and did not have any information on the long term effects (5 years or more), such as how does the articular cartilage change in the long term, and is the medial joint space narrower or widened by year?

Nevertheless, the 12 months result was satisfactory. This clinical outcome was beyond our expectations and the long-term action of the drug in this regiment was at least the same as the standard injection regiment. However, from our experience from this research point of view, treatment recommendations to use this regiment requires definite knee selection in Ahlback grade I or II. In cases of the knee pain in Ahlback grade I or II with medial collateral ligament tendinitis, this ligament should be treated first. When the tendinitis subsided and patients still had intra-articular knee pain, the regiment of sodium hyaluronate injection was applied. In cases of Ahlback grade IV, in our opinion, it is not a good candidate or should be a contraindication for sodium hualuronate injections. But in some cases or some conditions of the patients, such as heart disease or other operative contraindications, the Ahlback grade III (also grade IV) knee might be suitable for injection to relieve or reduce pain for a short time. The regiments of 3 doses combined into 1 injection need to strictly follow the inclusion and exclusion criteria, a large volume of joint effusion was not suitable for injection, for example. But in cases of dry joint fluid, this regiment worked very well.

This research was intended to compare the outcome or results between pre and post intra articular knee injections of sodium hyaluronate. Most of the reports in the past were a comparative study to placebo or other drugs, such as steroids, NSAIDS, or sodium hyaluronate from other companies. By the comparative technique in this research, we could observe its real clinical results in the same patients and also exactly know the clinical results of the drug's action. This was because we all knew and accepted the efficiency of this drug action far better than placebos and its better long term results than steroids. If we look at the 100mm VAS scale and WOMAC score graph, they significantly declined from the starting point at the first week to the peak period at the 8th month and remained a little high, but still less than 10 points until the 12 month follow up. The Knee Society score and functional score gave the same results. Increases of both scores were seen at the first week after injection and rising up until the 12th month follow up. In this study we wanted to test the effectiveness of high volume (6 ml.) single doses of the high molecular weight sodium hyaluronate (Hyruan®III) in each patient. It reflected the efficiency of the drug to control pain and improve the function of the individual osteoarthritis knee, as we got a very good result from all measurement scales or scores and form statistical analysis. In this project study, we planned for 100 osteoarthritis knees, but 10 of the patients were excluded due to not fullfilling our criteria.

In conclusion, the technique of high volume sodium hyaluronate (Hyruan®III) intra-articular knee injections gave much earlier and long term clinical benefits to the osteoarthritis knees when compared between pre and post injection. The better results after injection could be detected within a week or a few weeks later. All the analysis indicators and the related statistical analysis revealed highly positive results. The single intra-articular knee injection with high volume (6ml.) sodium hyaluronate (Hyruan®III) is recommended in this article, but it must be injected to the osteoarthritis knee under the same criteria.

References

1. American College of Rheumatology (ACR). American College of Rheumatology Subcommittee on Osteoarthritis Guidelines. Recommendations for the Medical Management of Osteoarthritis of the Hip and Knee. Arthritis and Rheumatism. 2000; 43:1905-1915.
2. Mazieres B, Bannwarth B, Dougados M, Lequesne M. EULAR recommendations for the management of knee osteoarthritis: report of a taskforce of the Stand- ing Committee for International Clinical Studies In- cluding Therapeutic Trials. Joint Bone Spine. 2001; 68:231-240.

3. Raynauld J, Buckland-Wright C, Ward R, Choquette D, Haraoui B, Martel-Pelletier J, et al. Safety and efficacy of long-term intraarticular steroid injections in osteoarthritis of the knee. *Arth Rheum* 2003; 48: 370–7
4. Dieppe PA, Sathapatayavongs B, Jones HE, Bacon PA, Ring EF. Intra-articular steroids in osteoarthritis. *Rheumatol Rehabil* 1980; 19: 212–7.
5. Smith MD, Wetherall M, Darby T, Esterman A, Slavotinek J, Robert-Thomson P, et al. A randomized placebo-controlled trial of arthroscopic lavage versus lavage plus intra-articular corticosteroids in the management of symptomatic osteoarthritis of the knee. *Rheumatol* 2003; 42: 1477–85.
6. Peyron JG. Intraarticular hyaluronan injections in the treatment of osteoarthritis: state-of-the-art review. *J Rheumatol*. 1993;39(suppl):10–5.
7. Dahlberg L, Lohmander LS, Ryd L. Intraarticular injections of hyaluronan in patients with cartilage abnormalities and knee pain. A one-year double-blind, placebo-controlled study. *Arthritis Rheum*. 1994;37:521–8.
8. Henderson EB, Smith EC, Pegley F, Blake DR. Intra-articular injections of 750 kD hyaluronan in the treatment of osteoarthritis: a randomised single centre double-blind placebo-controlled trial of 91 patients demonstrating lack of efficacy. *Ann Rheum Dis*. 1994;53:529–34.
9. Lohmander LS, Dalen N, Englund G, Hamalainen M, Jensen EM, Karlsson K, et al. Intra-articular hyaluronan injections in the treatment of osteoarthritis of the knee: a randomised, double blind, placebo controlled multicentre trial. Hyaluronan Mulicentre Trial Group. *Ann Rheum Dis*. 1996;55:424–31.
10. Balazs EA, Denlinger JL. Viscosupplementation: a new concept in the treatment of osteoarthritis. *J Rheumatol Suppl*. Aug 1993;39:3-9.
11. Dougados M, Nguyen M, Listrat V, Amor B. High molecular weight sodium hyaluronate (hyalectin) in osteoarthritis of the knee: a 1 year placebo-controlled trial. *Osteoarthritis Cart*. 1993;1:97–103.
12. Puhl W, Bernau A, Greiling H, Kopcke W, Pfor-ringer W, Steck KJ, et al. Intraarticular sodium hyaluronate in osteoarthritis of the knee: a multi-centre double-blind study. *Osteoarthritis Cart*. 1993;1:233–41.
13. Jones AC, Pattrick M, Doherty S, Doherty M. Intra-articular hyaluronic acid compared to intra-articular triamcinolone hexacetonide in inflammatory knee osteoarthritis. Osteoarthritis Cartilage 1995;3:269–273.
14. Bannuru RR, Natov NS, Obadan I, et al. Therapeutic Trajectory of Hyaluronic Acid Versus Corticosteroids in the Treatment of Knee Osteoarthritis: A Systematic Review and Meta-Analysis. Arthritis Rheum. 2009 Dec 15;61(12):1704-11.
15. Caborn D, Rush J, Lanzer W, et al. A randomized, single blind comparison of the efficacy and tolerability of hylan G-F 20 and traimcinolone hexacetonide in patients with osteoarthritis of the knee. J Rheumatol. 2004;31:333-343.
16. Frizziero I, Pasquali-Ronchetti I. Intra-articula treatment of osteoarthritis of the knee: an arthroscopic and clinical comparison between sodium hyaluronate (500-730 kDa) and methylprednisolone acetate. J Orthop Trauma. 2003:89-96.
17. Frizziero I, Pasquali-Ronchetti I. Intra-articula treatment of osteoarthritis of the knee: an arthroscopic and clinical comparison between sodium hyaluronate (500-730 kDa) and methylprednisolone acetate. J Orthop Trauma. 2003:89-96.
18. Jørgensen A, Stengaard-Pedersen K, Simonsen O, et al. Intra-articular hyaluronan is without clinical effect in knee osteoarthritis: a multicentre, randomised, placebo-controlled, double-blind study of 337 patients followed for 1 year. Ann Rheum Dis. 2010 Jun;69(6):1097-102. Epub 2010 May 6.
19. Jubb RW, Piva S, Beinat L, et al. A one-year randomized placebo (saline) controlled clinical trial of 500-730 kDa sodium hyaluronate (Hyalgan) on the radiological change in osteoarthritis of the knee. Int J Clin Pract. 2003:57(6):467-475.
20. Petrella RJ. Hyaluronic acid for the treatment of knee osteoarthritis: long-term outcomes from a naturalistic primary care experience. Am J Phys Med Rehabil. 2005 Apr;84(4):278-83; quiz 284, 293.
21. Tascioglu F, Oner C. Efficacy of intra-articular sodium hyaluronate in the treatment of knee osteoarthritis. Clini Rheumatol. 2003;22:112-117.
22. Tascioglu F, Oner C. Efficacy of intra-articular sodium hyaluronate in the treatment of knee osteoarthritis. Clini Rheumatol. 2003;22:112-117.
23. Chevalier X, Jerosch J, Goupille P, et al. Single, intra-articular treatment with 6 ml hylan G-F 20 in patients with symptomatic primary osteoarthritis of the knee: a randomised, multicentre, double- blind, placebo controlled trial. Ann Rheum Dis. 2010 Jan;69(1):113-9.

24. Altman RD, Akermark C, Beaulieu AD, Schnitzer T. Efficacy and safety of a single intra-articular injection of non-animal stabilized hyaluronic acid (NASHA) in patients with osteoarthritis of the knee. Osteoarthritis Cartilage 2004;12:642–649
25. Seikagaku announces U.S. FDA approval of Gel-One®, a single injection Hyaluronic Acid injectable treatment for osteoarthritis pain of the knee.Tokyo, Japan, March 24, 2011
26. Wewers M.E. & Lowe N.K. (1990) A critical review of visual analogue scales in the measurement of clinical phenomena. Research in Nursing and Health 13, 227±236.
27. Bellamy N Buchanan WW et al. Validation study of WOMAC: A health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol. 1988; 15: 1833-1840.
28. Bellamy N. Pain assessment in osteoarthritis: Experience with the WOMAC osteoarthritis index. Semin Arthritis Rheumatism. 1989; 18 (supplement 2): 14-17.
29. Bellamy N Kean WF et al. Double blind randomized controlled trial of sodium meclofenamate (Meclomen) and diclofenac soidum (Voltaren): Post validation reapplication of the WOMAC osteoarthritis index. J Rheumatol. 1992; 19: 153-159.
30. Hawker G Melfi C et al. Comparison of a generic (SF-36) and a disease specific (WOMAC) instrument in the measurement of outcomes after knee replacement surgery. J Rheumatol. 1995; 22: 1193-1196.
31. Stucki G Sangha O et al. Comparison of WOMAC (Western Ontario and McMaster Universities) osteoarthritis index and a self-report format of the self-administered Lequesne-Algofunctional index in patients with knee and hip osteoarthritis. Osteoarthritis and Cartilage. 1998; 6: 79-86.
32. 32. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. Clin Orthop Relat Res. 1989 Nov;(248):13-4. link to pubmed. Link SF36, SF12
33. Ann Rheum Dis. 1997 August; 56(8): 493–496.Radiographic osteoarthritis of the knee classified by the Ahlbäck and Kellgren & Lawrence systems for the tibiofemoral joint in people aged 35-54 years with chronic knee pain
34. Puttick MP, Wade JP, Chalmers A, Connell DG, Rangno KK. Acute local reactions after intraarticular hylan for osteoarthritis of the knee. J Rheumatol. 1995;22:1311-4.
35. Martens PB. Bilateral symmetric inflammatory reaction to hylan G-F 20 injection. Arthritis Rheum. 2001;44:978-9.
36. Chen AL, Desai P, Adler EM, Di Cesare PE. Granulomatous inflammation after Hylan G-F 20 viscosupplementation of the knee: a report of six cases. J Bone Joint Surg Am. 2002;84:1142-7.
37. Leopold SS, Warme WJ, Pettis PD, Shott S. Increased frequency of acute local reaction to intra-articular hylan GF-20 (Synvisc) in patients receiving more than one course of treatment. J Bone Joint Surg Am. 2002;84:1619-23.

การศึกษาเปรียบเทียบประสิทธิภาพของการฉีดสาร Sodium Hyaluronate (Hyruan® III) เข้าข้อในผู้ป่วยโรคข้อเข่าเสื่อมก่อนและหลังการรักษา

นรา จารุวังสันติ, พบ, ประกิต เทียนบุญ, พบ

วัตถุประสงค์ *: เพื่ออธิบายเทคนิคการฉีดสารโซเดียมไฮยารูโลเนต (Hyruan® III) เข้าข้อเข่าครั้งเดียวสามเข็ม ในผู้ป่วยโรคข้อเข่าเสื่อมและศึกษาประสิทธิภาพและความปลอดภัยของยาโดยเปรียบเทียบระหว่างก่อนและหลังการฉีด*

วัสดุและวิธีการ*: ศึกษาข้อมูลแบบไปข้างหน้าจากผลการรักษาผู้ป่วยอาสาสมัครของผู้ป่วยนอก โรงพยาบาลจุฬาลงกรณ์สภากาชาดไทยระหว่างเดือนกุมภาพันธ์ พ.ศ.2552 ถึงเดือนกุมภาพันธ์ พ.ศ.2554 เพื่อเปรียบเทียบผลการรักษาโรคข้อเข่าเสื่อมด้วยการฉีดครั้งเดียว 3 เข็มเข้าข้อเข่า กับงานวิจัยอื่นๆที่เคยฉีดสัปดาห์ละ 1 เข็ม และยังไม่มีงานวิจัยใดที่รักษาด้วยการฉีดครั้งเดียว 3 เข็ม จำนวนผู้รับการรักษา 100 ราย โดยประเมินผลลัพธ์หลัก (Primary efficacy variable): ความรุนแรงของการปวดข้อเข่าโดยใช้ 100 mm Visual Analogue Scale (VAS) , Functional Impairment :ประเมินอาการและผลการรักษาโดยใช้ Western Ontario and McMaster Universities Osteoarthritis (WOMAC) score รวมทั้ง Knee score และ Functional score สำหรับผลลัพธ์รอง (Secondary efficacy variable): ศึกษาการบวม ความตึงเนื่องจากแรงดัน การงอของข้อ (joint flexion) รวมถึงการประเมินความปลอดภัยของการฉีดซึ่งเป็นหลักการสำคัญของการประเมินผลร่วมด้วย

ผลการศึกษา : *จากการศึกษาพบว่ามีผู้ป่วยอาสาสมัคร 10 รายที่ต้องออกจากการศึกษา ดังนั้นงานวิจัยนี้จึงมีผู้ป่วยอาสาสมัครจำนวน 90 รายที่นำมาวิเคราะห์ผล พบว่าค่า VAS ลดลงจาก baseline อย่างมีนัยสำคัญทางสถิติ ระยะเวลา 8 เดือน ค่า WOMAC score ลดลงจาก baseline อย่างมีนัยสำคัญทางสถิติ ระยะเวลา 8 เดือนเช่นกัน สำหรับค่า Knee score หลังการฉีด 1 เดือน (knee score >75) และหลังการฉีด 8 เดือน (knee score >90) มีค่าเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติตามลำดับ และค่า Functional score หลังการฉีด 1 เดือน (Functional score >75) และหลังการฉีด 8 เดือน (Functional score >85) มีค่าเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติตามลำดับเช่นกัน*

สรุป : *การฉีดสารโซเดียมไฮยารูโลเนต (Hyruan® III) พร้อมกันครั้งเดียว 3 เข็ม เข้าข้อเข่าให้ผลการรักษาที่ดีเทียบเท่ากับการฉีดสัปดาห์ละ 1 เข็มจำนวน 3 สัปดาห์ หรือ สัปดาห์ละเข็ม จำนวน 5 สัปดาห์ และด้วยเทคนิคพิเศษที่ฉีดนั้นให้ประสิทธิภาพดีเทียบเท่ากับการฉีดแบบสัปดาห์ละเข็ม และให้ประสิทธิภาพในการรักษาถึงร้อยละ 95*

Proceedings of the Thai Consensus Conference

On Surgical Management of Knee Osteoarthritis 2016

Group 1
Hospital / Diagnosis / Indications / Contraindications

Group 2
Perioperative Management

Group 3
Postoperative Care, Pain Management and Rehabilitation

Group 4
Follow-up and Outcome Measures

Group 5
Diagnosis and Treatment of Complications

Group 6
Thai Joint Registry

Group 7
Knee Prosthesis Consideration

Summary

The Thai Consensus Conference On Surgical Management of Knee Osteoarthritis 2016 has been organized by The Thai Hip and Knee Foundation (THKF) and Thai Hip and Knee Association (THKA) under the support of the Royal College of Orthopaedic Surgeons of Thailand (RCOST) using the Modified Delphi Method which is an well accepted scientific method for inconclusive evidence-based sciences. The process of consensus has been divided into 7 groups and 7 responsible teams of facilitators according to specific topics. According to the highest incidence of surgery, we emphasized on total knee arthroplasty more than other surgical procedures.

This conference was held on Friday 24 and Saturday 25, 2016 at the Mida Dhavaravati Grande Hotel Nakhon Pathom with a very successful outcome. Furthermore, the proceedings of this consensus conference is believed to provide a better practical recommendation for orthopedic surgeons on patients with knee osteoarthritis than those previously proposed by a small group of assigned committee.

Last but not least, we would like to thank the national health security office for the funding support without the conflict of interest.

Aree Tanavalee, MD
Siwadol Wongsak, MD
Chairmen of the Conference

List of Delegates

1. Professor Colonel Dr.Thanainit Chotanaphuti
2. Professor Dr. Aree Tanavalee
3. Professor Dr. Sukit Saengnipanthkul
4. Clinical Professor Dr. Viroj Kawinwonggowit
5. Police Major General Dr. Thana Turajane
6. Associate Professor Dr. Chaithavat Ngarmukos
7. Associate Professor Dr. Satit Thiengwittayaporn
8. Associate Professor Dr. Vajara Wilairatana
9. Associate Professor Dr. Piya pinsornsak
10. Associate Professor Dr.Boonchana Pongcharoen
11. Associate Professor Dr. Nattapol Tammachote
12. Police Colonel Dr. Viroj Larbpaiboonpong
13. Group Captain Dr.Thana Narinsorasak
14. Captain Dr. Watcharin Panichcharoen
15. Lieutenant Colonel Dr. Saradej Khuangsirikul
16. Wing Commander Dr. Kritkamol Sithitool
17. Police Major Dr. Ukrit Chaweewannakorn
18. Assistant Professor Dr. Artit Laoruengthana
19. Assistant Professor Dr. Rapeepat Narkbunnam
20. Assistant Professor Dr. Piti Rattanaprechavej
21. Assistant Professor Dr. Chaturong Pornrattanamaneewong
22. Assistant Professor Dr. Paphon Sa-Ngasoongsong
23. Dr. Apisit Patamarat
24. Dr. Charlee Sumettavanich
25. Dr. Polawat Witoolkollachit
26. Dr. Arak Limtrakul
27. Dr. Udthapon Wandee
28. Dr. Suphachet Chiranavanit
29. Dr. Supod Jirarachwaro
30. Dr. Srihatach Ngarmukos
31. Dr. Sittipong Ketwongwiriya
32. Dr. Somsak Rujichanuntakul
33. Dr. Siwadol Wongsak
34. Dr. Saran Tantavisut
35. Dr. Visit Wangwittayakul
36. Dr. Wallop Adulkasem
37. Dr. Wasu Tachapaitoon
38. Dr. Worapol Jumroonwong
39. Dr. Worapoj Honglerspipop
40. Dr. Lak Chutithammanan
41. Dr. Rawee Sirithammawat
42. Dr. Ronnasak Mongkolrangsarit
43. Dr. Pruk Chaiyakit
44. Dr. Pramook Vanasbodeekul
45. Dr. Nuttaphan Keereewichian
46. Dr. Noratep Kulachote
47. Dr. Thana Bamroongshawgasame
48. Dr. Thanasak Yakumpor

49. Dr.Thananetr Sasivongsbhakdi
50. Dr. Natthpong Hongku
51. Dr. Chavarin Amarase
52. Dr. Chavarat Jarungvittayakon
53. Dr. Chavanont Sumanasrethakul
54. Dr. Jithayut Sueajui
55. Dr. Gunn Limool
56. Dr. Kreangsak Lekkreusuwan
57. Dr. Attanakan Kawpradijt
58. Dr. Nuttawut Chanalithichai
59. Dr. Science Metadilogkul

Workgroup 1 Hospital / Diagnosis / Indications / Contraindications

Leader

Siwadol Wongsak, MD

Delegates

Chavarat Jarungvittayakon, MD, Paphon Sa-ngasoongsong, MD, Viroj Kawinwonggowit, MD,

Sukit Sangniphankul, MD, Supod Jirarachwaro, MD, Nattaphan Sriwicheon, MD,

Wasu Techaphithun, MD, Watcharin Panichchareon, MD, Thana Bumrungchaokasem, MD,

Attapon Wandee, MD, Saran Tantitawisut, MD, Suphachet Chiranavanit, MD

Session 1: Hospital

Question 1: What are the basic requirements of hospitals in providing surgical treatment of knee osteoarthritis (OA)?
Consensus: The hospital requirements for the surgical treatment of knee OA include outpatient clinic, inpatient department, operative room, and key medical personnel, including orthopedic surgeon and internist.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Regarding the hospital requirement for the surgical treatment of knee OA, the outpatient clinic and inpatient department must be available for preoperative care, perioperative management, and postoperative follow-up. Standard operative room is required for the safety of these specific surgical procedures (the detail of operative room standardization will be discussed in question 2).

The surgical and medical specialists, including orthopedic surgeon(s) and internist(s), are required for the appropriate preoperative evaluation, comprehensively perioperative medical treatment and surgical procedure, and postoperative care and rehabilitation.

Question 2: What is the minimal requirement of the operative room for surgical treatment of knee OA?
Consensus: The operative room for the surgical treatment of knee OA must be at least the clean room according to national or international standard.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Quality of operative room must be one of the primary concerns of the surgical treatment of knee OA due to the guarantee of the patients' safety and for prevention of surgical site infection[1-3].

Question 3: Should the orthopedic surgeon be responsible as the key role in preoperative, intraoperative, and postoperative management of the patients undergoing the surgical treatment of knee OA?
Consensus: Orthopedic surgeon(s) must play a key role in preoperative evaluation, intraoperative management, postoperative management and follow-up care of the surgical treatment of knee OA.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Due to the complexity of the surgical treatment of knee OA and the specific related postoperative complication, orthopedic surgeon(s) should take part in the preoperative evaluation, intraoperative management and postoperative follow-up care to maximize the postoperative outcome.

Question 4: Is the anesthesiologist required for anesthetic procedures in the surgical treatment of knee OA?
Consensus: The anesthesiologist should be in charge for the anesthetic procedures in the surgical treatment of knee OA.
Delegate vote: Agree 83%, Disagree 17%, Abstain 0% (Strong Consensus)
Justification: Most of the patients undergoing the surgical treatment of knee OA are the elderly who have multiple comorbid diseases. Therefore, the anesthesiologist is required for performing or supervising the anesthetic procedure and intraoperative monitoring to ensure patient's safety during the operation.

Question 5: What are the roles of the internist in the surgical treatment of knee OA?
Consensus: The internist should take part in the preoperative evaluation and assist in the

perioperative management, especially for the high-risk patients.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Most of the patients undergoing the surgical treatment of knee OA are the elderly who have multiple comorbid diseases. Therefore, the internist is required for preoperative evaluation and, sometimes, required for postoperative care in the patients with complicated medical condition(s).

Question 6: Is the physical therapist required for the surgical treatment of knee OA?
Consensus: The physical therapist should be a part of patient care team in the surgical treatment of knee OA.
Delegate vote: Agree 75%, Disagree 25%, Abstain 0% (Strong Consensus)
Justification: The specific physiotherapy may be required in some patients undergoing surgical treatment of knee OA, such as the patients with high risk of fall, poor muscle control, or neuromuscular problem.

Session 2: Indications and contraindications of TKA

Question 7: When should a total knee arthroplasty (TKA) be performed in the patient with knee OA?
Consensus: TKA is indicated in patients with both following conditions:

1. Painful knee OA with degenerative articular surface involvement at least two of three compartments
2. Failure of adequate conservative treatment

Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Osteoarthritis of the knee, one of the most common causes of disability, continues to increase in prevalence in the older adult[4,5]. In evidence-based clinical review, nowadays, TKA is a commonly performed surgical procedure which is effective for improving quality of life in terms of reducing pain, returning to activities of daily living and restoring mechanical limb alignment[6,7].

End-stage degenerative knee joint disease, as evidenced by radiographs, and persistent pain after all conservative treatment measures have been exhausted, are the main indications for TKA[6,8,9]. The patient must have substantial knee pain limiting his or her activities of daily living, especially persistent pain occurring at night or with weight-bearing activities. These symptoms must be refractory to conservative treatments, which the patient had continued pain despite an attempt of an adequate course of nonoperative treatment[10].

Question 8: What is the appropriate radiographic classification of knee OA severity that should be considered for TKA?
Consensus: We recommended to use the Kellgren-Lawrence (KL) system for radiographic classification of knee OA severity, and TKA must be performed in the patients who have at least KL grade 3.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: According question 1, end-stage degenerative knee joint disease, as evidenced by radiographs is the key indication for TKA[6,8,9]. Radiographic OA of the knee joint is believed to be the most common manifestation of pathology in this joint. The Kellgren and Lawrence (KL) classification[11,12] is commonly used to describe the severity of disease by using the standing knee AP radiograph and classifying the severity based on the presence and severity of tibiofemoral osteophytes and joint space narrowing. The radiographic key features (grade 1-4)[11] are showed as below:
Grade 1: minute osteophyte of doubtful significance
Grade 2: definite osteophyte, and unimpaired joint space
Grade 3: definite osteophyte and moderate diminution of joint space
Grade 4: joint space greatly impaired with sclerotic of subchondral bone

Question 9: What should be the decent patient's age for performing TKA?
Consensus: We recommend performing TKA in the patients with primary knee OA and age 55 years or over. However, in case of secondary knee OA, TKA could be performed in the age less than 55 years.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: TKA is a common treatment options for patients with moderate to severe knee osteoarthritis for reducing pain, returning to activities of daily living and restore mechanical alignment[4,5]. End-stage primary knee OA was commonly found in old patients who are indicated for TKA[6,8,9]. However, in secondary osteoarthritis of the knee such as posttraumatic, inflammatory joint disease, osteonecrosis of the knee, infection or severe deformity can be found in younger patients[13,14]. In this patient group, if pain is persisted despite adequate conservative treatment and radiographs show evidence of severe knee arthritis, a TKA can be indicated[7].

