



# 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  
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## สมาชิกดีเด่น

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**Dr. Prapan Chonyuen**

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**Date of Birth:** February 15, 1961

### Office Address:

Department of Orthopedics

Nan Hospital

No.1 Woravichai Road, NaiWieang District,

Nan Province, Thailand

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**E-mail Address:** prapan2797@yahoo.com

### Education:

1988-1991	Lerdsin General Hospital, Bangkok, Thailand. Post Graduation (Residency in Orthopaedic)
1979-1985	Chulalongkorn University, Bangkok, Thailand. Faculty of Medicines, M.D.
1977-1979	Triamudomsuksa School, Bangkok, Thailand. Senior Secondary
1966-1977	Phra Mae Maree School, Bangkok, Thailand. Primary and Secondary

### Research and Publication:

- Spinal Epidural Abscess: The Importance of Early Treatment 3 Cases Report  
J Prapokklao Hosp Clin Med Educat Center 2006; 23: 22-28.

### Merit and Awards:

2015	Outstanding Physician Award Regional Hospital/General Hospital. Thailand
------	---

### Professional Experience:

April 1, 1985 - Present	
1985 - 1986	Medical Officer Level 4, Nan Hospital, Nan
1987	Medical Officer Level 5, Nan Hospital, Nan
1987 - 1988	Medical Officer Level 5, Pua Crown Prince Hospital, Nan
1991 - 1992	Medical Officer Level 6 and Orthopaedic Surgeon, Nan Hospital, Nan
1993 - 2006	Medical Officer Level 7 and Orthopaedic Surgeon, Nan Hospital, Nan
2006 - Present	Medical Officer Level 8 and Orthopaedic Surgeon, Nan Hospital, Nan
1991 - 2016	Head of Orthopaedic Department, Nan Hospital, Nan
1996 - Present	Consultant of Forensic Medicine, Nan Hospital, Nan
1996 - Present	Chairman of Mass Casualty Committee, Nan Hospital, Nan
1998 - 2013	Chairman of Emergency Room Committee, Nan Hospital, Nan
1999 - Present	Chairman of Operating Room Committee, Nan Hospital, Nan
2003 - Present	Consultant of Medical Equipment Center, Nan Hospital, Nan
2010 - Present	Chairman of Medical Record Audit Committee, Nan Hospital, Nan
2013 - 2015	Head of Hospital Medical Committee, Nan Hospital, Nan
2013 - Present	Deputy Director of Medical Supplies, Premises Subdivision Nan Hospital, Nan
2013 - Present	Medical Staff Manpower Planning
2015 - 2016	Deputy Director of General Administration Subdivision, Nan Hospital, Nan

**Achievement in Professional Career:**

- 1991 Trauma Management  
Anterior Spinal Surgery for TBC  
Reconstructive Surgery for Malunion Residual Poliomyelitis  
Lumbar Degenerative Spinal Surgery
- 1994 PDS for Thorcolumbar/Lumbar Spine  
Pediatric Surgery eg Clubfoot CP
- 1995 Organized and Developed Internship Program in Nan Hospital for the Doctors in Accordance to Thai Medical Council
- 1996 Organizing Committee of Annual Northern Orthopaedic Society Meeting in Nan Province
- 1998 Total Joint Arthroplasty  
Emergency C clamp for Pelvic Fractures
- 1999 Cervical Degenerative Spinal Surgery  
Bone Lengthening/Bone Transportation by Simple Threaded Rods External Fixation
- 2005 Organized and Prepared the First Orthopaedic Operation Theater in Pua Crown Prince Hospital, Nan
- 2005 Holistic Care for Complete Spinal Cord Injury- Social Career Disability Rights in Nan Province
- 2006 Workshop for General Public: Safety Workplace and Work Related Injuries to the Thai Traditional Scarf Tangle into Rice Milling Machine Causing Spinal and Long Bone Fracture in Nan Province  
Chairman of Annual Northern Orthopaedic Society Meeting in Nan Province
- 2008 ACDF and ACCF Laminaplasty  
Organizing Multidisciplinary Team for Falling Prevention in Phasingh Community. Nan Province
- 2010 Chairman of Annual Meeting of Specialized Hospital under Department of Medical Services Lerdsin Hospital in Nan Province
- 2013 Chairman of Thai Hip and Knee Society Meeting. Nan Province
- 2014 Committee of Master Plan of Nan Hospital Renovation  
Coordinate with Ministry of Health in Nan to Set Up a Telemedicine in Nan Province
- 2015 Organizing Committee of New Joint for Life Foundation Meeting in Nan Province
- 2016 Organizing Committee of Annual Northern Thai Spine Society Meeting in Nan Province
- 2017 Organizing Committee of Capture the Fracture. Nan Province
- 2018 Organizing Committee of Northern Orthopaedic Society/Royal Collage of Orthopaedic Surgeons of Thailand in Nan Province



## สมาชิกดีเด่น

ราชวิทยาลัยแพทย์ออร์โธปิดิกส์แห่งประเทศไทย

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นพ. กীরติ เจริญชลวานิช

**Dr. Keerati Charoencholvanich**

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**Date of Birth:** November 15, 1964

**Present Post:** Professor

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Faculty of Medicine Siriraj Hospital  
Mahidol University  
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**Phone:** (662) 419-7968

**Fax:** (662) 419-7970

### Education Qualification:

- |             |   |
|-------------|---|
| 1983 - 1988 | - Doctor of Medicine degree (MD.)<br>Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand    |
| 1988        | - Medical Science (Thailand)  |
| 1991 - 1992 | - First Year Resident of Department of Surgery<br>Certificate in Basic Science of Surgery                           |
| 1992        | - Diploma in Clinical Sciences  |
| 1992 - 1994 | - Resident of department of Orthopaedic Surgery   |
| 1994        | - Diploma Thai Board of Orthopaedic Surgery<br>Medical Council of Thailand  |
| 1995        | - Diploma of Sport Medicine (FIMS)  |
| 1995 - 1997 | - Fellowship in Adult Reconstructive Surgery<br>Hennepin Medical Center, University of Minnesota, Minnesota, U.S.A. |
| 1997        | - AO Fellowship in Pelvis and Hip Surgery<br>Inselspital Hospital, Bern, Switzerland                                |

### Practice:

- |                |   |
|----------------|---|
| 1988 - 1991    | Orthopaedic Practitioner<br>Orthopaedic Department, Faculty of Medicine, Chiang Mai University, Thailand  |
| 1994 - Present | Instructor in Orthopaedic Surgery<br>Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand |

### Academic Appointments:

- Attending Surgeon, Department of Orthopaedic Surgery  
Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand  
July 14, 1994.
- Clinical Instructor, Orthopaedic Oncology  
Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand  
December 25, 1996.
- Assistant Professor, Department of Orthopaedic Surgery  
Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand  
November 15, 2002.
- Associate Professor, Department of Orthopaedic Surgery  
Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand  
February 2, 2006.
- Professor, Department of Orthopaedic Surgery  
Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand  
October 28, 2016 - Present.



### Honors:

1. Second winner resident paper contest in Royal College of Surgery Thailand, Congress 1994.
2. Finalist new investigator recognition award in Orthopaedic Research Society Meeting, San Francisco 1997.
3. Best Research Award From the Royal College of Orthopedic Surgeons of Thailand 2012.
4. Best Research Award From the Royal College of Orthopedic Surgeons of Thailand 2013.
5. Siriraj Award From Siriraj Hospital, Mahidol University 2014.
6. Alumni Awards From Siriraj Hospital, Mahidol University 2014.
7. Best Research Award From the Royal College of Orthopedic Surgeons of Thailand 2015.
8. Siriraj Book Awards From Siriraj Hospital, Mahidol University 2016.
9. Esteemed Doctor Award 2016 From Siriraj Piyamaharajkarun Hospital.
10. Service Minded Doctor Award 2017 From Siriraj Piyamaharajkarun Hospital.