The recent study demonstrated that total knee arthroplasty in younger patients had a good results, which the Knee society clinical and functional scores were improved. Implant survivorship was reported between 90.6% and 99% in first decade and between 85% and 96.5% during the second decade of follow-up[15].

Secondary knee osteoarthritis can caused by the following conditions

- Fracture or trauma
- Infection
- Congenital severe limb deformity
- Osteonecrosis of the knee
- Other forms of arthritis such as enteric arthritis, gout, pseudogout, psoriatic arthritis, reactive arthritis or rheumatoid arthritis
- Diseases that affect the structure of the cartilage or bone such as acromegaly, hemochromatosis, hemophilia, ochronosis, Paget's disease, sickle cell disease or Wilson's disease

Question 10: What are the contraindications for primary TKA?
Consensus: The TKA surgery must not be performed in the patients with

- Recent or current knee infection
- Having remote source of ongoing infection
- Extensor mechanism discontinuity or severe dysfunction
- Patients with recurvatum deformity secondary to neuromuscular diseases

Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Theoretically, the absolute contraindications for TKA include recent or current knee sepsis, a remote source of ongoing infection, extensor mechanism discontinuity or severe dysfunction and recurvatum deformity secondary to muscular weakness because of poor reported outcomes.

The genu recurvatum is known to recur in patients with certain neuromuscular disorders. TKA in patients with this condition resulted in poor outcome[16]. Therefore, the etiology of the hyperextension deformity must be elucidated thoroughly before surgery. However, genu recurvatum without neuromuscular weakness can undergo TKA with meticulous surgical techniques or special implants[17].

Relative contraindications for TKA are numerous and debatable, including medical conditions that compromise the patient's ability to withstand the anesthesia, the metabolic demand of surgery and wound healing, significant atherosclerotic disease of the affected leg, skin condition such as psoriasis within the surgical field, venous static disease with recurrent cellulitis, neuropathic arthropathy, morbid obesity, recurrent urinary tract infection and history of osteomyelitis in the proximity of the knee. In patients with these conditions, TKA should be avoid. However, if it is necessary, TKA might be performed with cautions[18].

Session 3: Indications and contraindications of UKA

Question 11: What are the indications of unicompartmental knee arthroplasty (UKA) in the knee OA?
Consensus: UKA is indicated in the patients with all of the following conditions:

- Painful knee with unicompartmental knee OA
- Good function of both collateral and both cruciate ligaments
- Good range-of-motion of the knee
- Failure of adequate conservative treatment

Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: UKA has been a surgical option for treatment of single compartment osteoarthritis of the knee. Despite long-term UKA experience, the orthopedic community has not reached a consensus on the patient selection criteria or operative indications for UKA, due to varied outcome results in the literature[19].

The ideal candidate for a UKA is a non-inflammatory osteoarthritis with the slight mechanical axis deviation (no more than 5 degrees for a valgus knee or no more than 10 degrees for a varus knee). The knee should be passively correctable and the anterior cruciate ligament (ACL) should be intact. There should be no sign of mediolateral subluxation of the femur on the tibia, and patellofemoral pain should not be presented. In addition, flexion contractures may be difficult to correct if it is greater than 10–15 degrees[20].

Ideal indications have slightly changed since Kozinn and Scott has published classic indications in 1989. Their criteria included a diagnosis of unicompartmental osteoarthritis or spontaneous osteonecrosis in either the medial or lateral compartment, a low demand activity patient and a patient age of greater than 60 years. The patient should have minimal pain at rest, a range of motion arc that is greater than 90 degrees with less than 5 degrees of flexion contracture, and an angular deformity of less than 15 degrees that is passively correctable to neutral[21].

Question 12A: What are the contraindications for UKA?
Consensus: UKA should not be performed in the patients with the following conditions:

- Knee OA with opposite tibiofemoral compartment involvement
- Secondary knee OA from inflammatory joint arthritis

Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)

Question 12B: Does patient's body weight or body mass index (BMI) affect the decision on UKA?
Consensus: There is inconclusive data whether UKA should not be performed in the high body weight or high BMI patients.
Delegate vote: Agree 92%, Disagree 8%, Abstain 0% (Strong Consensus)

Question 12C: Does UKA able to be performed in unicompartmental knee OA patients with patellofemoral pain?
Consensus: There is inconclusive data whether UKA should not be performed in unicompartmental knee OA patients with patellofemoral pain.
Delegate vote: Agree 92%, Disagree 8%, Abstain 0% (Strong Consensus)

Question 12D: Which deformities of knee OA should not undergo UKA?
Consensus: UKA should not be performed in patients with varus deformity more than 10 degrees of mechanical axis, valgus deformity more than 5 degrees of mechanical axis or flexion contracture more than 10 degree.
Delegate vote: Agree 92%, Disagree 8%, Abstain 0% (Strong Consensus)
Justification: Traditionally, contraindications for UKA include the diagnosis of rheumatoid arthritis or other inflammatory arthritic conditions, knee pain in all compartments, decreased range of motion with a flexion contracture, obesity, knee instability, ACL rupture, and the age of less than 60 years[22].

In obese patient, Berend et al. concluded that failure, defined as a UKA requiring later revision or an impending revision, was not associated with age, gender, disease severity or implant design, but with increased BMI[23]. A BMI of greater than 32 was predictive UKA failure and a reduced survivorship. Studies published in the early 1990s also noted that obese patients have a failure rate of 1.4 times higher than patients with normal weight[24]. Unfortunately, most of the data related to risk stratification for UKA surgery were based upon Level 4 and 5 of evidence[23-25]. The level of evidence coupled with low statistical power in these studies contributes to disagreement and continued controversy in the literature regarding preoperative UKA patient selection criteria. However, due to inconclusive evidences, at the present time, UKA in the obese patients might be performed with caution.

In patients with patellofemoral pain, the presence of patellofemoral disease has been traditionally regarded as a contraindication to UKA of the medial or lateral compartment due to the risk of early failure[21,26-28]. However, Goodfellow and O'Connor and Beard et al. did not find a correlation between patellofemoral disease and outcomes of UKA and recommended that this contraindication might be disregarded[29,30]. Due to inconclusive evidences at the present time, we recommend that in the patients with mild symptom of patellofemoral pain may undergo UKA under the surgeon's caution.

Session 4: Indications and contraindications of HTO

Question 13: What are the indications for high tibial osteotomy (HTO) in the knee OA?
Consensus: HTO was indicated in the patients with all of the following conditions[31-36].

- Painful knee with unicompartmental knee OA
- Good function of both collateral and both cruciate ligaments
- Good range-of-motion of the knee
- Failure of conservative treatment

Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: HTO is effective surgical treatment for managing a variety of knee conditions including gonarthrosis with varus malalignment. The fundamental goals of the procedure are to unload diseased articular surfaces and to correct angular deformity at the tibiofemoral articulation. Although the clinical success of TKA has resulted in fewer HTO being done during the past decade, the procedure remains useful in appropriately selected patients with unicompartmental knee disease[31].

The most common indication for HTO is isolated medial compartment degenerative joint disease with associated varus tibiofemoral malalignment. There is consensus that candidates for HTO are patients with pain located primarily on the medial aspect of the knee and radiographic evidence of medial arthrosis demonstrated by less than 4 mm of medial joint space on a standing knee film along with mechanical overload associated with a varus deformity.

The HTO imaging indication is determined when the radiographs demonstrate changes such as moderate osteophytes and joint space narrowing, subchondral bone sclerosis and cysts, possible deformity of the bone contour, graded according to Kellgren and Lawrence (KL) classification as KL grade 2-3[11,37]. The arthroscopic indication for a HTO is determined when a grade two or three chondral lesion, according to Outerbridge[38] or ICRS classification[39], is presented in the medial compartment associated with a varus knee and with a good lateral compartment. An accurate technique is mandatory to obtain excellent results[40].

Question 14: What are the contraindications for HTO?
Consensus: HTO should not be performed in the patients with following conditions:

- Knee OA with opposite tibiofemoral compartment involvement

- Patient with tibiofemoral suxluxation more than 1 cm.
- Knee OA patients secondary to inflammatory arthritis

Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)

Justification: Theoretically, high tibial osteotomy is the procedure for unload diseased articular surfaces and to correct angular deformity at the tibiofemoral articulation. The opposite compartment of the knee must be normal. Patients with diffuse arthritis and knee OA secondary to inflammatory arthritis were the contraindications[18,36].

The others relative contraindication for HTO are numerous and debatable including stiffness of the knee (arc of motion less than 90 degrees), symptomatic patellofemoral disease, obesity or heavy smoking[36]. In these conditions, HTO should be avoided or performed with caution.

References

1. Salassa TE, Swiontkowski MF. Surgical attire and the operating room: role in infection prevention. J Bone Joint Surg Am 2014; 96(17): 1485-92.
2. Agodi A, Auxilia F, Barchitta M, Cristina ML, D'Alessandro D, Mura I, et al. Operating theatre ventilation systems and microbial air contamination in total joint replacement surgery: results of the GISIO-ISChIA study. J Hosp Infect 2015; 90(3): 213-9.
3. Melhado MA, Hensen J, Loomans M, Forejt L. Review of operating room ventilation standards.
4. Arden N, Nevitt MC. Osteoarthritis: epidemiology. Best Pract Res Clin Rheumatol 2006; 20(1): 3-25.
5. Nguyen UA, Zhang Y, Zhu Y, Niu J, Zhang B, Felson DT. Increasing prevalence of knee pain and symptomatic knee osteoarthritis: survey and cohort data. Ann Intern Med 2011; 155(11): 725-32.
6. Van Manen MD, Nace J, Mont MA. Management of primary knee osteoarthritis and indications for total knee arthroplasty for general practitioners. J Am Osteopath Assoc 2012; 112(11): 709-15.
7. Weber KL, Jevsevar DS, McGrory BJ. AAOS Clinical Practice Guideline: Surgical Management of Osteoarthritis of the Knee: Evidence-based Guideline. J Am Acad Orthop Surg 2016; 24(8): e94-6.
8. Kim RH, Springer BD, Douglas DA. Knee reconstruction and replacement. In: Flynn F, ed. Orthopaedic Knowledge Update. Rosemont, IL: American Academy of Orthopaedic Surgeons 2011: 469-75.
9. Jevsevar DS, Brown GA, Jones DL, Matzkin EG, Manner PA, Mooar P, et al. The American Academy of Orthopaedic Surgeons evidence-based guideline on: treatment of osteoarthritis of the knee, 2nd edition. J Bone Joint Surg Am 2013; 95(20): 1885-6.
10. Feeley BT, Gallo RA, Sherman S, Williams RJ. Management of osteoarthritis of the knee in the active patient. J Am Acad Orthop Surg 2010; 18(7): 406-16.
11. Kellgren JH, JeVrey M, Ball J. Atlas of standard radiographs. Vol 2. Oxford: Blackwell Scientific, 1963.
12. Petersson IF, Boegård T, Saxne T, Silman AJ, Svensson B. Radiographic osteoarthritis of the knee classified by the Ahlbäck and Kellgren & Lawrence systems for the tibiofemoral joint in people aged 35-54 years with chronic knee pain. Ann Rheum Dis 1997; 56(8): 493-6.
13. Bisschop R, Brouwer RW, Van Raay JJ. Total knee arthroplasty in younger patients: a 13-year follow-up study. Orthopedics 2010; 33(12): 876.
14. Losina E, Katz JN. Total knee arthroplasty on the rise in younger patients: are we sure that past performance will guarantee future success? Arthritis Rheum 2012; 64(2): 339-41.
15. Keeney JA, Eunice S, Pashos G, Wright RW, Clohisy JC. What is the evidence for total knee arthroplasty in young patients?: a systematic review of the literature. Clin Orthop Relat Res 2011; 469(2): 574-83.
16. Meding JB, Keating EM, Ritter MA, Faris PM, Berend ME. Genu recurvatum in total knee replacement. Clin Orthop Relat Res 2003; (416): 64-7.
17. Meding JB, Keating EM, Ritter MA, Faris PM, Berend ME. Total knee replacement in patients with genu recurvatum. Clin Orthop Relat Res 2001; (393): 244-9.
18. Canale ST, Beaty JH. Campbell operative orthopaedics 12th editions.
19. Jamali AA, Scott RD, Rubash HE, Freiberg AA. Unicompartmental knee arthroplasty: past, present, and future. Am J Orthop (Belle Mead NJ) 2009; 38(1): 17-23.
20. Larsson SE, Larsson S, Lundkvist S. Unicompartmental knee arthroplasty: a prospective consecutive series followed for six to 11 years. Clin Orthop 1988; (232): 174–81.
21. Kozinn SC, Scott R. Unicondylar knee arthroplasty. J Bone Joint Surg Am 1989; 71: 145–50.
22. Bert JM. Unicompartmental knee replacement. Orthop Clin North Am 2005; 36(4): 513-22.

23. Berend KR, Lombardi AV Jr, Mallory TH, Adams JB, Groseth KL. Early failure of minimally invasive unicompartmental knee arthroplasty is associated with obesity. Clin Orthop Relat Res 2005; 440: 60-6.
24. Heck DA, Marmor L, Gibson A, Rougraff BT. Unicompartmental knee arthroplasty. A multicenter investigation with long-term follow-up evaluation. Clin Orthop Relat Res 1993; (286): 154-9.
25. Tabor OB, Jr., Tabor OB, Bernard M, Wan JY. Unicompartmental knee arthroplasty: long-term success in middle-age and obese patients. J Surg Orthop Adv 2005; 14: 59–63.
26. Beard DJ, Pandit H, Ostlere S, Jenkins C, Dodd CA, Murray DW. Pre-operative clinical and radiological assessment of the patellofemoral joint in unicompartmental knee replacement and its influence on outcome. J Bone Joint Surg Br 2007; 89(12): 1602-7.
27. Berend KR, Lombardi AV, Jr., Morris MJ, Hurst JM, Kavolus JJ. Does preoperative patellofemoral joint state affect medial unicompartmental arthroplasty survival? Orthopedics 2011; 34(9): e494-6.
28. Pandit H, Jenkins C, Gill HS, Smith G, Price AJ, Dodd CA, et al. Unnecessary contraindications for mobile-bearing unicompartmental knee replacement. J Bone Joint Surg Br 2011; 93(5): 622-8.
29. Goodfellow JW, O'Connor J. Clinical results of the Oxford knee. Surface arthroplasty of the tibiofemoral joint with a meniscal bearing prosthesis. Clin Orthop Relat Res 1986; (205): 21-42.
30. Beard DJ, Pandit H, Gill HS, Hollinghurst D, Dodd CA, Murray DW. The influence of the presence and severity of pre-existing patellofemoral degenerative changes on the outcome of the Oxford medial unicompartmental knee replacement. J Bone Joint Surg Br 2007; 89(12): 1597-601.
31. Wright JM, Crockett HC, Slawski DP, Madsen MW, Windsor RE. High tibial osteotomy. J Am Acad Orthop Surg 2005; 13(4): 279-89.
32. Jackson JP. Osteotomy for osteoarthritis of the knee. J Bone Joint Surg Br 1958; 40: 826.
33. Coventry MB, Ilstrup DM, Wallrichs SL. Proximal tibial osteotomy: A critical long-term study of eighty-seven cases. J Bone Joint Surg Am 1993; 75: 196-201.
34. Insall JN, Joseph DM, Msika C. High tibial osteotomy for varus gonarthrosis: A long-term follow-up study. J Bone Joint Surg Am 1984; 66: 1040-8.
35. Marti RK, Verhagen RA, Kerkhoffs GM, Moojen TM: Proximal tibial varus osteotomy: Indications, technique, and five to twenty-one-year results. J Bone Joint Surg Am 2001; 83: 164-70.
36. Prodromos CC, Amendola A, Jakob RP. High tibial osteotomy: indications, techniques, and postoperative management. Instr Course Lect. 2015; 64: 555-65.
37. Luyten FP, Denti M, Filardo G, Kon E, Engebretsen L. Definition and classification of early osteoarthritis of the knee. Knee Surg Sports Traumatol Arthrosc 2012; 20: 401–6.
38. Outerbridge RE. The etiology of chondromalacia patellae. J Bone Joint Surg Br 1961; 43: 752–7.
39. www.cartilage.org/_files/contentmanagement/ICRS_evaluation.pdf
40. Puddu G, Cerullo G, Cipolla M, et al. Osteotomies about the knee. In: Management of osteoarthritis of the knee: an international consensus. American Academy of Orthopaedic Surgeons, Rosemont 2003: 17–30.

Workgroup 2 Perioperative Management

Leader

Nattapol Tammachote, MD

Delegates

Thanasak Yakumpor, MD, Kreangsak Lekkreusuwan, MD, Jithayut Sueajui, MD, Apisit Patamarat, MD, Lak Chutithammanan, MD, Wallop Adulkasem, MD, Nuttawut Chanalithichai, MD

Question 1: What preoperative evaluation modalities are suitable for patient undergoing TKA?
Consensus: The surgeon should perform proper clinical evaluations which include history taking, physical examination and knee radiographs. Basic investigations should include CBC, Electrolyte, BUN, Cr, Alb, CXR and EKG.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: The study related to preoperative hemoglobin revealed that if hemoglobin level was less than 13 g/dL, it would increase the risk of postoperative blood transfusion of 3.7 time[1]. The Albumin level of less than 3.5 g/dL was associated with surgical site infection, extended length of stay and readmission[2]. At preoperative evaluation, parameters that should be considered include the preoperative diagnosis, patient age and sex, characteristics of the knee pain, level of activity, functional limitations, involvement of other joints, mechanical symptoms, and previous treatment. The presence of comorbid conditions, smoking status, alcohol consumption, current medications, and mental status should be assessed carefully to further guide preoperative evaluation and medical optimization[3]. Examination of preoperative knee range of motion (ROM) is essential. Although postoperative stiffness is multifactorial, preoperative ROM remains the most important predictor of postoperative motion[4].

Question 2: Should the surgeon evaluate any sources of remote infection before surgery?
Consensus: Surgeon should evaluate source of remote infection before the operation. The common occult infections are dental caries and urinary tract infection, etc.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Active infection must be evaluated and treated until it is resolved before surgery in order to prevent postoperative infection. The occult infection, especially dental caries[5] and urinary tract infection may cause postoperative surgical site infection by hematogenous seeding[6].

Question 3: When should other specialists be consulted for preoperative evaluation of TKA?
Consensus: Specialists should be consulted when the investigation shows abnormal values related to fields of abnormal investigated parameters.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Total knee arthroplasty performed in patients who had fasting glucose more than 180 mg/dL or 10 mmol/L associated with higher postoperative complications. The patients should be evaluated by specialist(s) to control their medical condition before surgery. Several studies confirmed that fasting glucose of more than 180 mg/dL or 10 mmol/L were related to perioperative complications[7-9]. One study suggested that the desirable glycemic control was to obtain a hemoglobin A1c (HbA1c) of less than 7%[3]. The patient with malnutrition, morbid obesity and chronic renal disease should also be consulted to the specialist(s)[10].

Question 4: Should the surgeon provide preoperative education and clarify patient's expectation regarding TKA?
Consensus: Surgeon should provide adequate information, education and set mutual surgeon-patient expectation.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: The cross-sectional study of patient's satisfaction confirmed that 19% of primary TKA patients were not satisfied with the outcome at one year follow-up. Satisfaction with pain relief varied from 72–86% and with function from 70–84% for specific activities of daily living. The strongest predictors of patient's dissatisfaction after primary TKA were expectations not met[11]. For the success of TKA surgery, orthopedic surgeons and patients should discuss expectations before TKA surgery to assure that these are realistic.

Question 5: Should appropriate prophylactic antibiotic be prescribed before TKA to prevent surgical site infection?
Consensus: The surgeon should prescribe appropriate antibiotic prophylaxis. The antibiotic prophylaxis should cover gram-positive cocci, be administered within one hour before surgery and continued for one day after surgery unless there is special concern.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Antibiotic administration can reduce absolute risk of surgical site infection up to 8%. Compare to the placebo group, intravenous antibiotics can reduce relative risk of surgical site infection of 81%[12,13]. The antibiotic prophylaxis should cover gram-positive cocci and be administered within one hour before surgery. Cefazolin or cefuroxime were recommended for prophylaxis in knee arthroplasty. Vancomycin or Clindamycin were suggested to use in patients who have colonization of MRSA or history of sensitivity to beta-lactames.

Question 6: In TKA surgery, how should skin be prepared?
Consensus: Skin around surgical site should be scrubbed with antiseptic agents the night before surgery. Hairs around surgical site should be removed as needed with surgical clipper just before surgery.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Preoperative showering or cleansing with an antiseptic agent at the night before the surgical procedure is recommended by the U.S. Centers for Disease Control and Prevention (CDC). The CDC recommends that hair removal should be done immediately before the procedure with the use of electric clippers which is more preferred to razor blades[14]. Meta-analysis showed that electric clippers and depilatory creams were associated with lower infection rates over shaving with razor blades[15].

Question 7: In TKA surgery, should the tourniquet be applied?
Consensus: The use of tourniquet in TKA surgery is controversial, in terms of indication, pressure and duration. It should be used with caution, if surgeons prefer.
Delegate vote: Agree 87.5%, Disagree 12.5%, Abstain 0% (Strong Consensus)
Justification: The tourniquet decreased the measured blood loss but did not decrease the calculated blood loss, which indicated the actual blood loss. Patients underwent TKA with a tourniquet might have higher risks of thromboembolic complications[16,17]. Although, the use of a tourniquet during TKA was effective in reducing measured blood loss but it produced more postoperative inflammation and muscle damage. The use of a tourniquet was related to slightly increase postoperative pain but did not affect postoperative recovery[18].

Question 8: In TKA surgery, what is the proper length of skin incision?
Consensus: The length of skin incision should be adequate for surgical procedure based on surgeon's experience.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Skin incision length should be adequate for surgical procedure because neither the incision length nor minimally invasive surgery (MIS) affects clinical outcomes. There was no difference between the MIS and conventional exposure groups in evaluation respected to the Knee Society Scoring System (KSS), including objective KSS scores or functional KSS scores, and total surgical duration, total blood loss, estimated intra-operative blood loss, postoperative drained blood loss, and the requirement for blood transfusion[19]. At six months after surgery, the MIS did not reveal any differences in range of motion, KSS scores, the physical or mental subscale of SF-12, patient's pain perception, patient's satisfaction and subjective knee improvement compare with conventional approach[20].

Question 9: In TKA surgery, what is the role of tranexamic acid for blood loss reduction?
Consensus: Tranexamic acid administration associates with perioperative blood loss reduction. In high-risk patients such as coronary artery disease, ischemic stroke or previous DVT, it should be used with caution.
Delegate vote: Agree 87.5%, Disagree 12.5%, Abstain 0% (StrongConsensus)
Justification: Multiple studies have shown the efficacy of tranexamic acid in reducing blood loos after TKA[21-23]. There was inconclusive for administration of tranexamic acid and also no statistically significant difference between topical and intravenous administration of tranexamic acid, in terms of blood loss, transfusion requirements and thromboembolic complications[24-26].

The total occurrence of vascular occlusive events was statistically significantly higher in the tranexamic acid group but this finding was confined to the calf veins[27]. And, no statistically significant change was found in 30-day mortality with tranexamic acid administration[28].

Question 10: In TKA surgery, should postoperative vacuum drainage be used?
Consensus: The use of postoperative suction drainage is inconclusive. It can be used as surgeon preference.

Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: The need for transfusion was significantly less in the no-drainage TKA[29]. There were no differences in wound healing, wound infection, swelling, and deep vein thrombosis in TKA with and without drainage except for less erythema and ecchymosis around the wound in the drainage group[30]. Most recent studies could not conclude the presumed advantage of using a drainage, in terms of reduced incidence of intraarticular hematoma, lessened incidence of wound drainage and subsequent infection[31,32]. The systemic review has shown the possibility that drain was not needed to assist early recovery following TKA[33].

Question 11: In TKA surgery, should urinary catheter be applied?
Consensus: Urinary catheter should be applied in patients who have risk for urinary retention, such as patients who underwent epidural analgesia, spinal analgesia with intrathecal morphine and prostate disease.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Studies have shown that the surgery using epidural morphine, patients who have past history of urinary retention, male sex, older age at surgery, patients undergoing one stage bilateral TKA, hypertension, the use of patient controlled analgesia, related to peak urinary flow rate of less than 17 mls/s, which caused the patient inability to pass urine in a bottle while lying down in bed. In those patients who had bladder outflow problems, the rate of urinary retention increased from 24% to 62%[34-36].

Major risk factors of urinary retention are patients who have history of urinary retention and postoperative spinal morphine or intravenous pain killer requirements. With these risks, the surgeon should take a closer monitoring evaluation of these patients, postoperatively[35-37].

Question 12: In TKA surgery, is antibiotic-impregnated cement recommended?
Consensus: Antibiotic-impregnated cement is recommended to be used.
Delegate vote: Agree 100%, Disagree 0%, Abstain 0% (Unanimous Consensus)
Justification: Study has shown that antibiotic-impregnated cement released high concentration of antibiotic at the surgical site. We recommend the use of antibiotic-impregnated cement in patients with high risk of postoperative infection[38]. The most commonly used antibiotics are gentamicin and tobramycin[38,39]. Use of antibiotic-loaded bone cement during primary arthroplasty procedures has been shown to decrease the incidence of periprosthetic joint infection (PJI) and did not change or increase the antimicrobial resistance patterns of pathogens[40].

Question 13: In TKA surgery, should the number and the traffic of operating personnel is restricted?
Consensus: The number and the traffic of operating personnel should be restricted as low as possible.
Delegate vote: Agree 87.5%, Disagree 12.5%, Abstain 0% (Strong Consensus)
Justification: Study has recommended to restrict the number of operating personals and the number of door opening as low as possible[41,42]. Because opening of the operating room door disrupts the laminar airflow, allowing pathogens to enter the space surrounding the site of the operation. These pathogens have the potential to lead to increased rates of infection[42].