### Publication:

1. Waikakul S, Penkitti P, Charoencholvanich K. Oral antimicrobials in compound fracture of Thailand: Comparison of dicloxacillin and of ofloxacin. J Med Assoc Thai 1996.
2. Chareancholvanich K, Becker DA, Gustilo RB. Treatment of congenital dislocated hip by arthroplasty with femoral shortening. Clin Orthop Relat Res. 1999; (360): 127-35.
3. Chareancholvanich K, Tanchuling A, Seki T, Gustilo RB. Cementless acetabular revision for aseptic failure of cemented hip arthroplasty. Clin Orthop Relat Res. 1999; (361): 140-9.
4. Harnrongroj T, Asavamongkolkul A, Charoencholvanich K. Reconstruction of the pelvic brim and its role in the reduction accuracy of displaced T-shape of acetabular fracture. J Med Assoc Thai. 2000; 83(5): 483-93.
5. Chareancholvanich K, Bourgeault CA, Schmidt AH, Gustilo RB, Lew WD. In vitro stability of cemented and cementless femoral stems with compaction. Clin Orthop Relat Res. 2002; (394): 290-302.
6. Kold S, Bechtold JE, Ding M, Chareancholvanich K, Rahbek O, Soballe K. Compacted cancellous bone has a spring-back effect. Acta Orthop Scand. 2003; 74(5): 591-5.
7. Charoencholvanich K, Siriattanasakul P. Patellar thickness in patients undergoing total knee arthroplasty. Thai J Orthop Surg 2004; 29(2): 73-6.
8. Charoencholvanich K, Kruwanont W, Piyawinichwong S, Harnrongroj T. Subchondral plate thickness of the femoral head and the talar dome. Thai J Orthop Surg 2004; 29(2): 77-80.
9. Charoencholvanich K, Pongcharoen B. Oxford knee score and SF-36: Translation & Reliability for use with total knee arthroscopy patients in Thailand. J Med Assoc Thai 2005; 88(9): 1194-202.
10. Piyakunmala K, Sangkomkamhang T, Chareonchonvanitch K. 'Rail road' proximal femoral osteotomy: a new technique to remove well-fixed femoral stem or cement mantle in revision total hip arthroplasty. J Med Assoc Thai. 2009; 92 Suppl 6: S152-5.
11. Piyakunmala K, Sangkomkamhang T, Chareonchonvanitch K. Is magnetic resonance imaging necessary for normal plain radiography evaluation of contralateral non-traumatic asymptomatic femoral head in high osteonecrosis risk patient. J Med Assoc Thai. 2009; 92 Suppl 6: S147-51.
12. Tangsataphorn S, Chareancholvanich K. Paradoxical embolism in bilateral total knee arthroplasty: A case report. J Med Assoc Thai. 2009; 92 (10): 1387-92.
13. Sutipornpalangkul W, Morales NP, Charoencholvanich K, Harnrongroj T. Lipid peroxidation, glutathione, vitamin E, and antioxidant enzymes in synovial fluid from patients with osteoarthritis. International Journal of Rheumatic Diseases 2009; 12(4), pp. 324-8.
14. Charoencholvanich K, Siriattanasakul P. Tranexamic acid reduces blood loss and blood transfusion after TKA: A prospective randomized controlled trial. Clin Orthop Relat Res. 2011; 469(10): 2874-80.
15. Pikulkaew T, Pornrattanamaneewong C, Chareancholvanich K. Anatomical landmark to locate the ankle center for determination of the mechanical axis of the lower extremity in Thai subjects. J Med Assoc Thai 2012; 95 Suppl 9: S1-5.
16. Santanapipatkul P, Chareancholvanich K. Results for the mobile-bearing rotating platform knee: minimum 10-year follow-up. J Med Assoc Thai 2012; 95 Suppl 9: S36-40.
17. Pornrattanamaneewong C, Harnrongroj T, Chareancholvanich K. Loss of correction after medial opening wedge high tibial osteotomy: a comparison of locking plates without bone grafts and non-locking compression plates with bone grafts. J Med Assoc Thai 2012; 95 Suppl 9: S21-8.
18. Chareancholvanich K, Pikulkaew T, Pornrattanamaneewong C. Varus inclination of the tibial plateau in Thai adults: a concise radiographic evaluation. J Med Assoc Thai. 2012; 95 Suppl 9: S41-6.
19. Chareancholvanich K, Narkbunnam R. Novel method of measuring patellar height ratio using a distal femoral reference point. Int Orthop. 2012; 36(4): 749-53.