Question 14: In TKA surgery, what is the role of periarticular multimodal drugs infiltration?
Consensus: Periarticular multimodal drugs infiltration is effective for reducing pain after surgery. However, combination of multimodal drugs is based on surgeon preference.
Delegate vote: Agree 87.5%, Disagree 12.5%, Abstain 0% (Strong Consensus)
Justification: Several randomized controlled trial studies have shown that periarticular injection with multimodal drugs can significantly reduce the requirements for patient-controlled analgesia and improve patient's satisfaction, early rehabilitation with no apparent risks, following TKA[43-46].

References

1. Basora M, Tio M, Martin N, Lozano L, Salazar F, Sanchez-Etayo G, et al. Should all patients be optimized to the same preoperative hemoglobin level to avoid transfusion in primary knee arthroplasty? Vox Sang 2014; 107: 148-52.
2. Bohl DD, Shen MR, Kayupov E, Della Valle CJ. Hypoalbuminemia Independently Predicts Surgical Site Infection, Pneumonia, Length of Stay, and Readmission After Total Joint Arthroplasty. J Arthroplasty 2016; 31: 15-21.
3. Tanzer M, Makhdom AM. Preoperative Planning in Primary Total Knee Arthroplasty. J Am Acad Orthop Surg 2016; 24: 220-30.
4. Gandhi R, de Beer J, Leone J, Petruccelli D, Winemaker M, Adili A. Predictive risk factors for stiff knees in total knee arthroplasty. J Arthroplasty 2006; 21: 46-52.
5. Wiesel BB, Esterhai JLJ. Prophylaxis of Musculoskeletal Infection. In: Calhoun JH, Mader JT, editors. Musculoskeletal Infections. New York: Marcel Dekker, Inc.; 2003.

6. Stinchfield FE, Bigliani LU, Neu HC, Goss TP, Foster CR. Late hematogenous infection of total joint replacement. J Bone Joint Surg Am 1980; 62: 1345-50.
7. American Diabetes A. Standards of medical care in diabetes--2013. Diabetes Care 2013; 36(Suppl 1): S11-66.
8. Jamsen E, Nevalainen P, Kalliovalkama J, Moilanen T. Preoperative hyperglycemia predicts infected total knee replacement. Eur J Intern Med 2010; 21: 196-201.
9. Marchant MH, Jr., Viens NA, Cook C, Vail TP, Bolognesi MP. The impact of glycemic control and diabetes mellitus on perioperative outcomes after total joint arthroplasty. J Bone Joint Surg Am 2009; 91: 1621-9.
10. Proceedings of the International Consensus Meeting on Periprosthetic Joint Infection. Foreword. J Orthop Res 2014; 32(Suppl 1): S2-3.
11. Bourne RB, Chesworth BM, Davis AM, Mahomed NN, Charron KD. Patient satisfaction after total knee arthroplasty: who is satisfied and who is not? Clin Orthop Relat Res 2010; 468: 57-63.
12. AlBuhairan B, Hind D, Hutchinson A. Antibiotic prophylaxis for wound infections in total joint arthroplasty: a systematic review. J Bone Joint Surg Br 2008; 90: 915-9.
13. Meehan J, Jamali AA, Nguyen H. Prophylactic antibiotics in hip and knee arthroplasty. J Bone Joint Surg Am 2009; 91: 2480-90.
14. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control 1999; 27: 97-132; quiz 133-134; discussion 196.
15. Tanner J, Woodings D, Moncaster K. Preoperative hair removal to reduce surgical site infection. Cochrane Database Syst Rev 2006; CD004122.
16. Tai TW, Lin CJ, Jou IM, Chang CW, Lai KA, Yang CY. Tourniquet use in total knee arthroplasty: a meta-analysis. Knee Surg Sports Traumatol Arthrosc 2011; 19: 1121-30.
17. Zhang W, Li N, Chen S, Tan Y, Al-Aidaros M, Chen L. The effects of a tourniquet used in total knee arthroplasty: a meta-analysis. J Orthop Surg Res 2014; 9: 13.
18. Tai TW, Chang CW, Lai KA, Lin CJ, Yang CY. Effects of tourniquet use on blood loss and soft-tissue damage in total knee arthroplasty: a randomized controlled trial. J Bone Joint Surg Am 2012; 94: 2209-15.
19. Smith TO, King JJ, Hing CB. A meta-analysis of randomised controlled trials comparing the clinical and radiological outcomes following minimally invasive to conventional exposure for total knee arthroplasty. Knee 2012; 19: 1-7.
20. Hernandez-Vaquero D, Noriega-Fernandez A, Suarez-Vazquez A. Total knee arthroplasties performed with a mini-incision or a standard incision. Similar results at six months follow-up. BMC Musculoskelet Disord 2010; 11: 27.
21. Alshryda S, Mason J, Vaghela M, Sarda P, Nargol A, Maheswaran S, et al. Topical (intra-articular) tranexamic acid reduces blood loss and transfusion rates following total knee replacement: a randomized controlled trial (TRANX-K). J Bone Joint Surg Am 2013; 95: 1961-8.
22. Alshryda S, Sukeik M, Sarda P, Blenkinsopp J, Haddad FS, Mason JM. A systematic review and meta-analysis of the topical administration of tranexamic acid in total hip and knee replacement. Bone Joint J 2014; 96-B: 1005-15.
23. Wong J, Abrishami A, El Beheiry H, Mahomed NN, Roderick Davey J, Gandhi R, et al. Topical application of tranexamic acid reduces postoperative blood loss in total knee arthroplasty: a randomized, controlled trial. J Bone Joint Surg Am 2010; 92: 2503-13.
24. Nielsen CS, Jans O, Orsnes T, Foss NB, Troelsen A, Husted H. Combined Intra-Articular and Intravenous Tranexamic Acid Reduces Blood Loss in Total Knee Arthroplasty: A Randomized, Double-Blind, Placebo-Controlled Trial. J Bone Joint Surg Am 2016; 98: 835-41.
25. Wang H, Shen B, Zeng Y. Blood Loss and Transfusion After Topical Tranexamic Acid Administration in Primary Total Knee Arthroplasty. Orthopedics 2015; 38: e1007-16.
26. Yang ZG, Chen WP, Wu LD. Effectiveness and safety of tranexamic acid in reducing blood loss in total knee arthroplasty: a meta-analysis. J Bone Joint Surg Am 2012; 94: 1153-9.
27. Xie J, Ma J, Kang P, Zhou Z, Shen B, Yang J, et al. Does tranexamic acid alter the risk of thromboembolism following primary total knee arthroplasty with sequential earlier anticoagulation? A large, single center, prospective cohort study of consecutive cases. Thromb Res 2015; 136: 234-8.
28. Duncan CM, Gillette BP, Jacob AK, Sierra RJ, Sanchez-Sotelo J, Smith HM. Venous thromboembolism and mortality associated with tranexamic acid use during total hip and knee arthroplasty. J Arthroplasty 2015; 30: 272-6.

29. Abolghasemian M, Huether TW, Soever LJ, Drexler M, MacDonald MP, Backstein DJ. The Use of a Closed-Suction Drain in Revision Knee Arthroplasty May Not Be Necessary: A Prospective Randomized Study. J Arthroplasty 2016; 31: 1544-8.
30. Li N, Liu M, Wang D, He M, Xia L. Comparison of complications in one-stage bilateral total knee arthroplasty with and without drainage. J Orthop Surg Res 2015; 10: 3.
31. Kelly EG, Cashman JP, Imran FH, Conroy R, O'Byrne J. Systematic review and meta-analysis of closed suction drainage versus non-drainage in primary hip arthroplasty. Surg Technol Int 2014; 24: 295-301.
32. Mortazavi SM, Hansen P, Zmistowski B, Kane PW, Restrepo C, Parvizi J. Hematoma following primary total hip arthroplasty: a grave complication. J Arthroplasty 2013; 28: 498-503.
33. Quinn M, Bowe A, Galvin R, Dawson P, O'Byrne J. The use of postoperative suction drainage in total knee arthroplasty: a systematic review. Int Orthop 2015; 39: 653-8.
34. Huang Z, Ma J, Shen B, Pei F. General anesthesia: to catheterize or not? A prospective randomized controlled study of patients undergoing total knee arthroplasty. J Arthroplasty 2015; 30: 502-6.
35. Kotwal R, Hodgson P, Carpenter C. Urinary retention following lower limb arthroplasty: analysis of predictive factors and review of literature. Acta Orthop Belg 2008; 74: 332-6.
36. Sung KH, Lee KM, Chung CY, Kwon SS, Lee SY, Ban YS, et al. What are the risk factors associated with urinary retention after orthopaedic surgery? Biomed Res Int 2015; 2015: 613216.
37. Kumar P, Mannan K, Chowdhury AM, Kong KC, Pati J. Urinary retention and the role of indwelling catheterization following total knee arthroplasty. Int Braz J Urol 2006; 32: 31-4.
38. Hinarejos P, Guirro P, Puig-Verdie L, Torres-Claramunt R, Leal-Blanquet J, Sanchez-Soler J, et al. Use of antibiotic-loaded cement in total knee arthroplasty. World J Orthop 2015; 6: 877-85.
39. Soares D, Leite P, Barreira P, Aido R, Sousa R. Antibiotic-loaded bone cement in total joint arthroplasty. Acta Orthop Belg 2015; 81: 184-90.
40. Hansen EN, Adeli B, Kenyon R, Parvizi J. Routine use of antibiotic laden bone cement for primary total knee arthroplasty: impact on infecting microbial patterns and resistance profiles. J Arthroplasty 2014; 29: 1123-7.
41. Bedard M, Pelletier-Roy R, Angers-Goulet M, Leblanc PA, Pelet S. Traffic in the operating room during joint replacement is a multidisciplinary problem. Can J Surg 2015; 58: 232-6.
42. Panahi P, Stroh M, Casper DS, Parvizi J, Austin MS. Operating room traffic is a major concern during total joint arthroplasty. Clin Orthop Relat Res 2012; 470: 2690-4.
43. Busch CA, Shore BJ, Bhandari R, Ganapathy S, MacDonald SJ, Bourne RB, et al. Efficacy of periarticular multimodal drug injection in total knee arthroplasty. A randomized trial. J Bone Joint Surg Am 2006; 88: 959-63.
44. Dalury DF, Lieberman JR, MacDonald SJ. Current and innovative pain management techniques in total knee arthroplasty. J Bone Joint Surg Am 2011; 93: 1938-43.
45. Kelley TC, Adams MJ, Mulliken BD, Dalury DF. Efficacy of multimodal perioperative analgesia protocol with periarticular medication injection in total knee arthroplasty: a randomized, double-blinded study. J Arthroplasty 2013; 28: 1274-7.
46. Snyder MA, Scheuerman CM, Gregg JL, Ruhnke CJ, Eten K. Improving total knee arthroplasty perioperative pain management using a periarticular injection with bupivacaine liposomal suspension. Arthroplasty Today 2016; 2: 37-42.

Workgroup 3 Postoperative Care, Pain Management and Rehabilitation

Leader

Saradej Khuangsirikul, MD

Delegates

Chaturong Pornrattanamaneewong, MD, Chavanont Sumanasrethakul, MD, Charlee Sumettavanich, MD,

Thanainit Chotanaphuti, MD, Visit Wangwittayakul, MD, Pramook Vanasbodeekul, MD,

Sittipong Ketwongwiriya, MD

Question 1: Is an intensive care unit (ICU) necessary for high-risk total knee arthroplasty (TKA) patient?
Consensus: The high-risk patients, such as advanced age, cancer, renal disease, liver disease, chronic lung disease, cerebrovascular disease, peripheral vascular disease, myocardial infarction and the presence of postoperative cardiopulmonary complications, need postoperative intensive care.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Usually, TKA is performed in the elderly patients. Previous evidence suggested a higher rate of complications resulting from increases in comorbidity burden among these populations[1]. Based on the hospital discharge data of patients who underwent primary hip and knee arthroplasty in approximately 400 United States hospitals between 2006 and 2010, 3% of the patients required ICU. Risk factors with increased odds for requiring ICU included advanced age, general anesthesia versus neuraxial anesthesia, increasing comorbidity burden (such as cancer, renal disease, diabetes mellitus, liver disease, chronic obstructive lung disease, dementia, cerebrovascular disease, peripheral vascular disease, myocardial infarction, and obesity) and the presence of postoperative cardiopulmonary complications[2]. In addition, the same day bilateral TKA should be considered as a high-risk procedure. This condition should be set up for cardiorespiratory monitoring and observation in an ICU[3,4]. However, because the definition of high-risk TKA patient is not clearly defined, the requirement of postoperative ICU should be deliberated from the joint decision among arthroplasty surgeon, anesthesiologist and internal medicine physician.

Question 2: Is an internist necessary in postoperative care after TKA?
Consensus: Most of TKA patients are the elderly with medical comorbidities, the internist is necessary.
Delegate vote: Agree: 78%, Disagree: 22%, Abstain: 0% (Strong Consensus)
Justification: Most of TKA patients are the elderly with medical comorbidities, such as diabetes, hypertension, other cardiovascular problems, chronic lung disease and renal insufficiency. After major surgery, patient may have higher risk of medical complication. Early detection and proper management by the internist are necessary. All of the experts agree that TKA is an elective surgery; it should be performed in suitable facilities including availability of internist(s).

Question 3: Is the orthopedic surgeon necessary for postoperative care after TKA?
Consensus: In order to provide proper postoperative care and early detected complications, the orthopedic surgeon is necessary for postoperative care.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification:
TKA is a specific orthopedic surgery, which needs different postoperative care from other types of surgery. In order to get best postoperative results, appropriate postoperative care such as early ambulation, range of motion exercise and quadriceps strengthening is needed. Moreover, the orthopedic surgeon is necessary in early detection and management of postoperative complications.

Question 4: Should intravenous prophylactic antibiotics be discontinued within 1 day after TKA?
Consensus: Without any special considerations, the intravenous prophylactic antibiotics should be discontinued within 1 day after TKA.
Delegate vote: Agree 89% Disagree 11%, Abstain: 0% (Strong Consensus)

Justification: Most of the experts agree that the intravenous antibiotics should be discontinued within 1 day after knee arthroplasty in uncomplicated cases. Ritter et al, conducted a RCT in 196 patients to compare the efficacy of two different doses of intraoperative cefuroxime (1500 mg and 750 mg) and two similar cefuroxime regimens plus continuous cefuroxime at 750mg every eight hours for 24 hours. They found that there are no superficial and deep infection in both groups[5]. Mauerhan et al, comparing the one day cefuroxime and three days cefazolin in 1,345 patients after total joint arthroplasty. The patients were randomly assigned to receive either 1.5 grams of cefuroxime followed by 750 mg at 8-16 hours later, or 1,000 mg of cefazolin every eight hours for 3 days. For TKA patients, they found deep infection 0.6% in cefazolin group and 1.4% in cefuroxime group, which has no statistical significance[6].

The literatures suggest that there is no proven benefit in administration of parenteral antibiotics longer than 24 hours[7-10]. However, this recommendation is used in healthy patients. The prophylactic antibiotic administration may be prolonged in case of immunocompromised patients.

Question 5: In TKA surgery, are there any benefits of using oral antibiotics after discontinuing intravenous antibiotics?
Consensus: After discontinuing intravenous antibiotics, the advantage of oral antibiotics is inconclusive.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Currently, there is no evidence support in using oral antibiotics. However, when we discussed about using of oral antibiotics after discontinuing parenteral antibiotics, we found that 44.4% of the experts agree in using oral antibiotics even though there is no supporting evidence. Additional researches in this area would be helpful in the future.

Question 6: What is the highest acceptable postoperative visual analogue pain score (VAS) during patient's admission for TKA?
Consensus: Postoperative visual analogue pain score after TKA during patient's admission should not exceed 3, which represents the analgesic success.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: The majority of the experts unaccepted postoperative VAS more than 3. Srinivas, et al. reviewed 112 articles published recently in anesthesia journals for statistical reporting of VAS data[11]. Of the 112 articles, only two used confidence intervals (CI) to report mean pain scores and one used CIs to report differences in median pain scores between the study groups. Only two articles presented 95% CI for the mean pain scores graphically. A graphical method using CIs is proposed that allows ready interpretation of VAS data. With this approach, one evaluates whether the 95% CI for the mean pain score in a group during a particular period lies entirely within the zone defined as "analgesic success" (0-3). Analgesic techniques following TKA that produce VAS values in the range of 0-3 have been reported to represent adequate analgesia.

Question 7: Do postoperative TKA patients have benefit from multimodal analgesia?
Consensus: Multimodal analgesia, such as opioid, anti-inflammatory drug, regional analgesia and periarticular multimodal drugs infiltration, is beneficial in TKA patients.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Multimodal analgesia improves pain control and minimalizes side effects in patients undergoing total knee arthroplasty. Several studies have confirmed the safety of the protocol[12,13]. It has a great potential to enhance the postoperative recovery period.

Question 8: Do postoperative TKA patients with hemoglobin level less than 8 g/dL need blood transfusion?
Consensus: If hemoglobin level is less than 10 g/dL with hemodynamic unstable or anemic symptoms or less than 8 g/dL, blood transfusion must be done.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: All of the experts accepted that the postoperative transfusion trigger can be brought to 8.0 g% in a hemodynamically stable patient. Prasad, et al. found to tolerate low postoperative Hb up to 8.0 g% and the amount of perioperative blood loss was on the lower side, which may be related to the use of a cemented prosthesis and an intramedullary femoral plug[14]. Qi Zhou et al, Levels of Hb and Hct decreased during the first 4 days after arthroplasty and gradually returned to their normal levels within 6–12 weeks postoperatively. They found that asymptomatic patients with postoperative Hb 7.5–8 g/dL showed similar recovery process of Hb to those with Hb always above 8 g/dL. This suggests that the indications for blood transfusion after TKA may be decreased to 7.5 g/dL for patients without typical anemic symptoms[15].

Question 9: Should the suction drainage be removed within 2 days after TKA?
Consensus: The suction drainage should be removed on the next day after surgery, but no longer than 2 days.

Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: The use of a postoperative wound drain in surgical interventions has a long tradition. Non-significantly lower risk of infection after a wide range of orthopedic interventions and that drains prevent the development of postoperative hematomas. Retaining of suction drain may cause increasing in bleeding time[16]. Moreover, wound drainage for more than 24 hours may leads to an increased risk of retrograde contamination with bacteria[17,18].

Question 10: Should the urinary catheter be removed within 2 days after TKA?
Consensus: The urinary catheter should be removed on the next day after surgery, but no longer than 2 days.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Indwelling urinary catheter have a higher rate of postoperative bacteriuria than intermiitent catheter[19]. Therefore, the using of intermittent catheter is a better practice than the indwelling catheter. However, the pain and disturbance in using intermittent catheter is unacceptable in some of patient. Some orthopedic surgeon still using indwelling catheter in situation such as regional spinal block with opioid due to urinary retention or in male patient with benign prostatic hyperplasia[20].

Postoperative urinary retention (POUR) is a common complication following lower joint arthroplasty[21]. Moreover, POUR has been associated with the development of urinary tract infection (UTI) and the subsequent risk of wound and implant infection. Indwelling urinary catheterization, removed 24 – 48 hours postoperatively, was superior to intermittent catheterization in preventing POUR. Furthermore, indwelling urinary catheterization with removal 24 to 48 hours postoperatively did not increase the risk of UTI. In patients with multiple risk factors for POUR undergoing total joint arthroplasty of lower limb, the preferred option should be indwelling urinary catheterization removed 24 – 48 hours, postoperatively.

Question 11: When should the patient start ambulation after TKA?
Consensus: The TKA patients should start ambulation, such as sitting at bedside, up standing or walking, as soon as possible.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: The ambulation is defined as sitting at bedside, up standing or walking as able. Several studies have reported significant advantages of accelerated patient mobilization following TKA, including shorter length of stay, faster functional improvement, reduced or similar complication rate, and lower cost[22-25]. In terms of preventing venous thromboembolism, although there is no reliable supported evidence, the current AAOS clinical practice guideline recommends that patients should undergo early mobilization following TKA. Early mobilization is of low cost, minimal risk and consistent with current practice[26].

Question 12: Do TKA patients benefit from bulky compressive dressing?
Consensus: The benefit of bulky compressive dressing after TKA is not clear.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: A bulky compression dressing (the Robert Jones bandage) is often used after total knee arthroplasty. Brodell, et al. found that it increased compartment pressure and helped to reduce bleeding, tissue edema and the size of effusions and hemarthroses[27]. However, from prospective RCT, Pinsornsak, et al. found no differences in the mean postoperative blood loss, blood transfusion amounts, postoperative pain, and knee swelling between compressive dressing group and conventional dressing group[28].

Question 13: Do TKA patients benefit from cold compression therapy?
Consensus: The cold compression therapy has advantages in postoperative pain control in TKA. It might lead to improve ROM and shorter hospital stay.
Delegate vote: Agree: 89%, Disagree: 11%, Abstain: 0% (Strong Consensus)
Justification: Cryotherapy has been used routinely after total knee arthroplasty. Kullenberg, et al. found that cold compression therapy improves the control of pain and might thus lead to improve ROM and shorter hospital stay[29]. Market SE reviewed eleven studies and found that six of the studies showed significantly lower pain scores in the cold compression group than in a control group, including epidural analgesia, Robert Jones bandage, narcotic administration, and crushed ice[30]. However, Adie, et al. concluded from meta-analysis that potential benefits of cryotherapy was very low or low for all main outcomes[31. This needs to be balanced against potential inconveniences and expenses of using cryotherapy.

Question 14: Has the continuous passive motion (CPM) benefit in TKA patients?
Consensus: The CPM has no definite benefit in most TKA patients.
Delegate vote: Agree: 89%, Disagree: 0%, Abstain: 11% (Strong Consensus)
Justification: The continuous passive motion (CPM) does not have clear benefit in patients after TKA[32-34]. The final range of motion in patients

using CPM are not different from patients without using CPM[32-34]. Furthermore, CPM applications do not have any additional effect on prevention of venous thromboembolism, functional ability, or length of stay. Therefore, we believe that CPM should not be routinely used during in-hospital rehabilitation programs after primary TKA[32-35].

Question 15: Should the chemoprophylaxis for venous thromboembolism (VTE) be considered in TKA patients?

Consensus: The chemoprophylaxis should be considered in TKA patients who have no contraindications, such as bleeding risk, renal insufficiency or known allergy to the agents.

Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)

Justification: Although the incidences of symptomatic deep vein thrombosis (DVT) and pulmonary embolism (PE) after TKA in Asian populations are low[36,37], several multicenter studies stated that the incidence rates of VTE are similar compared with the Western[38,39]. Long-term complications, such as postthrombotic syndrome (PTS), is common and significantly decreases patients' quality of life[40]. There are still limitations in the literatures and the published guidelines. Most of the current guidelines focus on minimizing symptomatic VTE and bleeding complication[41,42]. The chemoprophylaxis agents including aspirin, warfarin, LMWH, fondaparinux, rivaroxaban, dabigatran and apixaban have been approved for their efficacy and safety. We recommend the use of one pharmaceutical VTE prophylaxis if the patient have no contraindication such as bleeding risk, renal insufficiency or known allergy to the material. However, a multimodal approach with early mobilization and the use of mechanical prophylaxis remain essential.

Question 16: Do TKA patients benefit from using an intermittent pneumatic compression device (IPCD), postoperatively?

Consensus: The IPCD has benefit in preventing venous thromboembolism after TKA, especially in patients who are contraindicated for chemoprophylaxis.

Delegate vote: Agree: 89%, Disagree: 11%, Abstain: 0% (Strong Consensus)

Justification: IPCD is a mechanical device that can reduce venous stasis by promoting venous blood flow through external compression. In a meta-analysis of Westrich et al, the incidence of deep vein thrombosis (DVT) after TKA in the patients receiving IPCD was 17% that was significantly lower than the patients receiving warfarin (45%) or aspirin (53%)[43]. For asymptomatic pulmonary embolism (PE), IPCD group had significant lower incidence than aspirin group (6.3% vs 11.7%). For Asian TKA patients, Chin et al. conducted the randomized controlled trial and found that the incidence of DVT was highest in non-prophylaxis group (22%), which was significantly higher than IPCD (8%) or enoxaparin group (6%)[44]. Enoxaparin group received more blood transfusion and bleeding complications. These studies show the benefit of IPCD in TKA patients.

Furthermore, from the Korean society of thrombosis and hemostasis evidence-bases clinical practice guideline, patients undergoing TKA are already at moderate risk for VTE[45]. This guideline recommends using mechanical (IPCD) or pharmacological prophylaxis for TKA patients. Especially, in patients with high risk of bleeding, IPCD is a preferred method for preventing VTE[45,46].

References

1. Memtsoudis SG, Della Valle AG, Besculides MC, Gaber L, Laskin R. Trends in demographics, comorbidity profiles, in-hospital complications and mortality associated with primary knee arthroplasty. J Arthroplasty 2009; 24: 518–27.
2. Memtsoudis SG, Sun X, Chiu YL, Nurok M, Stundner O, Pastores SM, et al. Utilization of critical care services among patients undergoing total hip and knee arthroplasty: epidemiology and risk factors. Anesthesiology 2012; 117(1): 107-16.
3. Peskun C, Mayne I, Malempati H, Kosashvili Y, Gross A, Backstein D. Cardiovascular disease predicts complications following bilateral total knee arthroplasty under a single anesthetic. Knee 2012; 19: 580–4.
4. Memtsoudis SG, Hargett M, Russell LA, Parvizi J, Cats-Baril WL, Stundner O, et al.; Consensus Conference on Bilateral Total Knee Arthroplasty Group. Consensus statement from the consensus conference on bilateral total knee arthroplasty group. Clin Orthop Relat Res 2013; 471(8): 2649-57.
5. Ritter MA, Campbell E, Keating EM, Faris PM. Comparison of intraoperative versus 24 hour antibiotic prophylaxis in total joint replacement. A controlled prospective study. Orthopaedic review 1989; 18(6): 694-6.
6. Mauerhan DR, Nelson CL, Smith DL, Fitzgerald RH Je, Slama TG, Petty RW, et al. Prophylaxis against infection in total joint arthroplasty. One day of cefuroxime compared with three days of cefazolin. J Bone Joint Surg Am 1994; 76(1): 39-45.
7. AlBuhairan B, Hind D, Hutchinson A. Antibiotic prophylaxis for wound infections in total joint arthroplasty: a systematic review. J Bone Joint Surg Br; 90: 915-9.