20. Narkbunnam R, Chareancholvanich K. Causes of failure in total knee arthroplasty. *J Med Assoc Thai*. 2012; 95(5): 667-73.
21. Chareancholvanich K, Udomkiat P, Waikakul S. A randomized control trial between fosfomycin and cefuroxime as the antibiotic prophylaxis in knee arthroplasty. *J Med Assoc Thai*. 2012; 95Suppl 9: S6-13.
22. Pornrattanamaneewong C, Narkbunnam R, Chareancholvanich K. Medial proximal tibial angle after medial opening wedge HTO: A retrospective diagnostic test study. *Indian J Orthop*. 2012; 46 (5): 525-30.
23. Chareancholvanich K, Siriwanasakul P, Narkbunnam R, Pornrattanamaneewong C. Temporary clamping of drain combined with tranexamic acid reduce blood loss after total knee arthroplasty: A prospective randomized controlled trial. *BMC Musculoskelet Disord*. 2012; 13: 124.
24. Pornrattanamaneewong C, Numkanisorn S, Chareancholvanich K, Harnroongroj T. A retrospective analysis of medial opening wedge high tibial osteotomy for varus osteoarthritic knee. *Indian J Orthop*. 2012; 46(4): 455-61.
25. Pornrattanamaneewong C, Narkbunnam R, Siriwanasakul P, Chareancholvanich K. Three-hour interval drain clamping reduces postoperative bleeding in total knee arthroplasty: A prospective randomized controlled trial. *Arch Orthop Trauma Surg*. 2012; 132(7): 1059-63.
26. Pengkhum T, Chatsiricharoenkul S, Akarasereenont P, Charoencholvanich K. Phase II clinical trial of Ayurved Siriraj Wattana Recipe for symptomatic relief in patients with osteoarthritis of the knee. *J Med Assoc Thai*. 2012; 95(3): 452-60.
27. Yuenyongviwat V, Pornrattanamaneewong C, Chinachoti T, Chareancholvanich K. Periarticular injection with bupivacaine for postoperative pain control in total knee replacement: a prospective randomized double-blind controlled trial. *Adv Orthop*. 2012; 2012: 107309.
28. Pornrattanamaneewong C, Numkanisorn S, Chareancholvanich K, Harnroongroj T. Author's reply. *Indian J Orthop*. 2013; 47(2): 215.
29. Narkbunnam R, Chareancholvanich K, Harnroongroj T. Sagittal plane evaluation of patellofemoral movement in patellofemoral pain patients with no evidence of maltracking. *Knee Surg Sports Traumatol Arthrosc*. 2013 Nov 29.
30. Chareancholvanich K, Narkbunnam R, Pornrattanamaneewong C. A prospective randomised controlled study of patient-specific cutting guides compared with conventional instrumentation in total knee replacement. *Bone Joint J*. 2013; 95-B(3): 354-9.
31. Pongcharoen B, Yakampor T, Charoencholvanich K. Patellar tracking and anterior knee pain are similar after medial parapatellar and midvastus approaches in minimally invasive TKA. *Clin Orthop Relat Res*. 2013; 471: 1654-60.
32. Boontanapibul K, Ruangsomboon P, Charoencholvanich K. Sterility verification of innovative pressurized carbon dioxide lavage for bone surface preparation in cemented knee arthroplasty. *J Med Assoc Thai*. 2014; 97 Suppl 9: S108-11.
33. Lapmahapaisan S, Chinachoti T, Maisat W, Kleebschan N, Chatsiricharoenkul S, Charoencholvanich K, et al. Plasma concentrations of bupivacaine after spinal anesthesia with single shot femoral nerve block and periarticular injection in total knee arthroplasty. *J Med Assoc Thai*. 2014; 97(7): 724-9.
34. Chareancholvanich K, Pornrattanamaneewong C. Does the length of incision in the quadriceps affect the recovery of strength after total knee replacement? a prospective randomised clinical trial. *Bone Joint J*. 2014; 96-B(7): 902-6.
35. Chareancholvanich K, Pornrattanamaneewong C, Narkbunnam R. Increased cartilage volume after injection of hyaluronic acid in osteoarthritis knee patients who underwent high tibial osteotomy. *Knee Surg Sports Traumatol Arthrosc*. 2014; 22(6): 1415-23.
36. Lapmahapaisan S, Chinachoti T, Maisat W, Kleebschan N, Chatsiricharoenkul S, Charoencholvanich K, et al. Plasma concentrations of bupivacaine after spinal anesthesia with single shot femoral nerve block and periarticular injection in total knee arthroplasty. *J Med Assoc Thai*. 2014; 97(7): 724-9.
37. Iamthanaporn K, Chareancholvanich K, Pornrattanamaneewong C. Revision primary total hip replacement: causes and risk factors. *J Med Assoc Thai*. 2015; 98(1): 93-9.
38. Narkbunnam R, Chareancholvanich K, Harnroongroj T. Sagittal plane evaluation of patellofemoral movement in patellofemoral pain patients with no evidence of maltracking. *Knee Surg Sports Traumatol Arthrosc*. 2015; 23(4): 986-90.
39. Narkbunnam R, Chareancholvanich K. Effect of patient position on measurement of patellar height ratio. *Arch Orthop Trauma Surg*. 2015; 135(8): 1151-6.
40. Ruangsomboon P, Chinprasertsuk S, Khejonit V, Chareancholvanich K. Effect of Depth of Centrifuged Synovial Fluid on Leukocyte Esterase Test for Periprosthetic Joint Infection.

- J Orthop Res. 2017; 35(11): 2545-50.
41. Ruangsomboon P, Chareancholvanich K, Harnroongroj T, Pornrattanamaneeewong C. Survivorship of medial opening wedge high tibial osteotomy in the elderly: two to ten years of follow up. Int Orthop. 2017; 41(10): 2045-52.
  42. Phermthai T, Pokathikorn P, Thongbopit S, Chareancholvanich K, Parnpai R, Julavijitphong S, et al. (2017) Quality of Life of Elderly and Obese Animal Models with Severe Knee Osteoarthritis after a Single Injection of Mesenchymal Stem Cells. Int J Stem Cell Res Transplant, S3:001, 1-9.
  43. Jitmuang A, Yuenyongviwat V, Charoencholvanich K, Chayakulkeeree M. Rapidly-growing mycobacterial infection: a recognized cause of early-onset prosthetic joint infection. BMC Infect Dis. 2017; 17: 802.
  44. Pornrattanamaneeewong C, Narkbunnam R, Chareancholvanich K. Guia personalizada para posicionamento de componente femoral para resurfacing em artroplastia do quadril. Acta Ortop Bras. 2017; 25(2): 103-6.
  45. Tangwiwat S, Iamaroon A, Lurngnateetape A, Chareancholvanich K, Nuntawinit C, Imkong P. A Block Room in Parallel Processing Shortens the Anesthesia Utilization Time in Orthopedic Operating Rooms; A Prospective Cross-Sectional Study. J Med Assoc Thai. 2017; 100 Suppl 7: S166-72.
  46. Pornrattanamaneeewong C, Ruangsomboon P, Chareancholvanich K, Wilairatana V, Narkbunnam R. Modified Robert Jones bandage cannot reduce invisible blood loss after total knee arthroplasty: a randomized-controlled trial. Arch Orthop Trauma Surg. 2018; 138(8): 1151-7.
  47. Iamthanaporn K, Chareancholvanich K, Pornrattanamaneeewong C. Reasons for revision of failed hemiarthroplasty: Are there any differences between unipolar and bipolar?. Eur J Orthop Surg Traumatol. 2018; 28(6): 1117-23.
  48. Ruangsomboon P, Ohashi M, Pornrattanamaneeewong C, Chareancholvanich K, Chotivichit A. Retrieval analysis of polyethylene in total knee arthroplasty in thailand: A case report. Siriraj Med J 2018; 70(2): 175-7.



## สมาชิกดีเด่น

ราชวิทยาลัยแพทย์ออร์โธปิดิกส์แห่งประเทศไทย

สมาชิกดีเด่น สาขาบริหาร

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### Education:

**High School:** Suankularb Wittayalai School 1972-1976

**University:** Faculty of Medicine Siriraj Hospital Mahidol University 1977-1983

#### Post graduation:

- Certificate of FIMS (Federation of International Sports Medicine) 1985
- Diplomate Thai Board of Orthopaedic (Faculty of Medicine Siriraj Hospital Mahidol University) 1989
- Certificate Fellowship in Orthopedics U. of Toronto Canada 1993

### University /Hospital/Organization Appointment:

1. Chairman, Department of Orthopaedic Surgery, Faculty of Medicine Vajira Hospital Navamindradhiraj University 1998-2002
2. Chairman, Department of Orthopaedics, Faculty of Medicine Srinakharinwirot University 1998-2002
3. Director, Sirindhorn Hospital 2002-2008
4. Director, Taksin Hospital 2008-2009
5. Director BMA General Hospital (Klang Hospital) 2009-2010
6. Deputy Director-General, Medical Service Department 2010-2012
7. Senior Inspector General Bangkok Metropolitan Administration 2012-2016
8. Director-General, Medical Service Department 2016-2017
9. Deputy Permanent Secretary for Bangkok Metropolitan Administration 2 October 2017-present

### RCOST Activities:

- Council member executive committee, The Royal College of Orthopaedic Surgeons of Thailand 1998-2018

### Other Professional Activities:

- Thailand Football team doctor [U18,U19] Olympic Team, F.A. Thailand 1985-1996
- Thailand National (First) team doctor, 1996-2011

### Awards and Honours:

- The prize of "the best paper award" from the Annual meeting of the Royal College of Orthopaedic Surgeons of Thailand 1995

- The scholarship of Zimmer-AAOS Traveling Fellowship for the annual meeting of American Academy of Orthopedic Surgeon, Atlanta, USA 1996

**Important Executive Course:**

- The National Defence College (NDC) 2012-2013
- Bangkok Municipal Administration (BMA),  
The Professional City Administrator batch 3,  
Institute of Metropolitan development 2014
- The programme for senior executives on justice  
Administration batch 19,  
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## Editorial

The Thai Journal of Orthopaedic Surgery Volume 42/Number 3-4 July-October 2018 is published in October 2018 along with the RCOST meeting in Pattaya. Congratulation to 3 RCOST members who get the honorary member this year including Dr. Prapan Chonyuen from Nan Hospital, Professor Dr. Keerati Charoencholvanich from Siriraj Hospital, Mahidol University and Dr. Pijaya Nagavajra from Bangkok Metropolitan Administration. This issue in your hand consists of several interesting articles. The first one is the Translation and Validation of the Thai Forgotten Joint Score for knee arthroplasty which will be one of the scoring system that translate into Thai and can be used to evaluate the outcomes in our country. The second is the development of alignment guide to facilitate the total knee arthroplasty, how to avoid the angular deformity in coronal plane. The third is the Comparison of Simultaneous Bilateral with Unilateral Total Knee Arthroplasty in Thabo Crown Prince Hospital. Bilateral TKR seems to be the aggressive procedure, however, this manuscript demonstrated the results and advantages for considering one stage procedure to reduce the admission, rehabilitation and hospitalization. This can also be done in the non university hospital. Lastly, the results of tibial plating comparing the results and complications of anteromedial and anterolateral approach. This common surgery will add the point how to select the patient for both approach. There is one review article of Factors affect successful Fast-Track total knee arthroplasty. I believe you will enjoy reading them.

Our journal is making progress in a positive way with supporting from the RCOST committee and all RCOST members who submit their valuable work in Orthopaedic field to demonstrated the up to date knowledge and skill or basic knowledge of Administration system to improve national policy in treating Orthopaedic patients. We will try our best aiming to have the journal list in the Level One of the Thai-Journal Citation Index (TCI) in the future.

Professor Theerachai Apivatthakakul, M.D.  
Editor, The Thai Journal of Orthopaedic Surgery



# Translation and Validation of the Thai Forgotten Joint Score for Knee Arthroplasty Patients

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**Introduction:** Several patient-reported outcome measurements (PROMs) are used to evaluate the outcomes after knee arthroplasty. Joint awareness in everyday life, which is a new aspect to evaluate the outcome and the ability to forget the artificial joint, is claimed as the ultimate goal resulting in maximum patient satisfaction. The purpose of this study is to translate and validate a Thai version of the Forgotten Joint Score (TH-FJS).