8. Prokuski L. Prophylactic antibiotics in orthopaedic surgery. J Am Acad Orthop Surg 2008; 16: 283-93.
9. Meehan J, Jamali AA, Nguyen H. Prophylactic antibiotics in hip and knee arthroplasty. J Bone Joint Surg Am. 2009; 91(10): 2480-90.
10. Voigt J, Mosier M, Darouiche R. Systematic review and meta-analysis of randomized controlled trials of antibiotics and antiseptics for preventing infection in people receiving primary total hip and knee prostheses. Antimicrob Agents Chemother 2015; 59(11): 6696-707.
11. Mantha S, Thisted R, Foss J, Ellis JE, Roizen MF. A proposal to use confidence intervals for visual analog scale data for pain measurement to determine clinical significance. Anesth analg 1993; 77: 1041-7.
12. Vendittoli PA, Makinen P, Drolet P, Lavigne M, Fallaha M, Guertin MC, et al. A Multimodal Analgesia Protocol for Total Knee Arthroplasty, Controlled study. J Bone joint Surg Br 2006; 88(2): 282-9.
13. Nuelle DG, Mann K. Minimal incision protocols for anesthesia, pain management, and physical therapy with standard incisions in hip and knee arthroplasties: the effect on early outcomes. J Arthroplasty 2007; 22: 20-25.
14. Prasad N, Padmanabhan V, Mullaji A. Blood loss in total knee arthroplasty: an analysis of risk factors. Anesth analg International Orthopaedics (SICOT) 2007; 31: 39–44.
15. Zhou Q, Zhou Y, Wu H, Wu Y, Qian Q, Zhao H, et al. Changes of hemoglobin and hematocrit in elderly patients receiving lower joint arthroplasty without allogeneic blood transfusion. Chinese Medical Journal 2015; 128: 75-8.
16. Ares O, Seijas R, Hernandez A, Castellet E, Sallent A. Knee arthroplasty and bleeding: when to remove drainages. Knee Surg Sports Traumatol Arthrosc 2013; 21(2): 393-7.
17. Mardian S, Perka C, Matziolis G. Wound drainange in primary knee arthroplasty--a prospective randomized study. Acta Chir Orthop Traumatol Cech 2013; 80(2): 114-7.
18. Willemen D, Paul J, White SH, Crook DW. Closed suction drainage following knee arthroplasty. Effectiveness and risks. Clin Orthop Relat Res 1991; (264): 232-4.
19. van den Brand IC, Castelein RM. Total joint arthroplasty and incidence of postoperative bacteriuria with an indwelling catheter or intermittent catheterization with one-dose antibiotic prophylaxis: a prospective randomized trial. J Arthroplasty 2001; 16: 850–5.
20. Elkhodair S, Parmar HV, Vanwaeyenbergh J. The role of the IPSS (International Prostate Symptoms Score) in predicting acute retention of urine in patients undergoing major joint arthroplasty. Surgeon 2005; 3: 63–5.
21. Balderi T, Carli F. Urinary retention after total hip and knee arthroplasty. Minerva Anestesiol 2010; 76: 120–30.
22. Larsen K, Sørensen OG, Hansen TB, Thomsen PB, Søballe K. Accelerated perioperative care and rehabilitation intervention for hip and knee replacement is effective: a randomized clinical trial involving 87 patients with 3 months of follow-up. Acta Orthop 2008; 79(2): 149-59.
23. Lenssen AF, Crijns YH, Waltjé EM, Van Steyn MJ, Geesink RJ, Van den Brandt PA, et al. Efficiency of immediate postoperative inpatient physical therapy following total knee arthroplasty: an RCT. BMC Musculoskelet Disord 2006; 7: 71.
24. Munin MC, Rudy TE, Glynn NW, Crossett LS, Rubash HE. Early inpatient rehabilitation after elective hip and knee arthroplasty. JAMA 1998; 279(11): 847-52.
25. Pearse EO, Caldwell BF, Lockwood RJ, Hollard J. Early mobilisation after conventional knee replacement may reduce the risk of postoperative venous thromboembolism. J Bone Joint Surg Br 2007; 89(3): 316-22.
26. Mont MA, Jacobs JJ. AAOS clinical practice guideline: preventing venous thromboembolic disease in patients undergoing elective hip and knee arthroplasty. J Am Acad Orthop Surg 2011;19(12): 777-8.
27. Brodell JD, Axon DL, Evarts CM. The Robert Jones bandage. J Bone Joint Surg Br 1986;68(5): 776-9
28. Pinsornsak P, Chumchuen S. Can a modified Robert Jones bandage after knee arthroplasty reduce blood loss? A prospective randomized controlled trial. Clin Orthrop Relat Res 2013; 471(5): 1677-81.
29. Kullenberg B, Ylipää S, Söderlund K, Resch S. Postoperative cryotherapy after total knee arthroplasty: a prospective study of 86 patients. J Arthroplasty 2006; 21(8): 1175-9.
30. Market SE, The use of cryotherapy after a total knee replacement: a literature review. Orthop Nurs 2011; 30(1); 29-36.
31. Adie S, Kwan A, Naylor JM, Harris IA, Mittal R, Cryotherapy following total knee replacement. Cochrane Database Syst Rev 2012; (9): CD007911.
32. Brosseau L, Milne S, Wells G, Tugwell P, Robinson V, Casimiro L, et al. Efficacy of continuous passive motion following total knee arthroplasty: a metaanalysis. J Rheumatol 2004; 31(11): 2251-64.

33. Joshi RN, White PB, Murray-Weir M, Alexiades MM, Sculco TP, Ranawat AS. Prospective Randomized Trial of the Efficacy of Continuous Passive Motion Post Total Knee Arthroplasty: Experience of the Hospital for Special Surgery. J Arthroplasty 2015; 30(12): 2364-9.
34. Mistry JB, Elmallah RD, Bhave A, Chughtai M, Cherian JJ, McGinn T, et al. Rehabilitative Guidelines after Total Knee Arthroplasty: A Review. J Knee Surg 2016; 29(3): 201-17.
35. He ML, Xiao ZM, Lei M, Li TS, Wu H, Liao J. Continuous passive motion for preventing venous thromboembolism after total knee arthroplasty. Cochrane Database Syst Rev 2014; 29(7): CD008207.
36. Clarke MT, Green JS, Harper WM, Gregg PJ. Screening for deep venous thrombosis after hip and knee replacement without prophylaxis. J Bone Joint Surg Br 1997; 79(5): 787-91.
37. Fujita S, Hirota S, Oda T, Kato Y, Tsukamoto Y, Fuji T. Deep venous thrombosis after total hip or total knee arthroplasty in patients in Japan. Clin Orthop Relat Res 2000; (375): 168-74.
38. Piovella F, Wang CJ, Lu H, Lee K, Lee LH, Lee WC, et al.Deep-vein thrombosis rates after major orthopedic surgery in Asia. An epidemiological study based on postoperative screening with centrally adjudicated bilateral venography. J Thromb Haemost 2005; 3(12): 2664-70.
39. Leizorovicz A. Epidemiology of post-operative venous thromboembolism in Asian patients. Results of the SMART venography study. Haematologica 2007; 92(9): 1194-200.
40. Khuangsirikul S, Sampatchalit S, Foojareonyos T, Chotanaphuti T. Lower extremities' postthrombotic syndrome after total knee arthroplasty. J Med Assoc Thai 2009; 92(6): S39-44.
41. Budhiparama NC, Abdel MP, Ifran NN, Parratte S. Venous thromboembolism (VTE) prophylaxis for hip and knee arthroplasty: changing trends. Curr Rev Musculoskelet Med 2014; 7:108–16.
42. Falck-Ytter Y, Francis CW, Johanson NA, Curley C, Dahl OE, Schulman S, et al. Prevention of venous thromboembolism: antithrombotic therapy and prevention of thrombosis, 9th ed: American college of chest physicians evidence-based clinical practice guidelines. CHEST 2012; 141(2)(Suppl): e278S–e325S.
43. Westrich GH, Haas SB, Mosca P, Peterson M. Meta-analysis of thromboembolic prophylaxis after total knee arthroplasty. J Bone Joint Surg Br 2000; 82(6): 795-800.
44. Chin PL, Amin MS, Yang KY, Yeo SJ, Lo NN. Thromboembolic prophylaxis for total knee arthroplasty in Asian patients: a randomised controlled trial. J Orthop Surg (Hong Kong) 2009; 17(1): 1-5.
45. Bang SM, Jang MJ, Kim KH, Yhim HY, Kim YK, Nam SH, et al. Korean Society of Thrombosis and Hemostasis. Prevention of venous thromboembolism, 2nd edition: Korean Society of Thrombosis and Hemostasis Evidence-based Clinical Practice Guidelines. J Korean Med Sci 2014; 29(2): 164-71.
46. Mont MA, Jacobs JJ. AAOS clinical practice guideline: preventing venous thromboembolic disease in patients undergoing elective hip and knee arthroplasty. J Am Acad Orthop Surg 2011; 19(12): 777-8.

Workgroup 4 Follow-up and Outcome Measures

Leader

Srihatach Ngarmukos, MD

Delegates

Aree Tanavalee, MD, Somsak Kuptniratsaikul, MD, Vajara Wilairatana, MD, Chavarin Amarase, MD,

Noratep Kulachote, MD, Arak Limtrakul, MD, Ronnasak Mongkolrangsarit, MD

Question 1A: Should patients with knee OA be clinically and functionally assessed before TKA surgery?
Consensus: All patients with knee OA should be assessed for clinical and functional parameters as a baseline information before TKA surgery.
Delegate Vote: Agree: 87.5%, Disagree: 12.5%, Abstain: 0% (Strong Consensus)

Question 1B: Should patients with knee OA be clinically and functionally assessed after TKA surgery?
Consensus: All patients with knee OA should be assessed for clinical and functional parameters after TKA surgery in order to evaluate postoperative changes during each follow-up and to evaluate outcomes.
Delegate Vote: Agree: 87.5%, Disagree: 12.5%, Abstain: 0% (Strong Consensus)
Justification: Almost all reports of TKA surgery published in peer-reviewed journals provided pre- and postoperative clinical and functional parameters[1-12]. The summary of outcome measures of TKA patients are showed in the below.

Question 2: Which outcome measures should be used for evaluation of patients following TKA surgery?
Consensus: The outcome measures used for evaluation of patients following TKA surgery should be universal standard, simple, less time-consuming, and appropriate for individual hospital system and workload of the orthopedic surgeon. Minimum outcome measures should consist of visual analog scale (VAS) for pain at rest and at motion, range of motion (ROM), and at least one of functional performance tests such as 5-time sit to stand test, and time up and go test.
Delegate Vote: Agree: 75%, Disagree: 12.5%, Abstain: 12.5% (Strong Consensus)
Justification: According to The California Joint Replacement Registry (CJRR), patient-reported outcomes (PRO) for patient's assessment after total joint arthroplasty, provide data that are useful and practical for informing clinical decision-making, high levels of responsiveness, minimize questionnaire length as a means to maximize response and compliance[13]. The measures using PRO may include one generic (SF-12 or SF-36), one disease specific (Oxford Knee Score (OKS) or WOMAC), one disease burden (Charnley) and one activity scale (UCLA). However limitation of using PRO for Thai patients is language problem, as there are limited Thai version of PRO such as WOMAC[14], EQ-5D[15] and SF-36[16] with are commonly used.

Functional performance measure is a groups of tests which can determine functions which represent actual ability of the examined knee. However, major disadvantage of functional performance measure is the risk of fall or accident during the test. The Osteoarthritis Research Society International (OARSI) has recommended 5 performance-based tests of physical function after total joint replacement including 1) the 30-s chair-stand test represented sit to stand activity, 2) 40 m fast-paced walk test represented walking short distances, 3) a stair-climb test represented stair negotiation, 4) timed up-and-go test represented ambulatory transitions 5) 6-min walk test represented aerobic capacity/walking long distances[17].

In a study of Ha et al.[18], the postoperative knee ROM significantly correlated with functional score of WOMAC and Knee Society Score. Additionally, change or improvement of knee ROM correlated with patient satisfaction.

The outcome measures used for evaluation of patients following TKA surgery should be universal standard, simple, and less time-consuming which accommodate patient compliance, response rates and quality of response[19,20]. For the simple and efficacy of patient's assessment, we recommend using Visual Analog Scale (VAS) for pain (both pain at rest and pain on motion), knee range of motion (ROM) and at least one of functional performance measurement such as 5-time sit to stand test, time up and go test.

Publication	Number of patients	F/U	Measurements of improvement of pre-and postoperative clinical and functional parameters
Dawson, et al. 1998[1]	117	6 months	OKS
ROOS, et al. 1998[2]	21	3 months 6 months	KOOS: pain, ADL, QOL All of KOOS
Gandhi, et al. 2009[3]	142	12 weeks	WOMAC, SF-36, TUGT
Medalla, et al. 2009[4]	195	2 years 5 years 10 years	OKS, AKS OKS, AKS OKS, AKS
Stratford, et al. 2010[5]	47	9-13 weeks	WOMAC, not improved 6MWD & TUGT
Mizner, et al. 2011[6]	100	1 month 12 months	All of test worsen 6MWD, TUGT, stair-climb test, SF-36 PCS
Stevens-Lapsley, et al. 2011[7]	39	1 moth 3 months 6 months.	3/5 of KOOS (pain, ADL, QOL) 5/5 of KOOS, 6MWD, TUGT, stair climb test, quadriceps strength 5/5 of KOOS, 6MWD, TUGT, stair climb test, quadriceps strength
Soohoo, et al. CJRR database 2014[8]	229	3 months	SF-12 PCS, WOMAC, UCLA activity
Naal, et al. 2015[9]	233	3 months 6 months 12 months	OKS, EQ-5D, WOMAC, UCLA OKS, EQ-5D, WOMAC, UCLA OKS, EQ-5D, WOMAC, UCLA
Bolink,et al. 2015[10]	20	12 months	WOMAC, KSS, sit to stand test
Harris, et al. 2015[11]	71607	6 months	OKS
Giesinger , et al. 2015[12]	765	Compare 2 mo. & 12 mo.	WOMAC, EQ-5D, KSS

OKS: Oxford Knee Score, KOOS: Knee Injury and Osteoarthritis Outcome Score, ADL: Activities of daily living, QOL: quality of life WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index, SF-36: 36-item short-form health survey, SF-36 PCS: SF-36 physical component summary, TUGT: Timed up-and-go test, AKS: American Knee Society Score, 6MWD: 6-minute Walk Distance, EQ-5D: EuroQol-5 dimensions, KSS: Knee Society Score

Question 3: What are additional optional outcome measures for TKA surgery?
Consensus: Outcome measures for TKA surgery, which is able to use as additional options, are categorized into 3 groups. They included 1) Patient-reported outcome measurements (PROMs) such as KOOS, KOOS-JR, WOMAC, and SF-36, 2) Physician-based outcome measurements such as Knee Society Score (KSS), and 3) Functional performance tests such as 6-minute walking distance (6MWD), and Stair climb test (SCT).

Delegate Vote: Agree: 75%, Disagree: 25%, Abstain: 0% (Strong Consensus)
Justification: According to the review article of Amarase et al.[21], the outcome measures for TKA were categorized into 3 groups, including 1) patient-reported outcome measures (PROM) which the patient answered questionnaire according to his or her subjective perception to questions, 2) physician-reported outcome measures which the surgeon evaluated the patient according to the list of parameters and patient's reported on functions such as Knee Society Score (KSS), The New Knee

Society Score, The Hospital for Special Surgery knee scale (HSS), and 3) functional performance tests which evaluate the performance on specific activities, such as stair climbing, 30-s chair-stand test, 40 m fast-paced walk test, a stair-climb test, time up-and-go test, 6-min walk test, and 5 times sit to stand test.

PROM can be divided into 2 subgroups according to disease-specific or general health assessment. Disease-specific assessment is rather specific to the health issues caused by the disease and more sensitive to the effects of a given condition on health such as WOMAC, OKS, The Knee Injury and Osteoarthritis Outcome Score (KOOS), KOOS-Joint Registry (KOOS-JR), and Lysholm Knee Scale. General health assessment represents the overall patient's health; however, it does not refer to the disease or certain problem that may cause poor health such as SF-36, SF-12, EQ-5D, and UCLA activity score.

Question 4A: How should "pain score" be used to assess outcomes of TKA surgery?
Consensus: Pain score after TKA surgery are highly variable among patients. Patients may experience severe pain up to 6 months after surgery. Adequate pain control is mandatory during this period in order to avoid negative effect to long-term outcomes, of which the pain score at this postoperative period should be controlled to be not more than 3.
Delegate Vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)

Question 4B: Should "improvement of pain score" during the first 6 weeks be used to determine outcomes of TKA surgery?
Consensus: Pain score during the first 6 weeks should not be used to determine satisfactory outcomes after TKA surgery, because there are highly variable scores among patients. Low pain scores at this period of time relates to adequate pain control.
Delegate Vote: Agree: 75%, Disagree: 25%, Abstain: 0% (Strong Consensus)

Question 4C: Should "improvement of pain score" during the first 6 weeks to 6 months after surgery be used to determine outcomes of TKA surgery?
Consensus: Pain score during the first 6 weeks to 6 months after surgery should not be used to determine satisfactory outcomes after TKA surgery, because there are still highly variable scores among patients. Low pain scores at this period of time relates to adequate pain control.
Delegate Vote: Agree: 87.5%, Disagree: 12.5%, Abstain: 0% (Strong Consensus)
Justification: The systematic review and meta-analysis of Done et al.[22] demonstrated that there were limited well designed studies related to immediate postoperative (after surgery to the time before patients discharged from hospital) pain control in TKA surgery. Although Boonen et al. showed improved VAS pain at 3 months after TKA surgery[23], Roos et al. showed improved KOOS pain at 3 months and 6 months after TKA surgery[2], and Stevens-Lapsley et al. showed improved KOOS pain at 1, 3 and 6 months after TKA surgery[7], there was no study defined that the maximum reduction of pain score occurred within 6 months after TKA surgery.

Therefore, improvement of pain score at 6 months after surgery shouldn't be used to determine the outcomes after TKA surgery. We recommend that, in uncomplicated TKA surgery, postoperative pain score should be well controlled within 3 in VAS scale of 10, although, the study of Sakellariou et al. showed 39% of patients felt persistent pain 1 year after TKA surgery, with a median pain score of 3 in the scale of 10[24].

Question 5: After TKA surgery, when should determine the final range of motion (ROM) of the operated knee and how much the final range of motion (ROM) of the operated knee should be?
Consensus: The final knee ROM following uncomplicated TKA surgery should be evaluated from 6 months onward, which the operated knee should gain at least 90 degrees of flexion. If flexion contracture is detected, it should be within 10 degrees. Similarly, if knee hyperextension is detected, it should be within 5 degrees.
Delegate Vote: Agree: 75%, Disagree: 12.5%, Abstain: 12.5% (Strong Consensus)
Justification: According to the study of Hiyama et al., the final postoperative knee ROM can be reliably evaluated from 6 months onward[25]. Following uncomplicated knee arthroplasty, the operated knee should have at least 90 degrees of flexion for comfortably daily activities. The study by Rowe et al.[26] showed that a normal gait on even or slope floors require less than 90 degrees of knee flexion. Climbing stairs and rise from chairs require 90–120 degrees of knee flexion. Getting in and off a bath tub needs approximately 135 degrees of flexion. The study by Mulholland et al.[27] reported that to cross-legged siting and squatting require 111-165 degrees of knee flexion.
The study by Lam et al.[28] demonstrated that patients were dissatisfied if the operated knees had more than 10 degrees of flexion contracture and less than 90 degrees of maximum flexion. The gait analysis of Harato et al.[29] demonstrated that knee flexion contracture more than 15 degrees significantly increased quadriceps force to achieve knee stability. Therefore, knee flexion contracture following uncomplicated TKA is unacceptable if it is more than 10 degrees. The study of Siddiqui et al.[30] showed postoperative knee hyperextension of

5 degrees or more, significantly impacted daily function and quality of life of patients.

Question 6: What is the appropriate time to determine the outcome of TKA using minimum outcome measures, including visual analog scale (VAS) for pain at rest and at motion, range of motion (ROM), and at least one of functional performance tests?
Consensus: The appropriate time to determine the outcome of TKA using minimum outcome measures, including visual analog scale (VAS) for pain at rest and at motion, range of motion (ROM), and at least one of functional performance tests can be evaluated from 1 year onward.
Delegate Vote: Agree: 87.5%, Disagree: 12.5%, Abstain: 0% (Strong Consensus)
Justification: Several studies supported the significant improvement of patient-reported outcome measures (PROMs), functional performance measure, pain score, ROM and patient satisfaction at 1 year after TKA. For example of studies are the study by Naal et al.[9] showed more than 90 % of the patients were satisfied or very satisfied. Additionally, patient-reported outcome measures (PROMs), including WOMAC and EQ-5D, largely improved after 12 months. Similarly, the study by Giesinger et al.[12] identified that cut-off improved scores of the WOMAC, the EQ-5D and the KSS in TKA patients at 1 year after TKA significantly facilitated the outcome interpretation.

Question 7: How long should patients be followed up and evaluated after TKA surgery?
Consensus: There is no conclusive agreement whether what should be the minimum time for follow-up and evaluation after TKA surgery. However, patients should be followed up at 2 weeks, 6 weeks, 12 weeks, 6 months and 1 year after TKA. Follow-up after 1 year is an optional.
Delegate Vote: Agree: 75%, Disagree: 25%, Abstain: 0% (Strong Consensus)
Justification: There was no study determined the minimal follow-up and the proper duration of follow-up after TKA surgery. We recommend all patients should be followed up at 2 weeks for closely evaluation of surgical wound or possible signs of complications. At 6 weeks and 12 weeks, besides regular evaluation, knee ROM should be closely evaluated. At 6 months, the patients' clinical and functional parameters should closely evaluated. At 1 year, several assessment measures (Pain score, ROM, Functional performance measure) should be evaluated for outcome after TKA surgery. Follow-up after 1 year are optional for evaluate mid-term and long-term survivorship.
Question 8: How often should postoperative knee radiographs be taken and how should knee radiographs post TKA radiographs be evaluated?
Consensus:

1. Postoperative knee radiographs should be taken at least once before the patient is discharged from the hospital.
2. Postoperative knee radiographs should be taken at least once within 1 year after surgery, excluding radiographs taken before hospital discharge.
3. For patients who are available for further follow-up, postoperative knee radiographs should be taken at least once every 2 years.
4. For radiographic evaluation, the anteroposterior (AP) and the lateral views of knee radiographs are minimum necessary.

Delegate Vote: Agree: 87.5%, Disagree: 12.5%, Abstain: 0% (Strong Consensus)
Justification: Postoperative knee radiographs in anteroposterior (AP) and lateral views are minimum requirement which should be taken and evaluated after TKA surgery, whilst postoperative knee radiographs in skyline view is optional. Knee radiographs should be taken at least once before the patient is discharged from hospital in order to evaluate the limb and component alignments, as well as immediate complication defined by radiographs. Then, knee radiographs should be taken at least once within 1 year after surgery, excluding radiographs taken before hospital discharge, and at least once every 2 year period, especially those patients who are available for follow-up visits for early detection of abnormal radiographic signs.

References

1. Dawson J, Fitzpatrick R, Murray D, Carr A. Questionnaire on the perceptions of patients about total knee replacement. J Bone Joint Surg Br 1998; 80(1): 63-9.
2. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)--development of a self-administered outcome measure. J Orthop Sports Phys Ther 1998; 28(2): 88-96.
3. Gandhi R, Tsvetkov D, Davey JR, Syed KA, Mahomed NN. Relationship between self-reported and performance-based tests in a hip and knee joint replacement population. Clin Rheumatol 2009; 28(3): 253-7.
4. Medalla GA, Moonot P, Peel T, Kalairajah Y, Field RE. Cost-benefit comparison of the Oxford Knee score and the American Knee Society score in measuring outcome of total knee arthroplasty. J Arthroplasty 2009; 24(4): 652-6.
5. Stratford PW, Kennedy DM, Maly MR, Macintyre NJ. Quantifying self-report measures' overestimation of mobility scores postarthroplasty. Phys Ther 2010; 90(9): 1288-96.