**Methods:** We performed the Thai translation procedure based on an internationally accepted standard. Between November 2017 and June 2018, we evaluated the TH-FJS for validity and reliability. In the validity study, the patient following knee arthroplasty completed the TH-FJS questionnaire, Oxford Knee Score (OKS), and Western Ontario & McMaster Universities Osteoarthritis Index (WOMAC). The test-retest evaluation was performed in the reliability study with a 2-week interval. A ceiling effect was defined as participants reaching a score within 15% of the maximum score.

**Results:** There were 85 patients (average age, 71.0 years) included in this study. The test-retest reliability of the TH-FJS was high with an intraclass correlation coefficient (ICC) = 0.95 (95% CI 0.9, 0.97). We found a high level of internal consistency with a Cronbach's  $\alpha$  of 0.92. The ceiling effect for the TH-FJS was 28%, as compared to 49% for OKS, and 58% for WOMAC.

**Conclusion:** The Thai language version of the FJS had high level of internal consistency and was proved to be a reliable tool for evaluating knee arthroplasty patients in Thailand. The low ceiling effect characteristic of the score can help the surgeon to detect small difference in the good and excellent outcomes after knee arthroplasty.

**Keywords:** Thai, forgotten joint score, FJS, knee arthroplasty, ceiling effect

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**Full text. e journal:** <http://www.rcost.or.th>, <http://thailand.digitaljournals.org/index.php/JRCOST>

## Introduction

Knee arthroplasty is one of the most effective treatment options for pain relief and functional recovery in patients with severe knee osteoarthritis<sup>(1)</sup>. In the past, the outcomes of the knee arthroplasty were evaluated using mainly on the measurements from surgeon-centered view, such as the postoperative range of motion (ROM), joint stability, implant survivorship, and radiographic parameters. Despite the fact that knee arthroplasty is one of the most successful operation and has the reliable outcomes, there are approximately 20% of the patients report dissatisfaction following knee replacement<sup>(2)</sup>. Harris et al.<sup>(3)</sup> reported there was a discordance between patient satisfaction and surgeon satisfaction (90.3% vs. 94.5%) in 331 total knee arthroplasty (TKA).

The patient satisfaction becomes the important part of the outcome evaluation after knee arthroplasty. The surgeons have to use the patient-reported outcome measures (PROMs) as a tool to

access the patient satisfaction with the treatment. There are many patient satisfaction measurement tools reported in the literature. The commonly used PROMs include the 12-item Short Form Health Survey (SF-12)<sup>(4)</sup>, the Western Ontario and McMaster Universities Arthritis Index (WOMAC)<sup>(5)</sup>, the Knee injury and Osteoarthritis Outcome Score (KOOS)<sup>(6)</sup>, and the Oxford Knee Score (OKS)<sup>(7)</sup>.

In 2012, Behrend et al.<sup>(8)</sup> proposed the Forgotten joint score (FJS) as a new aspect of PROMs.

The questionnaire measures the patient's ability to forget the artificial joint in everyday life. The concept is that loss of awareness of the artificial joint can define as the ultimate goal and resulting in maximum patient satisfaction. Many publications trended to use the FJS as one of the outcome measurements not only in the field of the hip and knee arthroplasty<sup>(9-11)</sup>, but also the arthroscopic surgery<sup>(12,13)</sup>.

The FJS has the unique characteristic of lower ceiling effect when compared to other PROMs<sup>(14)</sup>. In terms of the low ceiling effect, the FJS has an ability to discriminate between patients with good outcomes and patients with excellent outcomes which makes the FJS an interesting tool

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for the outcome measurement to detect subtle difference in this group of patients.

The FJS is a self-administered questionnaire. It has been translated into many different languages worldwide<sup>(15-18)</sup>. However, the applicability of the FJS for the Thai population is questionable because there is a difference both in language and culture between Thai people and the people in the western countries, where the questionnaire was developed.

The objectives of the study were to develop a Thai version of the FJS and to evaluate the validity and reliability of the Thai version of the FJS (TH-FJS).

## Materials and Methods

### Translation

A Thai version of the FJS was developed using the internationally accepted standard process in translating of the health status questionnaires<sup>(19)</sup> and was also approved by the developer of the original FJS. Translation methods included:

- 1) Two forward translations into Thai, performed by two people working independently from each other
- 2) Reconciliation of the two translations by three senior arthroplasty surgeons in our center who chooses the better version for each item, or merges the two in order to achieve the optimal translation
- 3) Two back translations into English, performed by two bilingual translators working independently from each other and who have not seen the original English questionnaire
- 4) Review of the translation report and comments from the developer team
- 5) Proofreading by a professional translator
- 6) Pilot-testing on 10-15 patients with knee and hip problems
- 7) Review of the report of the pilot-testing
- 8) Established the finalized Thai version of the FJS (TH-FJS)

### Patients

A prospective descriptive study was conducted at the outpatient clinic, Department of Orthopaedics, Faculty of Medicine, Chulalongkorn University from November 2017 to June 2018. The study protocol was approved by the Ethics Committee of Faculty of Medicine, Chulalongkorn University. The informed consent from each participant was obtained before inclusion into the study.

The patients who underwent unilateral unicompartmental knee arthroplasty (UKA) or total knee arthroplasty (TKA) for at least 12 months postoperative period with sufficient reading and comprehension capacity were included in the study.

The exclusion criteria included another disorders of the lower extremity, mental disorders such as dementia, and revision surgery for any causes.

All participants were asked to complete the TH-FJS, OKS, and WOMAC for the validity study. For the test-retest reliability study, some participants were asked to complete the second TH-FJS questionnaire at least 2 weeks interval from the first questionnaire.

### The Forgotten Joint Score

The FJS is a self-administered questionnaire. It measures the awareness of the artificial joint using a five-grade Likert scale. The FJS comprises of 12 questions (Table 1.) regarding whether patients are aware of having the artificial joint during activities of daily living (such as being in bed at night, climbing stairs, and taking a bath). The scoring method of the FJS is as follows: 0, never; 1, almost never; 2, seldom; 3, sometimes; 4, mostly. The mean value for the 12 items is multiplied by 25, and the obtained value is subtracted from 100. The final score range is 0 (worst) to 100 (best).

**Table 1** Questions included in the FJS questionnaire (adapted from<sup>(17)</sup>)

	Are you aware of your artificial knee ...
1	... in bed at night?
2	... when sitting on a chair for more than one hour?
3	... when you are walking for more than 15 minutes?
4	... when taking a bath/shower?
5	... when traveling in a car?
6	... when climbing stairs?
7	... when walking on uneven ground?
8	... when standing up from a low-sitting position?
9	... when standing for long periods of time?
10	... when doing housework or gardening?
11	... when taking a walk or hiking?
12	... when doing your favorite sport?

### Statistical analysis

The test-retest reliability was evaluated using the intraclass correlation coefficient (ICC) estimated from a one-way ANOVA model. The ICC calculated was classified in terms of according to the guidelines presented by Landis and Koch<sup>(20)</sup>: < 0.2, poor; 0.2-0.4, fair; 0.4-0.6, moderate; 0.6-0.8, substantial; and > 0.8, almost perfect. Cronbach's  $\alpha$  was used to evaluate the internal consistency of the FJS, which measures the extent to which each of the 12 items of the FJS questionnaire measure the same construct. A Cronbach's  $\alpha$  of > 0.9 was considered satisfactory<sup>(21)</sup>.

A ceiling effect was defined as when patients reached a score within 15% of the maximum achievable score for the FJS ( $\geq 85$  points) and the OKS ( $\geq 41$  points). Statistical analysis was performed using SPSS software. A  $p$ -value < 0.05 was considered statistically significant.



**Hip Questionnaire (Forgotten Joint Score - 12)**

ผู้ป่วย: \_\_\_\_\_ วันที่: \_\_\_\_\_

ข้อต่อที่ศึกษาจะทำให้เรารู้สึกถึงข้อในในชีวิตประจำวัน อย่างไรก็ตาม ปัญหาเกี่ยวกับข้อนี้เพียงเล็กน้อยจะส่งผลให้เรารู้สึกถึงข้อไม่ได้ หมายความว่าถ้าทำให้เรารู้สึกถึงข้อให้มีความสนใจข้อนี้มากกว่าปกติ

คำถามต่อไปนี้จะถามเกี่ยวกับความถี่ที่คุณรู้สึกข้อสะโพกที่มีปัญหาในชีวิตประจำวัน (เช่น อากาศปวด มีเสียงดังในข้อ ข้อฝืด ข้อไม่มั่นคง เป็นต้น)

โปรดเลือกคำตอบที่เหมาะสมมากที่สุดในแต่ละคำถามต่อไปนี้

คุณรู้สึกข้อสะโพกของคุณหรือไม่...	ไม่เคย	เกือบจะ ไม่เคย	นานๆ ครั้ง	บางครั้ง	ส่วนใหญ่
1. ... ตอนนอนกลางคืน?	○	○	○	○	○
2. ... เมื่อคุณนั่งบนเก้าอี้นานมากกว่า 1 ชั่วโมง?	○	○	○	○	○
3. ... เมื่อคุณเดินมากกว่า 15 นาที?	○	○	○	○	○
4. ... เมื่อคุณกำลังอาบน้ำ?	○	○	○	○	○
5. ... เมื่อคุณกำลังเดินทางด้วยรถยนต์?	○	○	○	○	○
6. ... เมื่อคุณเดินขึ้นลงบันได?	○	○	○	○	○
7. ... เมื่อคุณกำลังเดินบนพื้นขรุขระ?	○	○	○	○	○
8. ... เมื่อคุณกำลังลุกขึ้นยืนจากตำแหน่งนั่งต่ำ?	○	○	○	○	○
9. ... เมื่อคุณยืนเป็นเวลานาน?	○	○	○	○	○
10. ... เมื่อคุณกำลังทำงานบ้านหรือทำสวน?	○	○	○	○	○
11. ... เมื่อคุณกำลังเดินขึ้นหรือลงบันได?	○	○	○	○	○
12. ... เมื่อคุณกำลังเดินขึ้นบันไดที่คุณชื่นชอบ?	○	○	○	○	○