6. Mizner RL, Petterson SC, Clements KE, Zeni JA, Jr., Irrgang JJ, Snyder-Mackler L. Measuring functional improvement after total knee arthroplasty requires both performance-based and patient-report assessments: a longitudinal analysis of outcomes. J Arthroplasty 2011; 26(5): 728-37.
7. Stevens-Lapsley JE, Schenkman ML, Dayton MR. Comparison of self-reported knee injury and osteoarthritis outcome score to performance measures in patients after total knee arthroplasty. PM R 2011; 3(6): 541-9; quiz 9.
8. SooHoo NF, Li Z, Chenok KE, Bozic KJ. Responsiveness of patient reported outcome measures in total joint arthroplasty patients. J Arthroplasty 2015; 30(2): 176-91.
9. Naal FD, Impellizzeri FM, Lenze U, Wellauer V, von Eisenhart-Rothe R, Leunig M. Clinical improvement and satisfaction after total joint replacement: a prospective 12-month evaluation on the patients' perspective. Qual Life Res 2015; 24(12): 2917-25.
10. Bolink SA, Grimm B, Heyligers IC. Patient-reported outcome measures versus inertial performance-based outcome measures: A prospective study in patients undergoing primary total knee arthroplasty. Knee 2015; 22(6): 618-23.
11. Harris K, Lim CR, Dawson J, Fitzpatrick R, Beard DJ, Price AJ. The Oxford knee score and its subscales do not exhibit a ceiling or a floor effect in knee arthroplasty patients: an analysis of the National Health Service PROMs data set. Knee Surg Sports Traumatol Arthrosc: official journal of the ESSKA. 2015.
12. Giesinger JM, Hamilton DF, Jost B, Behrend H, Giesinger K. WOMAC, EQ-5D and Knee Society Score Thresholds for Treatment Success After Total Knee Arthroplasty. J Arthroplasty 2015; 30(12): 2154-8.
13. Selecting a Tool for Evaluating Patient-Reported Outcomes. California Joint Replacement Registry 2010.
14. Kuptniratsaikul V, Rattanachaiyanont M. Validation of a modified Thai version of the Western Ontario and McMaster (WOMAC) osteoarthritis index for knee osteoarthritis. Clin Rheumatol 2007; 26(10): 1641-5.
15. Kimman M, Vathesatogkit P, Woodward M, Tai ES, Thumboo J, Yamwong S, et al. Validity of the Thai EQ-5D in an occupational population in Thailand. Qual Life Res 2013; 22(6): 1499-506.
16. Lim LL, Seubsman SA, Sleigh A. Thai SF-36 health survey: tests of data quality, scaling assumptions, reliability and validity in healthy men and women. Health Qual Life Outcomes 2008; 6: 52.
17. Dobson F, Hinman RS, Roos EM, Abbott JH, Stratford P, Davis AM, et al. OARSI recommended performance-based tests to assess physical function in people diagnosed with hip or knee osteoarthritis. Osteoarthritis Cartilage 2013; 21(8): 1042-52.
18. Ha CW, Park YB, Song YS, Kim JH, Park YG. Increased Range of Motion Is Important for Functional Outcome and Satisfaction After Total Knee Arthroplasty in Asian Patients. J Arthroplasty 2016; 31(6): 1199-203.
19. Kalantar JS, Talley NJ. The effects of lottery incentive and length of questionnaire on health survey response rates: a randomized study. J Clin Epidemiol 1999; 52(11): 1117-22.
20. Dunbar MJ, Robertsson O, Ryd L, Lidgren L. Appropriate questionnaires for knee arthroplasty. Results of a survey of 3600 patients from The Swedish Knee Arthroplasty Registry. J Bone Joint Surg Br 2001; 83(3): 339-44.
21. Amarase C, Tanavalee A, Veerasethsiri P, Ngarmukos S. Review Articles: Outcome Measurements Following Total Knee Arthroplasty. Thai J Orthop Surg 2015; 39(2):35-42.
22. Dong CC, Dong SL, He FC. Comparison of Adductor Canal Block and Femoral Nerve Block for Postoperative Pain in Total Knee Arthroplasty: A Systematic Review and Meta-analysis. Medicine (Baltimore) 2016; 95(12): e2983.
23. Boonen B, Schotanus MG, Kerens B, van der Weegen W, Hoekstra HJ, Kort NP. No difference in clinical outcome between patient-matched positioning guides and conventional instrumented total knee arthroplasty two years post-operatively: a multicentre, double-blind, randomised controlled trial. Bone Joint J 2016; 98-B(7): 939-44.
24. Sakellariou VI, Poultsides LA, Ma Y, Bae J, Liu S, Sculco TP. Risk Assessment for Chronic Pain and Patient Satisfaction After Total Knee Arthroplasty. Orthopedics 2016; 39(1): 55-62.
25. Hiyama Y, Wada O, Nakakita S, Mizuno K. Factors Affecting Mobility after Knee Arthroplasty. J Knee Surg 2016.
26. Rowe PJ, Myles CM, Walker C, Nutton R. Knee joint kinematics in gait and other functional activities measured using flexible electrogoniometry: how much knee motion is sufficient for normal daily life? Gait Posture 2000; 12(2): 143-55.

27. Mulholland SJ, Wyss UP. Activities of daily living in non-Western cultures: range of motion requirements for hip and knee joint implants. Int J Rehabil Res 2001; 24(3): 191-8.
28. Lam LO, Swift S, Shakespeare D. Fixed flexion deformity and flexion after knee arthroplasty. What happens in the first 12 months after surgery and can a poor outcome be predicted? Knee 2003; 10(2): 181-5.
29. Harato K, Nagura T, Matsumoto H, Otani T, Toyama Y, Suda Y. Knee flexion contracture will lead to mechanical overload in both limbs: a simulation study using gait analysis. Knee 2008; 15(6): 467-72.
30. Siddiqui MM, Yeo SJ, Sivaiah P, Chia SL, Chin PL, Lo NN. Function and quality of life in patients with recurvatum deformity after primary total knee arthroplasty: a review of our joint registry. J Arthroplasty 2012; 27(6): 1106-10.

Workgroup 5 Diagnosis and Treatment of Complications

Leader

Piya Pinsornsak, MD

Delegates

Chaitawat Ngarmukos, MD, Pruk Chaiyakit, MD, Rapeepat Narkbunnam, MD, Kriskamol Sitthitool, MD, Sunti Rojanavijitkul, MD, Science Metadilogkul, MD

Question 1: After TKA surgery, when is the optimal time for postoperative follow up?
Consensus: The patients need to be followed by orthopedic surgeon at 2-3 weeks, 6-8 weeks, 3-6 months and yearly. If complications are detected (painful knee / stiff knee / infection / VTE), special follow-up can be modified.
Delegate Vote: Agree: Agree: 100 %, Disagree: 0 %, Abstain: 0 % (Unanimous Consensus)
Justification: Postoperative complications after TKA are difficult to diagnose by general practitioner. The consensus of the group agree to follow the patient by orthopedic surgeons. The time period should be at least 2-3 weeks after surgery to see the early complications especially for postoperative pain, wound infection and VTE complications, 6-8 weeks for the range of motion, ambulation, 3-6 months and yearly for the late complications. In case, the patients come to the hospital with complications, orthopedic surgeon should follow the patients closely.

Question 2: Which symptom should be considered as a painful TKA?
Consensus: Patient will be considered of having painful TKA if had the following symptoms

1. VAS pain >6 or
2. Pain does not improve with time or
3. Persistent severe pain requiring strong pain killer or
4. New episode of pain and disability.

Delegate Vote: Agree: Agree: 100 %, Disagree: 0 %, Abstain: 0 % (Unanimous Consensus)
Justification: There is no published agreement of definition of painful total knee. However we believe that the level of pain requiring further work up should be severe pain, which at level of VAS > 6 implied it is severe pain. And generally, the VAS pain scale after early post-operative period should be less than that. And the self-resolvable pain should be subsided with time and not persistent. And if there is a new episode of pain and disability, the systematic work up should be done.

Question 3: Which investigations should be the done in the patient with painful TKA?
Consensus: Early management of painful TKA should include the followings:

1. Knee radiographs investigation
2. CBC, ESR and CRP
3. Knee aspiration and joint fluid analysis

Delegate Vote: Agree: 100 %, Disagree: 0 %, Abstain: 0 % (Unanimous Consensus)
Justification: One most common and disastrous complication of TKA is PJI, which its early symptoms is pain. The earlier the detection of PJI, the better the results we can expect. Therefore the early management in painful TKA should be evaluation of PJI. If PJI is excluded then further investigation for other causes will be considered[1,2].

Question 4: When should the patients be considered having periprosthetic joint infection (PJI)?
Consensus: PJI should be considered if a patient has:

1. Episode of wound drainage or
2. Painful TKA or
3. Clinical symptoms support infection

Delegate Vote: Agree: 100 %, Disagree: 0 %, Abstain: 0 % (Unanimous Consensus)
Justification: PJI is devastating complication after total knee arthroplasty[3]. The incidence of PJI after knee arthroplasty is 0.5 to 1%[4,5]. However the diagnosis of PJI after knee arthroplasty is difficult. Therefore, the Musculoskeletal Infection Society (MSIS) developed a new definition for PJI for increasing the accuracy of diagnosis[6]. The new criteria is

1. There is a sinus tract communicating with the prosthesis; or
2. A pathogen is isolated by culture from at least two separate tissue or fluid samples obtained from the affected prosthetic joint; or
3. Three of the following five criteria exist:

3.1 Elevated serum erythrocyte sedimentation rate (ESR) and serum C-reactive protein (CRP)
concentration (ESR>30 mm/hour; CRP>10 mg/L)
3.2 Elevated synovial leukocyte count (>3000 cells/lL) or ++ leukocyte esterase strip test
3.3 Elevated synovial neutrophil percentage (PMN> 65%),
3.4 Isolation of a microorganism in one culture of periprosthetic tissue or fluid, or
3.5 Greater than five neutrophils per high-power field in five high-power fields observed from histologic analysis of periprosthetic tissue at ×400 magnification.

The consensus group suggested to recognize the early signs and symptoms in every patients after TKA surgery. Individual's patients who suspected of having PJI after knee arthroplasty should be assessed using a MSIS criteria.

Question 5: Which investigation should be considered in the patient whom PJI is suspected?
Consensus: Suspected PJI patient should undergo the following investigations:
1. Radiographic studies
2. CBC, ESR, CRP
3. Joint aspiration for cell count /cell differentiation / culture & sensitivity

Delegate Vote: Agree: 100 %, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: The Musculoskeletal Infection Society (MSIS) criteria for diagnosis of PJI help surgeons to identify the patient who was suspected having infection after knee arthroplasty[7]. The investigations such as CBC, ESR, CRP, Joint aspiration for cell count, cell differentiation, and culture should be done for every patients[8-11].

Question 6. When should the patient be considered of having stiff knee after TKA?
Consensus: A patient should be considered of having stiff knee if he had less than 90 degrees of flexion after 6-8 weeks
Delegate Vote: Agree: 100 %, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Because the range of motion needed for each activity of daily living is different. Going up stair needs 83 degrees of flexion, down stair needs 90-100 degrees, and changing position from sit to stand needs 93 degrees[12]. Generally accepted "90 degree of flexion" is the minimal requirement for daily activity. The goal of flexion after TKA also aims for 90 degrees[13]. Early treatment of stiff knee after TKA is manipulation under anesthesia (MUA) which is should to be done within 3 months after operation. Reported of complications, such as patellar tendon rupture, quadriceps rupture, supracondylar fracture, and hemathrosis found more in late MUA. The earlier MUA found achieving better knee flexion but no recommended exact time of MUA in stiff knee[14-16]. Surgeons usually follow postoperative clinical outcome at 2 weeks, 6 weeks, 3-6 month after TK, and later on. It seems to be too late to detect and to make decision for MUA stiff knee from 3 months after operation. Although some surgeons preferred manipulation between 6-12 weeks, the consensus group decided using 6-8 weeks after TKA for early detection and MUA[16,17].

Question 7: When should the patient be suspected of deep vein thrombosis (DVT)?
Consensus: DVT should be suspected if a patient has the following conditions:
1. Entire leg swelling or
2. Calf swelling > 3 cm compared to asymptomatic calf (10 cm below tibial tuberosity) or
3. Unilateral pitting edema in symptomatic leg

Delegate Vote: Agree: 100 %, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Venous thromboembolism (VTE) has been identified as one of a threaten complication to patients undergoing TKA. The incidence of asymptomatic deep vein thrombosis (DVT) has been estimated to be 30 %–80 % of inpatients undergoing TKA, however the incidence of symptomatic DVT is less common, ranging from 0.5 to 4 %[18,19]. The consensus group recommended to identify the early warning signs and symptoms, as mentioned above, in every suspected patient after TKA surgery. Patients who are suspected of having DVT should be assessed using a clinical prediction rule such as the Well's score[20,21]. In high score patients, investigations including D-dimer test, ultrasound or venography are required for diagnosis.

References

1. Djahani O, Rainer S, Pietsch M, Hofmann S. Systematic analysis of painful total knee prosthesis, a diagnostic algorithm. Arch Bone Jt Surg 2013; 1(2): 48-52.
2. Mandalia V, Eyres K, Schranz P, Toms AD. Evaluation of patients with a painful total knee replacement. J Bone Joint Surg Br 2008; 90(3): 265-71.
3. Bozic KJ, Kurtz SM, Lau E, Ong K, Chiu V, Vail TP, et al. The epidemiology of revision total knee arthroplasty in the United States. Clin Orthop Relat Res 2010; 468(1): 45–51.
4. Phillips JE, Crane TP, Noy M, Elliott TS, Grimer RJ. The incidence of deep prosthetic infections in a specialist orthopaedic hospital: A 15-year prospective survey. J Bone Joint Surg Br 2006; 88(7): 943–8.

5. Pulido L, Ghanem E, Joshi A, Purtill JJ, Parvizi J. Periprosthetic joint infection: The incidence, timing, and predisposing factors. Clin Orthop Relat Res 2008; 466(7): 1710–5.
6. Parvizi J, Gehrke T; International Consensus Group on Periprosthetic Joint Infection. Definition of periprosthetic joint infection. J Arthroplasty 2014; 29(7): 1331.
7. Parvizi J, Zmistowski B, Berbari EF, Bauer TW, Springer BD, Della Valle CJ, et al. New definition for periprosthetic joint infection: From the Workgroup of the Musculoskeletal Infection Society. Clin Orthop Relat Res 2011; 469(11): 2992–4.
8. Della Valle CJ, Sporer SM, Jacobs JJ, Berger RA, Rosenberg AG, Paprosky WG. Preoperative testing for sepsis before revision total knee arthroplasty. J Arthroplasty 2007; 22(6 Suppl 2): 90–3.
9. Ghanem E, Parvizi J, Burnett RS, Sharkey PF, Keshavarzi N, Aggarwal A, et al. Cell count and differential of aspirated fluid in the diagnosis of infection at the site of total knee arthroplasty. J Bone Joint Surg Am 2008; 90(8): 1637–43.
10. Larsson S, Thelander U, Friberg S. C-reactive protein (CRP) levels after elective orthopedic surgery. Clin Orthop Relat Res 1992; (275): 237–42.
11. Parvizi J, Jacovides C, Antoci V Jr, Ghanem E. Diagnosis of periprosthetic joint infection: the utility of a simple yet unappreciated enzyme. J Bone Joint Surg Am 2011; 93(24): 2242-8.
12. Laubenthal KN, Smidt GL, Kettelkamp DB: A quantitative analysis of knee motion during activities of daily living. Phys Ther 1972; 52(1): 34-43.
13. Maloney WJ. The stiff total knee arthroplasty: evaluation and management. J Arthroplasty 2002; 17(4 suppl 1): 71–3.
14. Daluga D, Lombardi AV Jr, Mallory TH, Vaughn BK. Knee manipulation following total knee arthroplasty: analysis of prognostic variables. J Arthroplasty 1991; 6(2): 119–28.
15. Esler CN, Lock K, Harper WM, Gregg PJ. Manipulation of total knee replacements: is the flexion gained retained? J Bone Joint Surg Br 1999; 81(1): 27–9.
16. Yercan HS, Sugun TS, Bussiere C, Ait Si Selmi T, Davies A,Neyret P. Stiffness after total knee arthroplasty: prevalence, management and outcomes. Knee 2006; 13(2): 111–7.
17. Schuderi GR. The Stiff Total Knee Arthroplasty. Causality and Solution. J Arthroplasty 2005; 20(4): 23-6.
18. Geerts WH, Bergqvist D, Pineo GF, Heit JA, Samama CM, Lassen MR, et al. Prevention of venous thromboembolism: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). Chest 2008; 133(6 Suppl): 381S-453S.
19. Januel JM, Chen G, Ruffieux C, Quan H, Douketis JD, Crowther MA, et al. Symptomatic in-hospital deep vein thrombosis and pulmonary embolism following hip and knee arthroplasty among patients receiving recommended prophylaxis: a systematic review. JAMA 2012; 307(3): 294-303.
20. Geersing GJ, Zuithoff NP, Kearon C, Anderson DR, Ten Cate-Hoek AJ, Elf JL, et al. Exclusion of deep vein thrombosis using the Wells rule in clinically important subgroups: individual patient data meta-analysis. BMJ 2014; 348: g1340.
21. Bates SM, Jaeschke R, Stevens SM, Goodacre S, Wells PS, Stevenson MD, et al. Diagnosis of DVT: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012; 141(2 Suppl): e351S-418S.

Workgroup 6 Thai Joint Registry

Leader

Viroj Larbpaiboonpong, MD

Delegates

Thana Turajane, MD, Ukrit Chaweewannakorn, MD, Polawat Witoolkollachit, MD,

Rawee Sirithammawat, MD, Science Metadilogkul, MD, Worapoj Honglerspipop, MD,

Suphachet Chiranavanit, MD

Question 1: What are the benefits of Joint Registry in Thailand?
Consensus: Joint Registry in Thailand can improve quality of patient's life, better health care service and better patient safety and outcomes.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Joint registryprovides three main values that benefit directly to the patients as the followings[1]:

1. Reduce complications and revision rates by monitoring some errors from implant designs that cause the significant complications.
2. Monitor functional efficacy in each design of prostheses available in Thailand. Medical professionals can provide the right and beneficial information to the patients. In worst case scenario, it may lead to recall any prostheses that cause the significant problems[2].
3. Improve standard care of patients who undergo knee arthroplasty surgery.

One indirect benefit of joint registry is knowledge & education. Joint registry can help surgeons to predict the trend of surgery and lead to the future study about many aspects on outcome of various types of surgery.

Question 2: How should registry data be recorded in order to accomplish a successful Joint Registry in Thailand?
Consensus: Both decent number of questions, which the in charging medical personnel are comfortable to record, and the record data must be enough for data analysis are the key success factor for joint registry in Thailand.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Since data collection of each patient in joint registry need to be recorded in detail, it can increase workload to orthopedic surgeon or involved medical personnel. This increasing workload may cause them decline to proceed on data recoding. To implement the joint registry become successful task force nationwide, the recorded data should be simplified and could be registered in several ways.

The averaged data recording time per patient should not exceed 5 minutes, and does not disturb the routine practice of the surgeon. In fact, the work load compensation for involved personnel, as the recorder, may be applied to increase the level of participation. However, the most important thing is to encourage the surgeon to realize how important of joint registry. Not only improvement of patient's care in institutional and national level will be gained from the joint registry, but also statistical data & related researches enhancing orthopedic publications will be the results in the future.

Question 3: How should the Thai Joint Registry be funded?
Consensus: The budget for the operation of the Thai Joint Registry can be funded by any sources; however, the budget provider must has nothing related to any conflicts of interest.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: According to the standard confidential data managing, all information collected regarding joint registry must be stored securely in a safe data storage system, whilst the data pulling system should be practical and effective by only authorized personnel. Therefore, a continuous budget for maintaining proper data storage and management such software, security and maintaining system, is necessary. In case of improper data security, it may facilitate any sponsors who may have conflict of interest on using registry data to provide their benefits.

In order to avoid any conflicts of interest, the sources of grant should be from those public organizations in-charging the reimbursement of national health care system. However, the grants may be supported from any sources, such as private

sector (orthopedic industries) without any influential to the joint registry organization, as the third party, to run the activities[3].

Question 4: For data collection in the Thai Joint Registry, is the patient's consent necessary?
Consensus: It is necessary to have the patient's consent for data collection and usage in the Thai Joint Registry.
Delegate Vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: While the aim of the joint registry is to collect a certain medical information of patients into the national database for monitoring the use of knee implants inserted into patients, and analyzing the recorded data every year, the patient's rights is the top priority of joint registry. Therefore, it is necessary to have the patient's consent for data collection and usage in the Thai Joint Registry [3].

Form of consent should be designed by the working group of joint registry committee, in order to be the same pattern for nationwide usage. Individual patient should be informed that all of his (her) information will be the best confidential. The sensitive information such as patient's name, identification number (ID) will not be disclosed. It is necessary to reassure patients that the joint registry is mainly to analyze the pool data of certain surgeries in order to improve patient's outcomes. The patient's permission to provide the information will not affect the treatment or surgery or implants, as well as any specific risks related to the permission.

Question 5: Which scoring system is the most suitable for data collection in the registry, in terms of preoperative clinical assessment and postoperative clinical result of the knee at follow up?
Consensus : KOOS-JR system is the most suitable for the Thai Joint Registry
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: According to the joint registry in countries worldwide, there are several parameters and scoring systems. There are both advantages and disadvantages in each system. Proper scoring system should be used are:

1. Direct answer from the patients without surgeon's influence
2. Selected scoring system should not be a copyright
3. Few questions and effective for evaluation
4. Available in Thai version

Following these principles, the KOOS-JR system is most suitable for postoperative patient evaluation. All parts of this system require answers directly from the patients with no copyright, only 7 questions, and available in Thai version.

Question 6: Which patient demographic data are necessary for recording and reporting in Thai joint Registry?
Consensus: Patient's name and last name, date of birth, body weight, height, ID number, gender and co-morbidity are necessary for recording and reporting in Thai joint Registry
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: The benefits of joint registry is to find the results of the certain surgeries nationwide. The important information should provide a link between the patient and the type of prostheses inserted into the patient. Therefore, the patient's basic demographic data, including name, age, date of birth, and ID number, should be included. Since the revision TKA may not be operated by the same institution which the patient had at the primary TKA, the ID number is important data for tracking.

The other basic information that should be recorded in the view the experts are weight, height, sex and underlying disease. Because studies showed these factors could affect the long-term outcome of TKA surgery.

Question 7: Which preoperative physical examinations are necessary for recording and reporting in Thai joint Registry?
Consensus: Coronal alignment and sagittal ROM are needed in Thai Joint Registry.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: At physical examination before surgery in patients with knee osteoarthritis, the angular deformity and range of motion of the knees are mandatory. Both factors affect the decision for TKA, as well as the result of surgery. So, the experts' opinion recommended that both physical examination data are necessary to collected in the joint registry.

Question 8: Which patient general health assessment is necessary for recording and reporting in Thai joint Registry?
Consensus: American Society of Anesthesia (ASA) Score for Physical Health classification system is necessary for recording and reporting in Thai joint Registry.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: There are several systems to assess the general health of the patient who undergo TKA surgery such as PROMIS 10, EQ5D, ASA. However, the most popular and easy system for evaluation is ASA Physical Health Classification. Currently, the ASA is the standard evaluation system before surgery in most hospitals in Thailand. It classifies the patient into 5 level which is easily to understand. Therefore, we recommended to use the ASA score for patient's

general health assessment due to simple and practical.

Question 9: Should the level of hospital service be recorded and reported in the Thai Joint Registry?
Consensus: We classify the hospital into primary, secondary, tertiary or superior tertiary care which should be recorded and reported in the Thai Joint Registry.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: The level of hospital in Thailand are classified according to size and potentiality including primary, secondary and tertiary hospitals. The experts agreed that surgeries performed at hospital with different levels may affect patient's outcomes including the short-term result, long-term result and complication rate. So, hospital level should be recorded and reported[4].

Question 10: Do we need to record and report the surgeon experience data?
Consensus: Surgeon experience is not necessary in recorded data, because it can be retrieved from previous data record.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: According to joint registry in other countries, surgical experience directly affected the outcome of surgery[4]. The outcome was better in the hand of surgeons who have more surgical cases per year than who have less cases. The number of surgical cases per year of a surgeon can be calculated according to the record automatically. The first one to two years is the period of data collection that the registry cannot report the result. However, from the third year onwards, analytic information will be reported. The experts agreed that there is no need to clarify surgeon's experience in surgery, except in the first phase of the Thai Joint Registry.

Question 11: Which intraoperative information data are needed to be recorded and reported in primary TKA?
Consensus: Recoded data consist of type of arthroplasty (TKA or UKA), date of surgery, laterality, implants, navigations, augmentation, stem usage, intraoperative incidences, surgical approaches, surgical techniques, operative time, tourniquet time, patellar resurfacing, and DVT prophylaxis.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: From the national joint registry in several countries, data were analyzed and were provided in a variety of benefits, in terms of the factors that affect treatment outcomes and complications. Most of experts agreed that intraoperative information is important and necessary to be recorded in Thai Joint Registry. It is also useful for research and analysis for the results of treatment in the future.

Question 12: Which intraoperative information data are needed to be recorded and reported in revision TKA?
Consensus: Recoded data consist of type of previous surgery, date of revision, date of previous surgery, diagnosis (ICD10), implants, navigations, augmentation, stem, intraoperative incidences, surgical approaches, surgical technique, patellar resurfacing, anesthetic types, operative time, tourniquet time, history of patellar resurfacing after primary TKA, and DVT prophylaxis.
Delegate vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Revision TKA data that are necessary are similar to those in primary TKA. However, there are some which are needed more than primary TKA such type of surgery, and date of previous surgery. Although, there may be no available data in the database in the first phase of the Thai Joint Registry, these information will be useful for evaluation of the longevity of each kind of implant in the future.

References

1. Von Knoch F, Malchau H. Why do we need a national joint replacement registry in the United States? Am J Orthop (Belle Mead NJ) 2009; 38(10): 500-3.
2. Herberts P, Malchau H. How outcome studies have changed total hip arthroplasty practices in Sweden. Clin Orthop Relat Res 1997; (344): 44-60.
3. Von Knoch F, Marchie A, Malchau H. Total Joint Registries: A foundation for evidence-based arthroplasty. The virtual mentor : VM 2010; 12(2): 124-9.
4. Katz JN, Losina E, Barrett J, Phillips CB, Mahomed NN, Lew RA, et al. Association between hospital and surgeon procedure volume and outcomes of total hip replacement in the United States medicare population. J Bone Joint Surg Am 2001; 83-A(11): 1622-9.

Workgroup 7 Knee Prosthesis Consideration

Leader

Satit Thiengwittayaporn, M.D.

Delegates

Artit Laoruengthana, M.D., Piti Rattanaprichavej, M.D.,Thana Narinsorasak, M.D., Natthapong Hongku, M.D., Somsak Ruchichananthakun, MD., Worapol Jumroonwong, MD.

Session 1: Cemented and Cementless TKA

Question 1: What is the role of cementless fixation in primary total knee arthroplasty (TKA)?
Consensus: Recent studies have shown no sufficient evidence to demonstrate the superiority of cementless fixation to cemented fixation in TKA in terms of survivorship and clinical outcome. Considering the current design and cost involved with the cementless fixation in TKA, it may be considered as an optional for young and good bone quality patients.
Delegate Vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Although the cement fixation in TKA is the most acceptable with the long-term survival rate in most studies, there is a problem of osteolysis at bone-cement interfaces leading to aseptic loosening, particularly in the young patients. Cementless fixation was reported to be able to avoid this problem [1-3] .The cementless TKA is an option for young patients with adequate bone stock. Concepts of the cementless TKA are to provide biological fixation with osteo-conductive prosthetic surfaces and improve the longevity of prosthesis, particularly in younger patients [4]. Many recent studies have reported survival rates of 99% and 97% for cemented and cementless TKA, respectively [4-7]. From the limited number of studies available, the cementless TKA has shown some advantages in term of survival rate and clinical outcomes over the cemented TKA.

In contrast, Meta-analysis from Mahomed et al has not shown a clear superiority of cementless over cemented TKA, in terms of survival rates and clinical outcomes [7].Khaw et al reported a randomized controlled study comparing survival rates between cemented and cementless TKAs (95.3% for cemented TKAs versus 95.6% for cementless TKAs) in 501 implants of the same design [8].

Park et al conducted a study of 50 patients undergoing a simultaneous bilateral knee replacement with implants of the same design, which were cemented on one side and cementless on the contralateral side. The survival rate of the femoral components was 100% for both implants, while the tibial component showed a survival rate of 100% for the cemented TKAs, and 98% for the cementless TKAs but no significant differences in clinical results were found [9].

Cementless TKA can be used in a young patient (under 65 years old) with a good bone quality but the cost of this fixation may be up to 3 times more than that of cemented TKA. Finally, the decision of prosthetic selection should depend on a surgeon to weigh advantages and disadvantages with patients and their family.

Session 2: PS and CR design

Question 2: When should the posterior-stabilized (PS) total knee system be considered?
Consensus: Regarding primary TKA, the posterior-stabilized design could be used in almost all patients.
Delegate Vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Both posterior-stabilizes (PS) and posterior cruciate-retaining (CR) TKA have shown survival rates > 90% at follow-up time of 10 to 20 years [10-14]. Many studies comparing PS with CR design have reported differences [15-17] and no differences [18-21] in clinical outcomes. However, PS TKA remains as a popular design for all age groups of osteoarthritis knee patients [22-25]. With PS TKA, the studies have shown a better range of motion (ROM) [17], easier ligament balance, and more reliable femoral rollback [16,26]. We believed that PS designs require less technical experience, created more stable component interface, increased knee flexion and could be used in all primary TKA [27-31].

Question 3: When should the posterior cruciate-retaining (CR) total knee system be avoided?
Consensus: The posterior cruciate-retaining (CR) design total knee arthroplasty should be avoided in

severe knee deformity, poor soft tissue balance, excessive bone loss, impaired PCL function and when surgery performed by less experienced surgeons.

Delegate Vote: Agree: 71.4% Disagree: 0%, Abstain: 28.6% (Strong Consensus)

Justification: Theoretically, the posterior cruciate-retaining (CR) TKA provided advantages in term of the better clinical outcomes: increased post-operative knee proprioception, normal knee kinematic [18,32]. In addition, CR design allowed preservation of bone stock from avoiding the cutting of femoral bone, creating of femoral rollback on the tibia during knee flexion and greater stabilization of the prosthesis with the preventing anterior translation of the femur on the tibia from PCL function [28-31].

Several important factors for successful CR TKA were PCL balancing and how to assess PCL function. In severe deformity knee, some surgeons concerned about the function of PCL and many surgeons felt that the PCL balancing was too difficult that PCL cannot be preserved. For this type of patient, we required a step-wise PCL release which may damage of the PCL during operation. These issues led most surgeons to avoid CR TKA in severe deformity knee and chose the PS design instead [33-35]. In case of poor soft tissue balance or PCL dysfunction, CR TKA may create the instability after TKA, especially flexion instability that presented with painful knee, recurrent knee effusion, and difficulty stair climbing [34,36,37]. Adjustment of PCL tension can be achieved with an accurate measured resection technique which the resected bone of femur and tibia is exactly replaced with prosthesis material. The distances between ligament insertions must be kept constant, and the ligament tensions should remain the same before and after operation. For a less experienced surgeon, the correct bone cut might be challenging.

Session 3: Fixed and Mobile bearing TKA

Question 4: When should the mobile-bearing total knee system be considered?

Consensus: The theoretical advantages of mobile bearing total knee system include more coronal and sagittal conformity, lower contact stress and lower backside wear. However, the recent meta-analysis comparing fixed-bearing and mobile-bearing total knee system have found no significant differences in prosthesis longevity or functional outcome. Choice of prosthesis should be therefore made on the basis of other factors, including cost and surgeon's experience.

Delegate Vote: Agree: 100% Disagree: 0%, Abstain: 0% (Unanimous Consensus)

Justification: Based on many previous studies, good functional outcomes, long term survival rate over 90 % at a minimum 10-year follow-up following the use of fixed-bearing TKA [13,38,39] were reported. However, some studies of fixed-bearing TKA have reported high wear rate patterns including delamination, pitting and scratching of the polyethylene insert [40,41]. To correct these problems, mobile-bearing TKA was introduced as an alternative to the original fixed-bearing TKA [42]. The aim of mobile-bearing TKA is to decrease the contact stresses and wear [43,44]. Mobile-bearing TKA allows the movement of polyethylene insert relative to the tibial tray and this motion has been shown to decrease in wear rate and subsequently reduce polyethylene-induced osteolysis [45]. But this concept of mobile-bearing TKA is theoretical as clinical and functional outcomes between the fixed and mobile-bearing TKA remain unclear.

A published RCT in 2009 compared early clinical and functional results of a fixed-bearing TKA and rotating platform (RP) TKA. Outcomes including range of motion (ROM), Knee Society Score (KSS), Western Ontario MacMaster (WOMAC) and Short Form-36 (SF-36) were measured preoperatively and at 6 weeks, 3 months, 6 months, 1 year, and 2 years. No significant differences were shown in the ROM, KSS, WOMAC and SF-36 at any period. No clinically significant differences were noted in the radiographic analysis. They concluded that the use of a fixed-bearing or RP TKA did not affect the early functional outcomes [46].

Kwang Jun Oh et al. conducted a meta-analysis in 2009 comparing the advantages of mobile-bearing with those of fixed-bearing TKA, and founded no significant difference in the KSS, Pain Scores, ROM, occurrence of radiolucent lines, prosthesis-related complications, and participant preference. The results suggest that the mobile-bearing does not offer clinical or radiologic advantage over the fixed-bearing TKA [47].

A prospective randomized trial in 2011 reported a minimum 10-year clinical and radiologic follow-up of 89 patients (107 knees) who were randomized to have one of these different designs for TKA. Twenty-six patients (30 knees) who had fixed-bearing and 24 patients (33 knees) who had mobile-bearing TKA were available for follow-up. They founded that two mobile-bearing TKA were revised for aseptic loosening at tibial component in one and femoral component fracture in the other. In patients who did not have revision surgery, there were no differences between the groups with respect to mean KSS, knee flexion, or pain scores [48].

A meta-analysis study in 2011 reviewed 14 studies reporting primary outcome of KSS, post-operative ROM and Hospital for Special Surgery scores (HSS). This meta-analysis demonstrated no difference between fixed-bearing and mobile-bearing TKA in all aspects. They concluded that

mobile-bearing TKA did not offer any superiority to fixed-bearing TKA so far, and suggested more randomized trials with a larger sample size and longer follow-up were needed to evaluate these two designs of prosthesis [49].

In 2013, a meta-analysis identified 29 papers reporting survivorship and clinical and function KSS of 6437 TKAs using the Low Contact Stress (LCS) Rotating Platform (RP) mobile bearing TKA by comparing the survivorship of the LCS RP TKA to that of the Swedish Knee Registry at 10-year follow-up. It reported very high survivorship up to 20 years with a very low incidence of wear-related revision in the second decade. Survivorship of LCS RP knees up to 14 years was higher than that of all knees in the Swedish Knee Registry [50].

Data from another meta-analysis showed that in 1614 knees performed in 807 patients from 12 RCTs, the 2- to 5-year follow-up demonstrated that no statistical difference was found between mobile-bearing and fixed-bearing TKA in terms of America Knee Society score (WMD:−1.29, 95% CI:−5.65 to 3.06), pain score (WMD:−3.26, 95% CI:−10.45 to 3.93), ROM (WMD:−4.16, 95% CI:−9.97 to 1.66), reoperation (RR: 1.00, 95% CI: 0.28 to 3.60), and radiolucent lines (RR: 1.51, 95% CI: 0.70 to 3.24). The results were similar at 1-, 5- to 8-, or > 8-year follow-up. Patient's satisfaction (RR: 0.85, 95% CI: 0.54 to 1.34), and complication (≤2-year, RR: 0.55, 95% CI: 0.29 to 1.04; >2-year, RR: 1.0, 95% CI = 0.73 to 1.38) also showed no difference between two groups. So based on this meta-analysis, the superiority of mobile-bearing to fixed-bearing TKA was not detected. More randomized trials with a larger sample size and longer follow-up are needed to evaluate these two types of prosthesis [51].

An article in April 2016 reviewed the literature comparing fixed-bearing and mobile-bearing TKA in biomechanical and clinical aspects, including observational studies, clinical trials, national and international registries analyses, randomized controlled trials, meta-analyses and Cochrane reviews. It found that none of the published studies has reported any significant improvement in term of patient satisfaction, clinical, functional and radiological outcome or medium and long-term survivorship from using mobile-bearing in TKA. The choice of prosthetic selection should be based on other factors, including cost and surgeon experience [52].

Session 4: Single and Multi-radius design

Question 5: Are there any differences between single-radius and multi-radius designed total knee systems regarding to the clinical outcomes?
Consensus: Both single-radius and multi-radius designed knee prostheses were found to improve knee function and patients' quality of life in short-term and midterm follow-up. There are no differences in clinical outcomes: analyses of function range of motion, complications, patient satisfaction and survival rate. The sagittal radius of femoral component should not be considered as a main factor when choosing prosthesis for total knee arthroplasty.
Delegate Vote: Agree: 85.7%, Disagree: 0%, Abstain: 14.3% (Strong Consensus)
Justification: The differences of prosthetic design in TKA have been deemed to affect the clinical results after TKA. Classical multi-radius (MR) design TKA allows multiple knee centers of rotation, which moves in a J-curve pattern [53]. In contrast, single-radius (SR) design TKA was deemed to allow a constant knee center of rotation, which might result in a more stable on fixed femoral axis, closed to the transepicondylar axis and create the tightening of both medial and lateral collateral ligament along knee flexion than in the MR design [54]. The theoretical advantages in knee kinematics of the SR designs are a better recovery of the extensor mechanism, a decrease in patellar load, and better ligament stability [55-58]. However, results from recent studies remain controversial in term of the clinical outcomes of the SR and MR femoral designs [59-61]. A previous meta-analysis did not provide clinical support for the theoretical advantages of the SR implant design [62]. Finally, many studies have considered that both SR and MR femoral designs in TKA can significantly reduce pain, improve knee joint function, patients' quality of life, same range of motion, patient satisfaction if used with a proper technique [63,64]. In conclusion, the sagittal radius of the femoral component should not be considered as the main factor when choosing the design of TKA.

Session 5: High-flexion designed TKA

Question 6A: What are the differences between high-flexion designed and conventional designed in primary TKA?
Consensus: There are no significant differences between high-flexion designed primary TKA and conventional designed TKA, in terms of range of motion (ROM), clinical outcomes and patient satisfaction.
Delegate Vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)

Question 6B: When should the high-flexion design be considered in primary TKA?
Consensus: There is no conclusive recommendation for the indication to use high-flexion design in primary TKA.
Delegate Vote: Agree: 85.7%, Disagree: 0%, Abstain: 14.3% (Strong Consensus)

Justification: Range of flexion of the knee is an important indicator of postoperative functional outcome, especially in Asian patients. A theoretical advantages of high-flexion (HF) implants over conventional implants is to increase in knee flexion and improve clinical outcomes by an additional 2-mm bone cut from posterior femoral condyle, modification of tibial insert component [65].

Recent meta-analysis has demonstrated that HF implants improve postoperative ROM and functional outcome, but there were no significant differences in term of ROM, KSS score, HSS score, WOMAC, SF-36, patients satisfaction, survival rate and complication when compared to conventional implants [66-70]. Even in subgroup analysis comparing between HF-cruciate retaining (CR) implant vs standard CR implant and HF-posterior stabilization (PS) implant vs standard PS implant showed no superiority outcome of HF implant over standard implant [66,67,71,72].

Meanwhile, some studies showed that HF implants gain about 0.4- 2^{O} of significant difference in ROM when compared to conventional implants [65,73]. However, the difference is very small and might not have any clinical advantage.

Session 6: Gender-specific designed TKA

Question 7: When should a gender-specific (GS) implant be considered?
Consensus: A gender-specific implant did not confer any benefit in functional outcome or patient satisfaction when compared to a conventional implant except for lower overhang rate in gender-specific TKA. There was no obvious superiority with use of gender-specific implant.
Delegate Vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Nowadays, the difference in anatomy of knee between men and women has been well defined. Women tend to have narrower medial to lateral dimension of femoral condyle for any given anterior to posterior dimension, greater Q angle, less pronounce of anterior femoral condyle [74,75]. However, most of the conventional prostheses used in TKA are designed according to aspect of male femoral condyle. Thus, conventional prostheses in women tend to be oversized which may cause overstuff of patellofemoral compartment, overhang of knee capsule and lead to reduction of ROM and functional outcome [76]. Theoretically, GS prosthesis has been developed to solve these problems.

Although GS prosthesis has significantly reduced overhang rate of femoral component and increased in a perfect fit rate of femoral component, there were no clinical significances [76,77]. The evidence from current literature did not show any clinical benefits of GS prosthesis over conventional prosthesis in term of KSS score, HSS score, WOMAC, postoperative pain, ROM, complication and patients satisfaction[76,78-80].

Session 7: Patellar resurfacing in TKA

Question 8: Are there any differences between patellar resurfacing and non-resurfacing in TKA surgery?
Consensus: No significant differences were found between patellar resurfacing and non-resurfacing in term of anterior knee pain rate, knee pain score, knee society score and knee functional score. Selectively resurface should base on the presence of anterior knee pain, notably damaged articular cartilage, inflammatory arthritis, isolated PF arthritis and patellar subluxation/maltracking.
Delegate Vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)
Justification: Whether to resurface the patellar during primary TKA remains controversial. Even though some surgeons selectively resurface the patellar based on the presence of significant cartilage damage, inflammatory arthritis, isolated patellofemoral arthritis, persistent anterior knee pain and patellar subluxation or maltracking, others routinely resurface to avoid the increased rate of postoperative anterior knee pain and reoperation for secondary resurfacing [81,82].

It has been believed that the risk of anterior knee pain and reoperation rate in nonresurfaced patient are higher, but it is not clear whether these problems would be resolved with secondary resurfacing. The available evidence revealed that patellar resurfacing may reduce the risk of reoperation by 4% when compared to nonresurfaced group [83,84] and 20-65% of secondary resurfaced patients were dissatisfied with this procedure [85,86]. Meanwhile, the anterior knee pain rate, knee pain score, knee society score and knee functional score were not different between the groups [81,83,84,87]. Patellar denervation without patellar resurfacing may be an alternative option to reduce postop anterior knee pain after TKA [88].

Session 8: Alternative bearing in TKA

Question 9: What are the roles of highly cross-linked polyethylene (XLPE) in primary TKA?
Consensus: No significant difference was found between conventional PE and XLPE in primary TKA in terms of total number of reoperation, reoperation due to prosthesis loosening, osteolysis, mechanical failure related to tibial PE and post-operative KSS score.
Delegate Vote: Agree: 85.7%, Disagree: 0%, Abstain: 14.3% (Strong Consensus)
Justification: Polyethylene wear, osteolysis and prosthesis loosening are major complications affecting the longevity of TKA. Particularly, younger and more active patients can experience

early onset of polyethylene wear associated with prosthesis loosening. Therefore, in an attempt to improve the survivorship of TKA, the 10-year results of XLPE in THA have led to its use in TKA.

However, the cross-linking process of polyethylene to enhance wear property had a negative effect of reducing the mechanical properties of XLPE, which can lead to fatigue failure. Other concern is that wear mechanism in the knee is difference from the hip [89].

Current literatures only reported midterm clinical outcomes of XLPE in TKA. These available data support comparative safety of XLPE to conventional PE related to reoperation rate, prosthesis loosening, mechanical failure of tibial PE and osteolysis [90-92], but no clinical difference in term of postoperative Knee Society Score and Knee functional score [89,93]. A large, well designed and long-term follow-up study will be necessary to further clarify the effect of XLPE in TKA.

Session 9: Other design in TKA

Question 10: What are the roles of oxidized zirconium implant surface in primary TKA?
Consensus: TKA with an oxidized zirconium femoral component gives comparable long-term rates of survival and functional outcomes with conventional implants. Low-wear articulations may be considered cost-effective, although the cost effectiveness is age-dependent, with the cost per quality being significantly lower for younger people than for older people. Special surface prosthesis has a role in metal allergy patients.
Delegate Vote: Agree: 85.7%, Disagree: 0%, Abstain: 14.3% (Strong Consensus)
Justification: Polyethylene (PE) wear leading to osteolysis and aseptic loosening of prosthesis remains as concerning complications that may jeopardize long-term outcomes of TKA, particular in young and active patients. In an attempt to reduce PE wear, secondary osteolysis, and improve survivorship of TKA, a pursuit of an alternative bearing has emerged. Oxidized zirconium was introduced as an alternative bearing for femoral component in TKA because of it "theoretical" superiority to conventional cobalt chromium (CoCr).

Zirconia, the oxide of zirconium, is a commonly utilized ceramic material. Concerns on potential *in vivo* breakage have prohibited its use in the field of TKA. However, oxidized zirconium has been developed as a metal-ceramic hybrid material. Unlike pure zirconia, oxidized zirconium composed of a solid metallic zirconium core with just the surface layer transformed to a zirconia ceramic.

Oxidized zirconium has been proven in *in vitro* and retrieval studies to have better wear properties than cobalt chromium and less surface damage on PE [94,95]. Furthermore, OxZr femoral component has no nickel particles, making this material safe and sound in patients with metal allergy [96-98]. However, the result from midterm studies demonstrated the comparable outcome, safety and longevity to CoCr[95,99,100], and an *in vivo* study also reported no difference in PE wear particle between OxZr and CoCr [101]. Recently, long-term studies reported that the 10-year survivorship of OxZr TKA were 97%[97,102]. These studies could not demonstrate the "theoretical" advantage of OxZr over CoCr.

Session 10: Fixed and Mobile bearing UKA

Question 11: Are there any different outcomes between fixed-bearing UKA design and mobile bearing UKA design?
Consensus: No significant different clinical outcome was demonstrated when comparing fixed-bearing and mobile bearing UKA designs. The surgeons should select UKA design based on surgeon experience.
Delegate Vote: Agree: 71.4%, Disagree: 0%, Abstain: 28.6% (Strong Consensus)
Justification: Extensively literatures and meta-analyses have compared the results between fixed-bearing and mobile bearing UKA by including short to long terms of follow-up studies. There is no significant difference in term of pain score, WOMAC score, SF-36, Oxford knee score, American Knee society knee and functional scores, range of motion and survivorship of the prosthesis [103,104]. However, the mean time to revision in mobile bearing UKA was 2.5 ± 1.8 years that was significantly earlier than 6.7 ± 2.5 years in fixed-bearing UKA [104]. A bearing dislocation and lateral compartment progression has been well documented as one of the predominated causes of early failure in mobile UKA[105-107]. Parratte. et al. reported a minimum 15 years of follow-up comparing between both UKA designs performed by experience surgeons from one institute, and found no difference of the knee society function and knee scores as well as the survivorship [108]. The main reason for revision of the fixed-bearing UKA in this long term study was wear of a polyethylene which was concordant to the study reported by Cheng T. et al. [105]. There is still a need for large, well-designed RCTs with long term follow-up to assess clinical, radiological and kinematic outcomes of mobile vs fixed bearing designs in UKA.

Session 11: HTO

Question 12: Which implant should be used for fixation in HTO operation?
Consensus: We should use implants such as plate, staple, and external fixator in HTO operation.

Delegate Vote: Agree: 85.7%, Disagree: 0%, Abstain: 14.3% (Strong Consensus)

Justification: It is well understood that a proper fixation is mandatory for a fracture healing. Since the high tibial osteotomy to realign the lower limb axis needs some forms of bone cut that mimic the fracture, the osteotomy site should be sufficiently fixed to promote bone healing, maintain correction and allow early knee motion. Hofmann et al. compared 19 conventional high tibial osteotomies with cast immobilization and 21 high tibial osteotomies utilizing a rigid fixation with a buttress plate and allowed an immediate knee motion. They found that 8 knees (42%) in conventional group had complications including 1 nonunion, 3 delayed unions, 2 losses of correction, 2 intra-articular fracture, 2 transient peroneal nerve palsies, 1 compartment syndrome, and 1 superficial infection versus only 1 knee in rigidly fixed osteotomy group which was an intra-articular fracture. The conventional group had 3 knees with less than 90 degrees of knee flexion at 6 months, whereas all rigidly fixed osteotomy knees had at least 90 degrees of flexion at 6 weeks of follow-up [(109)]. Westrich et al. had demonstrated less postoperative shortening of the patellar tendon in the high tibial osteotomy with a rigid fixation. A total of 34 HTO knees treated with postoperative immobilization had significant differences in an Insall-Salvati index and a Blackburne-Peel index compared to 35 HTO knees treated with internal fixation and early motion [(110)]. Many options of fixation are available for a specific osteotomy technique including bone staple, external fixation device and plate fixation which showed favorable rates of union, minimal prevalence of knee stiffness and persistence of alignment correction [(2,111-114)].

Session 12: General basis

Question 13: What are the standard specifications for TKA prosthesis?

Consensus: The prosthesis of choice should be made by international certified manufacturer or have good track record (at least 95% survival rate at 5 years). Its manufacturer should be able to provide the instruments and implants for any cases including complicated cases. New prosthesis models should be monitored by Thai Joint Registry after distribution in Thailand.

Delegate Vote: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous Consensus)

Justification: Variety of prosthesis from many companies were used in Thailand. To select appropriate knee prosthesis for patients, Thai orthopaedists should make a decision based on the track records from reliable registration and established training centers, etc. In the recent years, Thai orthopaedists make their decision on knee prosthesis based on several factors such as price of an implant, allowable budget per each patient, the country of new manufacturer, etc.

Important criteria to select an implant for Thai patients are the following:

1. Sufficient information of an implant: good track record, 95% survival rate at least for 5 years, safety information, etc. However, the 5-year survival rate information might not be available for a new version of prosthesis. Hence, it may be suggested to reduce the survival rate information to at least 2 years if an acceptable wear rate from a laboratory test is available.
2. Proper manufacturer: manufacturer should be able to supply complete sets of instrument for any situations such as for augmentation and revision.
3. Proper price: selected implants should be affordable considering the patient's healthcare allowance and benefits.
4. Systemic monitoring: Thai joint registry should keep a record of all prosthesis, especically new prosthesis, to evaluate the performance and safety. This information should become available for relevant organizations and orthopaedists.

Question 14: In complicated primary TKA or intra-operative periprosthetic fracture, which implants should be considered?

Consensus: The use of extra or special implants (such as metal augment, stem extension, and constrained prosthesis) should be recommended for primary total knee arthroplasty in the complicated cases (example in severe osteoporosis, severe deformity, severe bone loss, and collateral ligament insufficiency).

Delegate Vote: Agree: 71.4%, Disagree: 14.25%, Abstain: 14.25% (Strong Consensus)

Justification: In some circumstances, primary knee prosthesis may not be able to provide a good host bone-prosthesis stability or joint stability for the knee which complicated with severe deformity, bone defects, collateral ligament insufficiency that are commonly associated with posttraumatic condition, inflammatory arthritis, previous infection, extensor mechanism deficiency, iatrogenic fracture, or others.

The management of bone defects is generally considered based on size and site of the defect. The modular metal augments with or without a stem extension are useful for medium size non-contained defect ranged from 5-20mm because the laboratory testing has demonstrated that the metal wedge provided a superiority in resisting deflection compared to the use of bone cement with or without screws reinforcement for the peripheral tibial bone defect [(115)]. A good clinical survivorship have been shown, Pagnano et al. reported no TKA need to be revised following

metal wedge augmentation for tibia at an average 4.8 years of follow-up [116]. Hamai S et al. [117] reported the result of 26 knees in 21 rheumatoid arthritis patients using metal blocks with stem extension for the tibial bone defect with average depth of 19 mm. Significant improvements was shown in term of range of motion and Knee Society Score. At the mean follow-up of 6 years, there were 2 knees failure because of a supracondylar fracture and knee instability but no knee had an implant loosening. There were studies [118,119] demonstrated an osteointegration of a host bone into the femoral and tibial metaphyseal-cone type implant in all the patients after 5-47 months of follow-up. A structural allograft such as a femoral head or distal femoral allograft may be required for the noncontained bone defects larger than 20mm which exceed the thickness of the metal augmentation been usually available. Engh GA. et al. demonstrated 87% good or excellent clinical result without revision surgery of 30 patients underwent primary or revision TKA in conjunction with structural allografts [120].

The patient with severe varus or valgus deformity, an incompetence of the collateral ligament can be well stabilized with more constrained knee prosthesis with or without the stem extension. Lachiewicz PF and associate reported the results of 42 knees including 27 valgus knees, 12 severe flexion contracture knees and 3 others. All knees underwent primary TKA using the constrained prosthesis with a mean of 9 years follow-up. 86% of knees were rated as good or excellent results and a 10-year survivorship is 96%[121]. Anderon JA and associates also reported a good result without radiographic loosening of the constrained prosthesis implanted in 70 severe valgus knees even if the stem extension was not used[122].

An iatrogenic severe or excessive stripping of the medial collateral ligament can achieve a good result with an alternatively use of the constrained knee prosthesis as well. Lee GC. and Lotke PA have shown that the knee society score of 30 patients who increased prosthetic constraint because of an intraoperative MCL injury was comparable to the knee score of the control group. 4 of 7 patients treated without increased the component constraint were revised compared to none in the group treated with additional constraint [123].

In patient who has a substantial disruption of multiple ligament, tumor resection, neuropathic joint or a recurvatum associated with quadriceps mechanism insufficiency, a hinged type knee prosthesis should be considered. Zeng M. et al. reported a satisfactory outcomes ad radiographic assessment of 7 patients with 8 charcot knees treated with 3 rotating hinge prostheses and 5 long stem condylar-constrained prostheses [124]. Hinge type knee prosthesis also provided the favorable improvement for painful hyperextension knees in 13 patients affected by poliomyelitis without early complications [125].

Question 15A: Should Thailand produce our own knee prosthesis?
Consensus: Thailand should produce our own knee prosthesis.
Delegate Vote: Agree: 71.4%, Disagree: 14.25%, Abstain: 14.25% (Strong Consensus)
Justification: To have prosthesis produced by Thailand manufacturer is a very important strategy not only for healthcare system but also for the Thai economy. While the cost of and the demands for implants are rising every year, Thailand still completely depends on importing the prosthesis. To be able to produce its own prosthesis, Thai patients will benefit from more affordable healthcare. Thai economic deficit will be reduced; Thailand will also generate another important healthcare industry sector, creating jobs for Thai people. In addition, the Thai prosthesis industry will undoubtedly accumulate its own knowledge in prosthesis production, ensuring the compatibility of the products to Thai people. This whole process will warrant sustainability of the healthcare industry. However, the precautious measure is to ensure that Thai orthopeadists will use Thai products, which can be assured by relevant governmental bodies.

Question 15B: How will Thailand produce our own knee prosthesis?
Consensus: No conclusion was reached on how Thailand will produce our own knee prosthesis.
Delegate Vote: Agree: 85.7% Disagree: 0%, Abstain: 14.3% (Strong Consensus)
Justification: There are many concerns on how Thailand will produce its own knee prosthesis. The following factors should be taken into serious consideration before making it a national project such as material for production, quality control, cost and benefit, and intellectual properties of the design and the production process.

References

1. Lombardi AV, Jr., Berasi CC, Berend KR. Evolution of tibial fixation in total knee arthroplasty. J Arthroplasty 2007; 22(4 Suppl 1): 25-9.
2. Naudie DD, Ammeen DJ, Engh GA, Rorabeck CH. Wear and osteolysis around total knee arthroplasty. J Am Acad Orthop Surg 2007; 15(1): 53-64.

3. O'Rourke MR, Callaghan JJ, Goetz DD, Sullivan PM, Johnston RC. Osteolysis associated with a cemented modular posterior-cruciate-substituting total knee design : five to eight-year follow-up. J Bone Joint Surg Am 2002; 84-A(8): 1362-71.
4. Bassett RW. Results of 1,000 Performance knees: cementless versus cemented fixation. J Arthroplasty 1998; 13(4): 409-13.
5. Rand JA. Cement or cementless fixation in total knee arthroplasty? Clin Orthop Relat Res 1991(273): 52-62.
6. McCaskie AW, Deehan DJ, Green TP, Lock KR, Thompson JR, Harper WM, et al. Randomised, prospective study comparing cemented and cementless total knee replacement: results of press-fit condylar total knee replacement at five years. J Bone Joint Surg Br 1998; 80(6): 971-5.
7. Gandhi R, Tsvetkov D, Davey JR, Mahomed NN. Survival and clinical function of cemented and uncemented prostheses in total knee replacement: a meta-analysis. J Bone Joint Surg Br 2009; 91(7): 889-95.
8. Khaw FM, Kirk LM, Morris RW, Gregg PJ. A randomised, controlled trial of cemented versus cementless press-fit condylar total knee replacement. Ten-year survival analysis. J Bone Joint Surg Br 2002; 84(5): 658-66.
9. Park JW, Kim YH. Simultaneous cemented and cementless total knee replacement in the same patients: a prospective comparison of long-term outcomes using an identical design of NexGen prosthesis. J Bone Joint Surg Br 2011; 93(11): 1479-86.
10. Langlais F, Belot N, Ropars M, Lambotte JC, Thomazeau H. The long-term results of press-fit cemented stems in total knee prostheses. J Bone Joint Surg Br 2006; 88(8): 1022-6.
11. Vessely MB, Whaley AL, Harmsen WS, Schleck CD, Berry DJ. The Chitranjan Ranawat Award: Long-term survivorship and failure modes of 1000 cemented condylar total knee arthroplasties. Clin Orthop Relat Res 2006; 452: 28-34.
12. Baker PN, Khaw FM, Kirk LM, Esler CN, Gregg PJ. A randomised controlled trial of cemented versus cementless press-fit condylar total knee replacement: 15-year survival analysis. J Bone Joint Surg Br 2007; 89(12): 1608-14.
13. Rodricks DJ, Patil S, Pulido P, Colwell CW, Jr. Press-fit condylar design total knee arthroplasty. Fourteen to seventeen-year follow-up. J Bone Joint Surg Am 2007; 89(1): 89-95.
14. Attar FG, Khaw FM, Kirk LM, Gregg PJ. Survivorship analysis at 15 years of cemented press-fit condylar total knee arthroplasty. J Arthroplasty 2008; 23(3): 344-9.
15. Victor J, Banks S, Bellemans J. Kinematics of posterior cruciate ligament-retaining and -substituting total knee arthroplasty: a prospective randomised outcome study. J Bone Joint Surg Br 2005; 87(5): 646-55.
16. Harato K, Bourne RB, Victor J, Snyder M, Hart J, Ries MD. Midterm comparison of posterior cruciate-retaining versus -substituting total knee arthroplasty using the Genesis II prosthesis. A multicenter prospective randomized clinical trial. Knee. 2008; 15(3): 217-21.
17. Jacobs WC, Clement DJ, Wymenga AB. Retention versus removal of the posterior cruciate ligament in total knee replacement: a systematic literature review within the Cochrane framework. Acta Orthop 2005; 76(6): 757-68.
18. Swanik CB, Lephart SM, Rubash HE. Proprioception, kinesthesia, and balance after total knee arthroplasty with cruciate-retaining and posterior stabilized prostheses. J Bone Joint Surg Am 2004; 86-A(2): 328-34.
19. Chaudhary R, Beaupre LA, Johnston DW. Knee range of motion during the first two years after use of posterior cruciate-stabilizing or posterior cruciate-retaining total knee prostheses. A randomized clinical trial. J Bone Joint Surg Am 2008; 90(12): 2579-86.
20. Maruyama S, Yoshiya S, Matsui N, Kuroda R, Kurosaka M. Functional comparison of posterior cruciate-retaining versus posterior stabilized total knee arthroplasty. J Arthroplasty 2004; 19(3): 349-53.
21. Tanzer M, Smith K, Burnett S. Posterior-stabilized versus cruciate-retaining total knee arthroplasty: balancing the gap. J Arthroplasty 2002; 17(7): 813-9.
22. Brassard MF, Insall JN, Scuderi GR, Colizza W. Does modularity affect clinical success? A comparison with a minimum 10-year followup. Clin Orthop Relat Res 2001(388): 26-32.
23. Insall JN, Lachiewicz PF, Burstein AH. The posterior stabilized condylar prosthesis: a modification of the total condylar design. Two to four-year clinical experience. J Bone Joint Surg Am 1982; 64(9): 1317-23.
24. Lachiewicz PF, Soileau ES. Fifteen-year survival and osteolysis associated with a modular posterior stabilized knee replacement. A concise follow-up of a previous report. J Bone Joint Surg Am 2009; 91(6): 1419-23.
25. Scuderi GR, Clarke HD. Cemented posterior stabilized total knee arthroplasty. J Arthroplasty 2004; 19(4 Suppl 1): 17-21.

26. Conditt MA, Noble PC, Bertolusso R, Woody J, Parsley BS. The PCL significantly affects the functional outcome of total knee arthroplasty. J Arthroplasty 2004; 19(7 Suppl 2): 107-12.
27. Straw R, Kulkarni S, Attfield S, Wilton TJ. Posterior cruciate ligament at total knee replacement. Essential, beneficial or a hindrance? J Bone Joint Surg Br 2003; 85(5): 671-4.
28. Kolisek FR, McGrath MS, Marker DR, Jessup N, Seyler TM, Mont MA, et al. Posterior-stabilized versus posterior cruciate ligament-retaining total knee arthroplasty. Iowa Orthop J 2009; 29: 23-7.
29. Fantozzi S, Catani F, Ensini A, Leardini A, Giannini S. Femoral rollback of cruciate-retaining and posterior-stabilized total knee replacements: in vivo fluoroscopic analysis during activities of daily living. J Orthop Res 2006; 24(12): 2222-9.
30. Nabeyama R, Matsuda S, Miura H, Kawano T, Nagamine R, Mawatari T, et al. Changes in anteroposterior stability following total knee arthroplasty J Orthop Sci 2003; 8(4): 526-31.
31. Yoshiya S, Matsui N, Komistek RD, Dennis DA, Mahfouz M, Kurosaka M. In vivo kinematic comparison of posterior cruciate-retaining and posterior stabilized total knee arthroplasties under passive and weight-bearing conditions. J Arthroplasty 2005; 20(6): 777-83.
32. Nelissen RG, Hogendoorn PC. Retain or sacrifice the posterior cruciate ligament in total knee arthroplasty? A histopathological study of the cruciate ligament in osteoarthritic and rheumatoid disease. J Clin Pathol 2001; 54(5): 381-4.
33. Arbuthnot JE, Wainwright O, Stables G, Rathinam M, Rowley DI, McNicholas MJ. Dysfunction of the posterior cruciate ligament in total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2011; 19(6): 893-8.
34. Chouteau J, Lerat JL, Testa R, Moyen B, Banks SA. Sagittal laxity after posterior cruciate ligament-retaining mobile-bearing total knee arthroplasty. J Arthroplasty 2009; 24(5): 710-5.
35. Christen B, Heesterbeek P, Wymenga A, Wehrli U. Posterior cruciate ligament balancing in total knee replacement: the quantitative relationship between tightness of the flexion gap and tibial translation. J Bone Joint Surg Br 2007; 89(8): 1046-50.
36. Fitz W, Sodha S, Reichmann W, Minas T. Does a modified gap-balancing technique result in medial-pivot knee kinematics in cruciate-retaining total knee arthroplasty? A pilot study. Clin Orthop Relat Res 2012; 470(1): 91-8.
37. Heesterbeek P, Keijsers N, Jacobs W, Verdonschot N, Wymenga A. Posterior cruciate ligament recruitment affects antero-posterior translation during flexion gap distraction in total knee replacement. An intraoperative study involving 50 patients. Acta Orthop 2010; 81(4): 471-7.
38. Dixon MC, Brown RR, Parsch D, Scott RD. Modular fixed-bearing total knee arthroplasty with retention of the posterior cruciate ligament. A study of patients followed for a minimum of fifteen years. J Bone Joint Surg Am 2005; 87(3): 598-603.
39. Gill GS, Joshi AB. Long-term results of Kinematic Condylar knee replacement. An analysis of 404 knees. J Bone Joint Surg Br 2001; 83(3): 355-8.
40. Ho FY, Ma HM, Liau JJ, Yeh CR, Huang CH. Mobile-bearing knees reduce rotational asymmetric wear. Clin Orthop Relat Res 2007; 462: 143-9.
41. Lu YC, Huang CH, Chang TK, Ho FY, Cheng CK, Huang CH. Wear-pattern analysis in retrieved tibial inserts of mobile-bearing and fixed-bearing total knee prostheses. J Bone Joint Surg Br 2010; 92(4): 500-7.
42. Buechel FF, Pappas MJ. The New Jersey Low-Contact-Stress Knee Replacement System: biomechanical rationale and review of the first 123 cemented cases. Arch Orthop Trauma Surg 1986; 105(4): 197-204.
43. Matsuda S, White SE, Williams VG, 2nd, McCarthy DS, Whiteside LA. Contact stress analysis in meniscal bearing total knee arthroplasty. J Arthroplasty 1998; 13(6): 699-706.
44. Stukenborg-Colsman C, Ostermeier S, Hurschler C, Wirth CJ. Tibiofemoral contact stress after total knee arthroplasty: comparison of fixed and mobile-bearing inlay designs. Acta Orthop Scand 2002; 73(6): 638-46.
45. Kim YH, Kim JS. Prevalence of osteolysis after simultaneous bilateral fixed- and mobile-bearing total knee arthroplasties in young patients. J Arthroplasty 2009; 24(6): 932-40.
46. Harrington MA, Hopkinson WJ, Hsu P, Manion L. Fixed- vs mobile-bearing total knee arthroplasty: does it make a difference?--a prospective randomized study. J Arthroplasty 2009; 24(6 Suppl): 24-7.
47. Oh KJ, Pandher DS, Lee SH, Sung Joon SD, Jr., Lee ST. Meta-analysis comparing outcomes of fixed-bearing and mobile-bearing prostheses in total knee arthroplasty. J Arthroplasty 2009; 24(6): 873-84.
48. Woolson ST, Epstein NJ, Huddleston JI. Long-term comparison of mobile-bearing vs fixed-bearing total knee arthroplasty. J Arthroplasty 2011; 26(8): 1219-23.

49. Smith H, Jan M, Mahomed NN, Davey JR, Gandhi R. Meta-analysis and systematic review of clinical outcomes comparing mobile bearing and fixed bearing total knee arthroplasty. J Arthroplasty 2011; 26(8): 1205-13.
50. Hopley CD, Crossett LS, Chen AF. Long-term clinical outcomes and survivorship after total knee arthroplasty using a rotating platform knee prosthesis: a meta-analysis. J Arthroplasty 2013; 28(1): 68-77 e1-3.
51. Bo ZD, Liao L, Zhao JM, Wei QJ, Ding XF, Yang B. Mobile bearing or fixed bearing? A meta-analysis of outcomes comparing mobile bearing and fixed bearing bilateral total knee replacements. Knee 2014; 21(2): 374-81.
52. Capella M, Dolfin M, Saccia F. Mobile bearing and fixed bearing total knee arthroplasty. Ann Transl Med 2016; 4(7): 127.
53. Hollister AM, Jatana S, Singh AK, Sullivan WW, Lupichuk AG. The axes of rotation of the knee. Clin Orthop Relat Res 1993(290) :259-68.
54. Churchill DL, Incavo SJ, Johnson CC, Beynnon BD. The transepicondylar axis approximates the optimal flexion axis of the knee. Clin Orthop Relat Res 1998(356): 111-8.
55. Wang H, Simpson KJ, Chamnongkich S, Kinsey T, Mahoney OM. Biomechanical influence of TKA designs with varying radii on bilateral TKA patients during sit-to-stand. Dyn Med 2008; 7: 12.
56. Gomez-Barrena E, Fernandez-Garcia C, Fernandez-Bravo A, Cutillas-Ruiz R, Bermejo-Fernandez G. Functional performance with a single-radius femoral design total knee arthroplasty. Clin Orthop Relat Res 2010; 468(5): 1214-20.
57. Wolterbeek N, Garling EH, Mertens BJ, Nelissen RG, Valstar ER. Kinematics and early migration in single-radius mobile- and fixed-bearing total knee prostheses. Clin Biomech (Bristol, Avon) 2012; 27(4): 398-402.
58. Stoddard JE, Deehan DJ, Bull AM, McCaskie AW, Amis AA. The kinematics and stability of single-radius versus multi-radius femoral components related to mid-range instability after TKA. Orthop Res 2013; 31(1): 53-8.
59. Jenny JY, Miehlke R, Saragaglia D, Geyer R, Mercier N, Schoenahl JY, et al. Single-radius, multidirectional total knee replacement. Knee Surg Sports Traumatol Arthrosc 2013; 21(12): 2764-9.
60. Mizner RL, Petterson SC, Stevens JE, Vandenborne K, Snyder-Mackler L. Early quadriceps strength loss after total knee arthroplasty. The contributions of muscle atrophy and failure of voluntary muscle activation. J Bone Joint Surg Am 2005; 87(5): 1047-53.
61. Hall J, Copp SN, Adelson WS, D'Lima DD, Colwell CW, Jr. Extensor mechanism function in single-radius vs multiradius femoral components for total knee arthroplasty. J Arthroplasty 2008; 23(2): 216-9.
62. Liu S, Long H, Zhang Y, Ma B, Li Z. Meta-Analysis of Outcomes of a Single-Radius Versus Multi-Radius Femoral Design in Total Knee Arthroplasty. J Arthroplasty 2016; 31(3): 646-54.
63. Oliviu RC, Zazgyva A, Septimiu S, Ors N, Sorin PT. Mid-term results of total knee replacement with single-radius versus multi-radius posterior-stabilized implants. Acta Orthop Traumatol Turc 2016; 50(2): 125-31.
64. Hinarejos P, Puig-Verdie L, Leal J, Pelfort X, Torres-Claramunt R, Sanchez-Soler J, et al. No differences in functional results and quality of life after single-radius or multiradius TKA. Knee Surg Sports Traumatol Arthrosc 2015.
65. Arirachakaran A, Wande T, Pituckhanotai K, Predeeprompan P, Kongtharvonskul J. Clinical outcomes after high-flex versus conventional total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2015; 23(6): 1610-21.
66. Sumino T, Gadikota HR, Varadarajan KM, Kwon YM, Rubash HE, Li G. Do high flexion posterior stabilised total knee arthroplasty designs increase knee flexion? A meta analysis. Int Orthop 2011; 35(9): 1309-19.
67. Luo SX, Su W, Zhao JM, Sha K, Wei QJ, Li XF. High-flexion vs conventional prostheses total knee arthroplasty: a meta-analysis. J Arthroplasty 2011; 26(6): 847-54.
68. Li C, Shen B, Yang J, Zhou Z, Kang P, Pei F. Do patients really gain outcome benefits when using the high-flex knee prostheses in total knee arthroplasty? A meta-analysis of randomized controlled trials. J Arthroplasty 2015; 30(4): 580-6.
69. Jiang Y, Yao JF, Xiong YM, Ma JB, Kang H, Xu P. No Superiority of High-Flexion vs Standard Total Knee Arthroplasty: An Update Meta-Analysis of Randomized Controlled Trials. J Arthroplasty 2015; 30(6): 980-6.
70. Nakamura S, Ito H, Kobayashi M, Nakamura K, Toyoji U, Komistek RD, et al. Are the long term results of a high-flex total knee replacement affected by the range of flexion? Int Orthop 2014; 38(4): 761-6.

71. Malik A, Salas A, Ben Ari J, Ma Y, Gonzalez Della Valle A. Range of motion and function are similar in patients undergoing TKA with posterior stabilised and high-flexion inserts. Int Orthop 2010; 34(7): 965-72.
72. Seon J, Yim J, Seo H, Song E. No Better Flexion or Function of High-Flexion Designs in Asian Patients with TKA. Clin Orthop Relat Res 2013; 471: 1498-503.
73. Gandhi R, Tso P, Davey JR, Mahomed NN. High-flexion implants in primary total knee arthroplasty: a meta-analysis. Knee 2009; 16(1): 14-7.
74. Piriou P, Mabit C, Bonnevialle P, Peronne E, Versier G. Are gender-specific femoral implants for total knee arthroplasty necessary? J Arthroplasty 2014; 29(4): 742-8.
75. Hitt K, Shurman JR, 2nd, Greene K, McCarthy J, Moskal J, Hoeman T, et al. Anthropometric measurements of the human knee: correlation to the sizing of current knee arthroplasty systems. J Bone Joint Surg Am 2003; 85-A(Suppl 4): 115-22.
76. Xie X, Lin L, Zhu B, Lu Y, Lin Z, Li Q. Will gender-specific total knee arthroplasty be a better choice for women? A systematic review and meta-analysis. Eur J Orthop Surg Traumatol 2014; 24(8): 1341-9.
77. Yue B, Wang J, Wang Y, Yan M, Zhang J, Zeng Y. How the gender or morphological specific TKA prosthesis improves the component fit in the Chinese population? J Arthroplasty 2014; 29(1): 71-4.
78. Kim YH, Choi Y, Kim JS. Comparison of a standard and a gender-specific posterior cruciate-substituting high-flexion knee prosthesis: a prospective, randomized, short-term outcome study. J Bone Joint Surg Am 2010; 92(10): 1911-20.
79. Kim YH, Choi Y, Kim JS. Comparison of standard and gender-specific posterior-cruciate-retaining high-flexion total knee replacements: a prospective, randomised study. J Bone Joint Surg Br 2010; 92(5): 639-45.
80. Tanavalee A, Rojpornpradit T, Khumrak S, Ngarmukos S. The early results of gender-specific total knee arthroplasty in Thai patients. Knee 2011; 18(6): 483-7.
81. Meneghini RM. Should the patella be resurfaced in primary total knee arthroplasty? An evidence-based analysis. J Arthroplasty 2008; 23(7 Suppl): 11-4.
82. Abdel M, Parratte S, Budhiparama N. The patellar in total knee arthroplasty: to resurface or not is the question. Curr Rev Musculoskelet Med 2014; 7: 117-24.
83. Fu Y, Wang G, Fu Q. Patellar resurfacing in total knee arthroplasty for osteoarthritis: a meta-analysis. Knee Surg Sports Traumatol Arthrosc 2011; 19(9): 1460-6.
84. Chen K, Li G, Fu D, Yuan C, Zhang Q, Cai Z. Patellar resurfacing versus nonresurfacing in total knee arthroplasty: a meta-analysis of randomised controlled trials. Int Orthop 2013; 37(6): 1075-83.
85. Parvizi J, Mortazavi SM, Devulapalli C, Hozack WJ, Sharkey PF, Rothman RH. Secondary resurfacing of the patella after primary total knee arthroplasty does the anterior knee pain resolve? J Arthroplasty 2012; 27(1): 21-6.
86. Toro-Ibarguen AN, Navarro-Arribas R, Pretell-Mazzini J, Prada-Canizares AC, Jara-Sanchez F. Secondary Patellar Resurfacing as a Rescue Procedure for Persistent Anterior Knee Pain After Primary Total Knee Arthroplasty: Do Our Patients Really Improve? J Arthroplasty 2016; 31(7): 1539-43.
87. He JY, Jiang LS, Dai LY. Is patellar resurfacing superior than nonresurfacing in total knee arthroplasty? A meta-analysis of randomized trials. Knee 2011; 18(3): 137-44.
88. Li T, Zhou L, Zhuang Q, Weng X, Bian Y. Patellar denervation in total knee arthroplasty without patellar resurfacing and postoperative anterior knee pain: a meta-analysis of randomized controlled trials. J Arthroplasty 2014; 29(12): 2309-13.
89. Yu BF, Yang GJ, Wang WL, Zhang L, Lin XP. Cross-linked versus conventional polyethylene for total knee arthroplasty: a meta-analysis. J Orthop Surg Res 2016; 11: 39.
90. Meneghini RM, Lovro LR, Smits SA, Ireland PH. Highly Cross-Linked Versus Conventional Polyethylene in Posterior-Stabilized Total Knee Arthroplasty at a Mean 5-Year Follow-up. J Arthroplasty 2015; 30(10): 1736-9.
91. Meneghini RM, Ireland PH, Bhowmik-Stoker M. Multicenter Study of Highly Cross-linked vs Conventional Polyethylene in Total Knee Arthroplasty. J Arthroplasty 2016; 31(4): 809-14.
92. Kim YH, Park JW, Kim JS, Lee JH. Highly Crosslinked-remelted versus Less-crosslinked Polyethylene in Posterior Cruciate-retaining TKAs in the Same Patients. Clin Orthop Relat Res 2015; 473(11): 3588-94.
93. Kurtz SM. UHMWPE Biomaterials Handbook. Philadelphia PA, USA: Elsevier 2016.

94. Heyse TJ, Chen DX, Kelly N, Boettner F, Wright TM, Haas SB. Matched-pair total knee arthroplasty retrieval analysis: oxidized zirconium vs. CoCrMo. Knee 2011; 18(6): 448-52.
95. Innocenti M, Civinini R, Carulli C, Matassi F, Villano M. The 5-year results of an oxidized zirconium femoral component for TKA. Clin Orthop Relat Res 2010; 468(5): 1258-63.
96. Thienpont E, Berger Y. No allergic reaction after TKA in a chrome-cobalt-nickel-sensitive patient: case report and review of the literature. Knee Surg Sports Traumatol Arthrosc 2013; 21(3): 636-40.
97. Innocenti M, Matassi F, Carulli C, Nistri L, Civinini R. Oxidized zirconium femoral component for TKA: a follow-up note of a previous report at a minimum of 10 years. Knee 2014; 21(4): 858-61.
98. Innocenti M, Carulli C, Matassi F, Carossino AM, Brandi ML, Civinini R. Total knee arthroplasty in patients with hypersensitivity to metals. Int Orthop 2014; 38(2): 329-33.
99. Holland P, Santini AJ, Davidson JS, Pope JA. Five year survival analysis of an oxidised zirconium total knee arthroplasty. Knee 2013; 20(6): 384-7.
100. Hofer JK, Ezzet KA. A minimum 5-year follow-up of an oxidized zirconium femoral prosthesis used for total knee arthroplasty. Knee 2014; 21(1): 168-71.
101. Minoda Y, Hata K, Iwaki H, Ikebuchi M, Hashimoto Y, Inori F, et al. No difference in in vivo polyethylene wear particles between oxidized zirconium and cobalt-chromium femoral component in total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2014; 22(3): 680-6.
102. Ahmed I, Salmon LJ, Waller A, Watanabe H, Roe JP, Pinczewski LA. Total knee arthroplasty with an oxidised zirconium femoral component: ten-year survivorship analysis. Bone Joint J 2016; 98-B(1): 58-64.
103. Smith TO, Hing CB, Davies L, Donell ST. Fixed versus mobile bearing unicompartmental knee replacement: a meta-analysis. Orthop Traumatol Surg Res 2009; 95(8): 599-605.
104. Peersman G, Stuyts B, Vandenlangenbergh T, Cartier P, Fennema P. Fixed- versus mobile-bearing UKA: a systematic review and meta-analysis. Knee Surg Sports Traumatol Arthrosc 2015; 23(11): 3296-305.
105. Cheng T, Chen D, Zhu C, Pan X, Mao X, Guo Y, et al. Fixed- versus mobile-bearing unicondylar knee arthroplasty: are failure modes different? Knee Surg Sports Traumatol Arthrosc 2013; 21(11): 2433-41.
106. Pandit H, Jenkins C, Gill HS, Barker K, Dodd CA, Murray DW. Minimally invasive Oxford phase 3 unicompartmental knee replacement: results of 1000 cases. J Bone Joint Surg Br 2011; 93(2): 198-204.
107. Dervin GF, Carruthers C, Feibel RJ, Giachino AA, Kim PR, Thurston PR. Initial experience with the oxford unicompartmental knee arthroplasty. J Arthroplasty 2011; 26(2): 192-7.
108. Parratte S, Pauly V, Aubaniac JM, Argenson JN. No long-term difference between fixed and mobile medial unicompartmental arthroplasty. Clin Orthop Relat Res 2012; 470(1): 61-8.
109. Hofmann AA, Wyatt RW, Beck SW. High tibial osteotomy. Use of an osteotomy jig, rigid fixation, and early motion versus conventional surgical technique and cast immobilization. Clin Orthop Relat Res 1991(271): 212-7.
110. Westrich GH, Peters LE, Haas SB, Buly RL, Windsor RE. Patella height after high tibial osteotomy with internal fixation and early motion. Clin Orthop Relat Res 1998(354): 169-74.
111. Zuegel NP, Braun WG, Kundel KP, Rueter AE. Stabilization of high tibial osteotomy with staples. Arch Orthop Trauma Surg 1996; 115(5): 290-4.
112. Hsu RW. The study of Maquet dome high tibial osteotomy. Arthroscopic-assisted analysis. Clin Orthop Relat Res 1989(243): 280-5.
113. Weale AE, Lee AS, MacEachern AG. High tibial osteotomy using a dynamic axial external fixator. Clin Orthop Relat Res 2001(382): 154-67.
114. Giuseffi SA, Replogle WH, Shelton WR. Opening-Wedge High Tibial Osteotomy: Review of 100 Consecutive Cases. Arthroscopy 2015; 31(11): 2128-37.
115. Brand MG, Daley RJ, Ewald FC, Scott RD. Tibial tray augmentation with modular metal wedges for tibial bone stock deficiency Clin Orthop Relat Res 1989(248): 71-9.
116. Pagnano MW, Trousdale RT, Rand JA. Tibial wedge augmentation for bone deficiency in total knee arthroplasty. A followup study. Clin Orthop Relat Res 1995(321): 151-5.
117. Hamai S, Miyahara H, Esaki Y, Hirata G, Terada K, Kobara N, et al. Mid-term clinical results of primary total knee arthroplasty using metal block augmentation and stem extension in patients with rheumatoid arthritis. BMC Musculoskelet Disord 2015; 16: 225.
118. Radnay CS, Scuderi GR. Management of bone loss: augments, cones, offset stems. Clin Orthop Relat Res 2006; 446: 83-92.

119. Meneghini RM, Lewallen DG, Hanssen AD. Use of porous tantalum metaphyseal cones for severe tibial bone loss during revision total knee replacement. J Bone Joint Surg Am 2008; 90(1): 78-84.
120. Engh GA, Herzwurm PJ, Parks NL. Treatment of major defects of bone with bulk allografts and stemmed components during total knee arthroplasty. J Bone Joint Surg Am 1997; 79(7): 1030-9.
121. Lachiewicz PF, Soileau ES. Ten-year survival and clinical results of constrained components in primary total knee arthroplasty. J Arthroplasty 2006; 21(6): 803-8.
122. Anderson JA, Baldini A, MacDonald JH, Pellicci PM, Sculco TP. Primary constrained condylar knee arthroplasty without stem extensions for the valgus knee. Clin Orthop Relat Res 2006; 442: 199-203.
123. Lee GC, Lotke PA. Management of intraoperative medial collateral ligament injury during TKA. Clin Orthop Relat Res 2011; 469(1): 64-8.
124. Zeng M, Xie J, Hu Y. Total knee arthroplasty in patients with Charcot joints. Knee Surg Sports Traumatol Arthrosc 2016.
125. Rahman J, Hanna SA, Kayani B, Miles J, Pollock RC, Skinner JA, et al. Custom rotating hinge total knee arthroplasty in patients with poliomyelitis affected limbs. Int Orthop 2015; 39(5): 833-8.

Instruction to authors

Aims and scope

The Thai Journal of Orthopaedic Surgery is an official journal of **The Royal College of Orthopaedic Surgeons of Thailand**. It will accept original papers on clinical and experimental research that are pertinent in Orthopaedics. Original articles, short communication, case reports, review articles, letters to the Editor and miscellany are welcome.

It publishes: *original papers* - reporting progress and results in all areas of orthopaedics and its related fields; *review articles* - reflecting the present state of knowledge in special areas of summarizing limited themes in which discussion has led to clearly defined conclusions; *educational articles* - giving information on the progress of a topic of particular interest; *case reports* - of uncommon or interesting presentations of the condition.

Submission information

Online Submission

We are pleased to announce that we have moved to the online system of manuscript tracking, Authors are encouraged to submit their articles to **secretariat@rcost.or.th**
This will allow even quicker and more efficient processing of your manuscript.

Article types

- Original articles: word limit 5000 words, 45 references, no more than 6 figures/tables
- Short communications: 2500 words, 20 references, no more than 2 figures/tables.
- Reviews: word limit 10000 words, 100 references, no more than 10 figures
- Case Reports: 1500 words, 1-2 figures/tables, 20 references
- Letters: 500 words
- Editorial

Manuscript preparation

- Authorship Criteria and Contributions

All listed authors should have seen and approved the final version of the manuscript.

All authors of accepted articles must sign an authorship form affirming that they have met all three of the following criteria for authorship, thereby accepting public responsibility for appropriate portions of the content:

1. substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data;

2. drafting the article or revising it critically for important intellectual content;

3. approval of the version to be published and all subsequent versions.

If authorship is attributed to a group (such as for multi-center trials), the group must designate one or more individuals as authors or members of a writing group who meet full authorship criteria and who accepts direct responsibility for the manuscript.

Other group members who are not authors should be listed in the Acknowledgment section of the manuscript as participating investigators.

Individuals who do not meet the criteria for authorship but who have made substantial, direct contributions to the work (e.g., purely technical help, writing assistance, general or financial or material support) should be acknowledged in the Acknowledgments section of the manuscript, with a brief description of their contributions. Authors should obtain written permission from anyone they wish to list in the Acknowledgments section.

- Redundant, Duplicate or Fraudulent Publication

Authors must not simultaneously submit their manuscripts to another publication if that manuscript is under consideration by Osteoporosis International.

Redundant or duplicate publication is a paper that overlaps substantially with one already published in print or electronic media. At the time of manuscript submission, authors must inform the editor about all submissions and previous publications that might be regarded as redundant or duplicate publication of the same or very similar work. Any such publication must be referred to and referenced in the new paper.Copies of such material should be included with the submitted paper as a supplemental file.

Authors must not:
• Willfully and knowingly submit false data
• Submit data from source not the authors' own
• Submit previously published material (with the exception of abstracts) without correct and proper citation
• Omit reference to the works of other investigators which established a priority
• Falsely certify that the submitted work is original
• Use material previously published elsewhere without prior written approval of the copyright holder

Title Page

The title page must be written in both Thai and English and should include:

- The name(s) of the author(s)
- A concise and informative title
- The affiliation(s) and address(es) of the author(s)
- The e-mail address, telephone and fax numbers of the corresponding author

Abstract

Please provide a structured abstract in both Thai and English of 250 words which should be divided into the following sections:

- Purpose (stating the main purposes and research question)
- Methods
- Results
- Conclusions

Keywords

Please provide 4 to 6 keywords which can be used for indexing purposes.

The manuscript: The manuscript must be written in English or Thai.

Text Formatting

The text should be organized in the following order: Introduction, Methods, Results, Discussion, Acknowledgements, References, Tables and Figures. Manuscripts should be submitted in Word.

- Use a normal, plain font (e.g., 10-point Times Roman) for text.
- Use italics for emphasis.
- Use the automatic page numbering function to number the pages.
- Do not use field functions.

- Use tab stops or other commands for indents, not the space bar.
- Use the table function, not spreadsheets, to make tables.
- Use the equation editor or MathType for equations.
- Note: If you use Word 2007, do not create the equations with the default equation editor but use the Microsoft equation editor or MathType instead.
- Save your file in doc format. Do not submit docx files.

Headings

Please use no more than three levels of displayed headings.

Abbreviations

Abbreviations should be defined at first mention and used consistently thereafter.

Footnotes

Footnotes on the title page are not given reference symbols. Footnotes to the text are numbered consecutively; those to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data).

Acknowledgements

Acknowledgements of people, grants, funds, etc. should be placed in a separate section before the reference list. The names of funding organizations should be written in full.

Tables

- All tables are to be numbered using Arabic numerals.
- Tables should always be cited in text in consecutive numerical order.
- For each table, please supply a table heading. The table title should explain clearly and concisely the components of the table.
- Identify any previously published material by giving the original source in the form of a reference at the end of the table heading.
- Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body.

Figures

Electronic Figure Submission

- Supply all figures electronically.
- Indicate what graphics program was used to create the artwork.
- For vector graphics, the preferred format is EPS; for halftones, please use TIFF format. MS Office files are also acceptable.
- Vector graphics containing fonts must have the fonts embedded in the files.
- Name your figure files with "Fig" and the figure number, e.g., Fig1.eps.

References: List the references in consecutive, numerical order, as they are cited in the text. Use the Vancouver style. If the list of authors exceeds 6, the first 6 authors followed by et al should be listed for those references. Abbreviate journal titles according to the style used in the Index Medicus. See also http://www.medscape.com/home/search/indexMedicus/ Index Medicus-A.html

Example of references:

Journal articles.

1. You CH, Lee KY, Chey RY, Menguy R. Electrogastrographic study of patient with unexplained nausea, bloating and vomiting. Gastroenterol 1980;79:311-4.
2. Gulgolgarn V, Ketsararat V, Niyomthai R, et al. Somatic growth and clinical manifestation in formula fed infants born to HIV-infected mothers during the first year of life. J Med Assoc Thai 1999;82:1094-9.

Conference proceeding

1. Bengtsson S, Solheim BG. Enforcement of data protection, privacy and security in medical informatics. In: Lun KC, Degoulet P, Peimme TE, Reinhoff O, editors. MEDINFO 92. Proceeding fo the 7th World Congress on Medical informatics; 1992 Sep 6-10; Geneva, Switzerland. Amsterdam: North-Holland; 1992. p.1561-5.

Abstract in scientific presentation

1. Wettstein A, Dore G, Murphy C, Hing M, Edward P. HIV-related cholangiopathy in Australia. IX Annual Conference of the Australasian Society of HIV Medicine. Adelaide, November 1997 [abstract P45].
2. Clement J, De Bock R. Hematological complications of hantavirus nephropathy [abstract]. Kidney Int 1992;42:1285.

Book

1. Getzen TE. Health economics: Fundamentals of funds. New York: John Wiley & Sons; 1997.
2. Porter RJ, Meldrum BS. Antiepileptic drugs. In: Katzung BG, editor. Basic and clinical pharmacology. 6th ed. Norwalk: Appleton & Lange; 1995. p.361-80.

Electronic article

1. Morse SS. Factors in the emergence of infectious disease. Emerg Infect Dis [serial online] 1995 Jan-Mar;1(1):[24 screens]. Available from: URL:http://www/cdc/gov/ncidoc/EID/eid.htm. Accessed December 25,1999.
2. LaPorte RE, Marler E, Akazawa S, Sauer F. The death of biomedical journals. BMJ [serial online]. 1995;310:1387-90. Available from: http://www.bmj.com/bmj/archive/6991ed2.htm. Accessed September 26,1996.
3. Health on the net foundation. Health on the net foundation code of conduct (HONcode) for medical and health web sites. Available at: http://www.hon.ch/Conduct.html. Accessed June 30, 1998.

คำแนะนำสำหรับผู้ส่งบทความเพื่อลงตีพิมพ์

จุดมุ่งหมายและขอบเขต

วารสาร The Thai Journal of Orthopaedic Surgery เป็นวารสารทางวิชาการของราชวิทยาลัยแพทย์ออร์โธปิดิกส์แห่งประเทศไทยที่พิมพ์เผยแพร่อย่างสม่ำเสมอทุก 3 เดือน (4 ฉบับ/ปี) ทั้งแบบเป็นเอกสารรูปเล่ม และแบบออนไลน์ โดยเป็นวารสารที่ได้รับการประเมินบทความโดยผู้ทรงคุณวุฒิ (peer–reviewed journal) เพื่อเปิดโอกาสให้นักวิชาการที่สนใจเสนอบทความที่เกี่ยวข้องกับการรักษาผู้ป่วยและผลงานวิจัยทางศัลยศาสตร์ออร์โธปิดิกส์

เพื่อรักษามาตรฐานของวารสาร บทความที่จะลงตีพิมพ์ในวารสารจำเป็นต้องเขียนเป็นภาษาอังกฤษ ซึ่งประกอบด้วย Original Articles, Case Report, Review Articles, Letter to the Editor และ Miscellany

บทความประเภท Original articles เป็นรายงานผลการวิจัยทางด้านศัลยศาสตร์ออร์โธปิดิกส์ และสาขาอื่นที่เกี่ยวข้อง

บทความ Review articles เป็นบทความที่รวบรวมเอาผลงานในเรื่องใดเรื่องหนึ่งโดยเฉพาะ ซึ่งเคยลงตีพิมพ์มาแล้ว นำมาวิเคราะห์ วิจารณ์ เพื่อให้เกิดความกระจ่างในเรื่องนั้นยิ่งขึ้น

รายงานผู้ป่วย (Case report) เป็นรายงานผู้ป่วย วิจารณ์อาการทางคลินิกและผลตรวจทางห้องปฏิบัติการที่น่าสนใจ

เรื่องที่ส่งมาต้องไม่เคยพิมพ์เผยแพร่มาก่อน กองบรรณาธิการขอสงวนสิทธิ์ในการตรวจทาน แก้ไขต้นฉบับ และพิจารณาตีพิมพ์ข้อคิดเห็นในบทความเป็นความเห็นและเป็นความรับผิดชอบของเจ้าของบทความโดยตรง

การส่งบทความ

ทางราชวิทยาลัยฯ ขอแจ้งให้ทราบว่า เพื่อความสะดวกรวดเร็วและมีประสิทธิภาพในการส่งบทความ ราชวิทยาลัยฯ ผู้เขียนสามารถเสนอบทความเพื่อพิจารณาได้ทางจดหมายอิเล็กโทรนิกส์ secretariat@rcost.or.th

ประเภทของบทความ

- นิพนธ์ต้นฉบับ (original articles) ให้มีความยาวไม่เกิน 5,000 คำ, เอกสารอ้างอิงไม่เกิน 40 ข้อ, รูปภาพและตารางรวมกันไม่เกิน 6 รูป
- บทความปริทรรศน์ (review articles) ให้มีความยาวไม่เกิน 10,000 คำ, เอกสารอ้างอิงไม่เกิน 100 ข้อ, รูปภาพและตารางรวมกันไม่เกิน 10 รูป
- รายงานผู้ป่วย (case report) ให้มีความยาวได้ 1,500 คำ, รูปภาพและตาราง 1–2 รูป/ตาราง, เอกสารอ้างอิงไม่เกิน 20 ข้อ
- จดหมายให้มีความยาวได้ 500 คำ
- บทบรรณาธิการ

การเตรียมต้นฉบับ

- **เกณฑ์การเขียนบทความ**
  1. อธิบายเนื้อหาของบทความหรือวิเคราะห์ข้อมูลที่ได้มาให้ชัดเจน
  2. หากต้นฉบับมีข้อผิดพลาดของรูปแบบหรือมีความไม่สมบูรณ์ขององค์ประกอบในบทความ บทความนั้นจะถูกส่งกลับไปยังผู้เขียนเพื่อทำการแก้ไขต่อไป

3. แก้ไขปรับปรุงเนื้อหาของต้นฉบับตามคำแนะนำของผู้ประเมินบทความ

หากมีการเขียนบทความโดยกลุ่ม กรุณาระบุชื่อผู้เขียนทุกคน และระบุชื่อผู้วิจัยหลักให้ชัดเจน

ควรแสดงความขอบคุณแก่บุคคลที่ไม่ได้มีส่วนร่วมในการเขียนบทความ แต่มีส่วนช่วยเหลือโดยตรงในการวิจัย เช่น ผู้ช่วยทางเทคนิค, ที่ปรึกษาด้านการเขียนบทความ, ผู้สนับสนุนทุนและวัสดุในการทำงานวิจัย เป็นต้น ไว้ในกิตติกรรมประกาศ (acknowledgements)

- **บทความที่ส่งมาจะต้องเป็นเรื่องที่ไม่เคยตีพิมพ์ที่ใดมาก่อน และผู้เขียนจะต้องไม่ส่งบทความเพื่อไปตีพิมพ์ในวารสารฉบับอื่นในเวลาเดียวกัน**

หลักเกณฑ์สำหรับผู้เขียนบทความ

- ผู้เขียนบทความต้องไม่มีเจตนาส่งข้อมูลเท็จ
- บทความที่ส่งมาต้องเป็นผลงานของท่านเอง
- ผู้เขียนบทความจะต้องไม่ส่งบทความที่เคยลงตีพิมพ์ในวารสารอื่น โดยไม่ระบุว่าท่านได้เสนอผลงานนั้นในวารสารใดบ้างอย่างถูกต้องและสมเหตุสมผล
- ต้องระบุรายชื่อผู้เขียนทุกคนตามความเป็นจริง
- ผู้เขียนบทความต้องส่งต้นฉบับที่ได้รับการรับรองที่แท้จริง
- ผู้เขียนบทความต้องไม่ใช้วิธีการศึกษาที่มีผู้เผยแพร่มาก่อน โดยไม่ได้รับการอนุมัติจากเจ้าของลิขสิทธิ์

- **หน้าแรก (Title page)** เขียนเป็นภาษาไทยและภาษาอังกฤษ ประกอบด้วย
  (1) ชื่อ สกุลของผู้เขียน
  (2) ชื่อเรื่องอย่างย่อ ที่สื่อความหมายและชี้ให้เห็นสาระสำคัญของเนื้อหาในตัวบทความ
  (3) สถานที่ทำงาน
  (4) เบอร์โทรศัพท์, เบอร์แฟกซ์ และe-mail address ของผู้เขียน
- **บทคัดย่อ (Abstract)** ต้องมีทั้งภาษาไทยและภาษาอังกฤษมีความยาวไม่เกิน 250 คำ โดยเรียงลำดับเนื้อหา ดังนี้
  (1) วัตถุประสงค์ (Purpose)
  (2) วิธีการศึกษา (Methods)
  (3) ผลการศึกษา (Results)
  (4) สรุป (Conclusions**)**
- **คำสำคัญ (Keyword)** ระบุไว้ใต้บทคัดย่อ มีความยาว 4 – 6 คำ
- **ต้นฉบับ (Manuscript)** เป็นภาษาอังกฤษ
- **เนื้อเรื่อง (Text Formatting)** ให้ลำดับความสำคัญของเนื้อหาดังนี้คือ บทนำ (introduction), วิธีการศึกษา (methods), ผลการศึกษา (results), วิจารณ์ (discussion), บทขอบคุณ (acknowledgements), เอกสารอ้างอิง (references), ตารางและรูปภาพประกอบ (tables and figures) โดยต้นฉบับจะต้องใช้รูปแบบ ดังนี้
  (1) ใช้ตัวพิมพ์มาตรฐาน เช่นภาษาอังกฤษ ใช้ตัวอักษร “Times Roman” ขนาด 10 point ภาษาไทยใช้ ตัวอักษร “Angsana New” ขนาด 12 point
  (2) พิมพ์ข้อความสำคัญด้วยตัวเอน
  (3) ตั้งค่าเลขหน้าโดยอัตโนมัติ

(4) ไม่ใช้ “field functions”

(5) ใช้ปุ่ม “Tab” เมื่อขึ้นย่อหน้าต่อไป

(6) เลือกคำสั่งตาราง (Table) เมื่อต้องการพิมพ์ตาราง

(7) หากใช้โปรแกรม “Microsoft Word 2007” ให้ใช้โปรแกรม “Microsoft equation editor” หรือโปรแกรม “Math Type”

(8) ส่งต้นฉบับในรูปของแฟ้มข้อมูล โดยบันทึกข้อมูลเป็นไฟล์ “.doc” และห้ามบันทึกเป็นไฟล์ “.docx”

- **หัวข้อ (headings)** ไม่ควรมีขนาดต่างๆมากกว่า 3 ระดับ
- **คำย่อ (abbreviations)** จะต้องมีคำเต็มเมื่อปรากฏเป็นครั้งแรกในบทความ หลังจากนั้นสามารถใช้คำย่อเหล่านั้นได้ตามปกติ
- **เชิงอรรถ (footnotes)** คือ การอ้างอิงข้อความที่ผู้เขียนนำมากล่าวแยกจากเนื้อหาอยู่ตอนล่างของหน้า โดยใส่หมายเลขกำกับไว้ท้ายข้อความที่คัดลอกหรือเก็บแนวคิดมา และจะไม่เขียนเชิงอรรถเอาไว้ที่หน้าแรกของบทความ ถ้าต้องการแสดงที่มาของตารางหรือภาพประกอบให้ใช้เครื่องหมายแทนตัวเลข โดยเขียนไว้ที่ส่วนล่าง ของหน้า หรือใช้เครื่องหมายดอกจัน (*) เพื่อแสดงความหมายของค่าหรือข้อมูลทางสถิติ
- **กิตติกรรมประกาศ (acknowledgements)** เป็นการแสดงความขอบคุณแก่ผู้ที่ช่วยเหลือในการทำวิจัย หรือผู้สนับสนุนทุนการวิจัย เป็นต้น โดยจะเขียนไว้ก่อนเอกสารอ้างอิงและควรเขียนชื่อสถาบันที่ให้การสนับสนุนทุนการวิจัยโดยใช้ชื่อเต็ม
- **ตาราง (tables)**

(1) ให้เขียนหมายเลขตารางเป็นเลขอารบิก

(2) ให้เรียงตามลำดับที่ของตารางอย่างต่อเนื่องกันจาก 1, 2, 3, ….

(3) การอธิบายผลในตารางต้องไม่ซ้ำซ้อนกันและมีใจความกระชับรัดกุม และมีคำอธิบายกำกับไว้เหนือตาราง

(4) เขียนคำอธิบายเพิ่มเติมเกี่ยวกับแหล่งที่มาของเอกสารอ้างอิงไว้ที่ใต้ตาราง

(5) เชิงอรรถ (footnotes) ของตารางจะเขียนไว้ใต้ตารางหรือใช้เครื่องหมายดอกจัน (*) เพื่อแสดงความหมายของค่าหรือข้อมูลทางสถิติ

- **รูปภาพ (figures)**

(2) ให้ใช้โปรแกรมกราฟฟิกคอมพิวเตอร์ในการวาดรูป

(3) รูปภาพที่เป็นลายเส้นควรใช้รูปแบบ EPS ในการวาดเส้นรูปภาพและรูปภาพที่เป็นโทนสีควรใช้รูปแบบ TIFF ในการไล่เฉดสี

(4) รูปภาพทุกรูปจะต้องมีหมายเลขและคำบรรยายภาพกำกับไว้ใต้ภาพ โดยใช้ชื่อรูปภาพเป็น “Fig” ตามด้วยลำดับที่ของรูปภาพ เช่น “Fig1” เป็นต้น

- **เอกสารอ้างอิง (references)** เรียงลำดับเลขการอ้างอิงตามเอกสารอ้างอิงท้ายบทความ และใช้ตาม Vancouver style การอ้างอิงถึงชื่อบุคคล ถ้ามีผู้เขียนมากกว่า 6 คน ให้ใส่ชื่อ 6 คนแรก แล้วตามด้วย et al. ส่วนการเขียนเอกสารอ้างอิงท้ายบทความ การย่อชื่อวารสารให้ใช้ตาม Index Medicus โดยศึกษาได้ในเว็บไซต์ http://www.medscape.com/home/search/indexMedicus/IndexMedicus-A.html

กรุณาลงนามในแบบฟอร์มการส่งบทความเพื่อขอตีพิมพ์ เพื่อแสดงว่าผู้เขียนได้อ่านเกณฑ์การเขียนบทความทั้งหมด

- **ตัวอย่างการเขียนเอกสารอ้างอิง (references) กรุณาดูในหัวข้อ “ Instruction to authors ”**

The Thai Journal of Orthopaedic Surgery

Acknowledgements to Reviewers 2016

Pongsak Yuktanandana
Editor in Chief

We are fortunate to have an outstanding group of reviewers who kindly volunteer their time and effort to review manuscripts for *The Thai Journal of Orthopaedic Surgery*. They are critical team players in the continued success of the journal, ensuring a peer review process of the high integrity and quality. The editor would like to thank the following reviewers who provided their expertise in evaluating manuscripts for *The Thai Journal of Orthopaedic Surgery* during 2016. A special thanks goes to Jutamas Chearanaya for being our managing editor.

List of reviewers:

Apichart Asavamongkolkul
Aree Tanavalee
Chaithavat Ngarmukos
Charlee Sumettavanich
Charoen Chotigavanich
Chiroj Sooraphanth
Kongkit Pithankuakul
Paphon Sa-Ngasoongsong
Preecha Chalidapong
Piya Kiatisevi
Rapeepat Narkbunnam
Sittisak Honsawek
Surapoj Meknavin
Thanainit Chotanaphuti
Thipachart Bunyaratabanbhu
Thomas Mabey
Viroj Kawinwonggowit
Wanchai Sirisereewan
Wiroon Laupattarakasem