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Fig.2 TH-FJS Hip Questionnaire

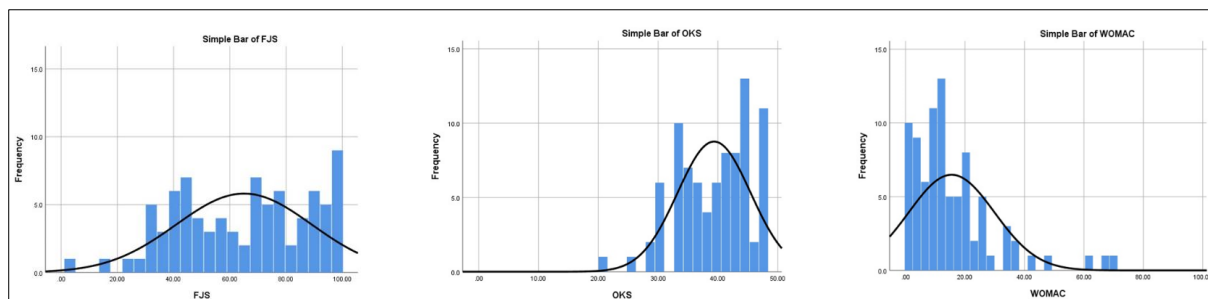


Fig.3 Distribution of each score

## Discussion

Although knee arthroplasty has been a successful operation with a reliable outcome after the surgery, advances of orthopedic technologies is continuing. In the recent years, there was improvement in the implant designs, biomaterials, surgical techniques, perioperative cares, and postoperative rehabilitation resulting in better postoperative outcomes. The outcome evaluation after knee arthroplasty can be classified into two main categories including the surgeon-based outcomes and PROMs. The PROMs has been developed because there was increasing more concern on the patient's satisfaction as one of the key to indicate the successful surgery.

FJS is one of the new PROMs developed in 2012<sup>(8)</sup> that have been used increasingly both in the clinical setting and in the literature. The major advantage of the FJS compared to other PROMs is that it has lower ceiling effect<sup>(14)</sup>. While other PROMs reported maximum achievable scores in the patients with good postoperative outcomes, the FJS still showed recorded scores within the range. So FJS can discriminate among patients with good, very good, and excellent outcomes. In this study, TH-FJS had lower ceiling effect when compared with OKS and WOMAC, which was similar to the previous studies<sup>(15,17)</sup>.

FJS is the self-administered questionnaire. The outcomes of the questionnaire will be valid and reliable when the patients have to read and answer

the questionnaire by themselves. However, in order to use the FJS effectively in the Thai patients, we have to translate the FJS to accommodate the different language and culture of individual country which is not the same as the originally developed FJS country.

The Thai translation process of the FJS is performed using the internationally accepted standard process<sup>(19)</sup> and all the steps of the translation were under the supervision from the FJS developer team. The reliability study showed that TH-FJS had high level of internal consistency demonstrated by Cronbach's  $\alpha$  which was similar to that of other studies<sup>(15-17)</sup>. The test-retest reliability in this study was almost perfect reliability from the high value of the ICC which was also similar to that of other studies<sup>(16,17)</sup>.

## Conclusion

The Thai language version of the FJS had high level of internal consistency and was proved to be a reliable tool for evaluating knee arthroplasty patients in Thailand. The low ceiling effect characteristic of the score can help the surgeon to detect small difference in the good and excellent outcomes after knee arthroplasty.

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## การแปลและการตรวจสอบความถูกต้องของ *Forgotten Joint Score* ฉบับภาษาไทยต่อผู้ป่วยที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียม

ปรีวัฒน์ ทวีศักดิ์กุล, พบ, สิทธิชัย งามอุโฆษ, พบ, อารี ตनावลี, พบ

**บทนำ:** มีการใช้แบบประเมินโดยตัวผู้ป่วยเอง (*patient-reported outcome measurements (PROMs)*) ในการประเมินผลลัพธ์หลังการผ่าตัดเปลี่ยนข้อเข่าเทียมมากมายในปัจจุบัน การรู้ถึงข้อดีข้อด้อยในชีวิตประจำวันนั้นถือเป็นรูปแบบใหม่ในการประเมินผู้ป่วยหลังการผ่าตัดเปลี่ยนข้อเข่าเทียม โดยเชื่อว่าการลืมนำข้อเข่าเทียมนั้นๆ ในการทำกิจวัตรประจำวัน ได้ถือว่าการประสบความสำเร็จของการผ่าตัดรวมทั้งแสดงถึงความพึงพอใจของผู้ป่วยอย่างมาก จุดประสงค์ของการศึกษานี้ เพื่อแปลและตรวจสอบความถูกต้องของ *Forgotten Joint Score* ฉบับภาษาไทย

**ระเบียบวิธีวิจัย:** คณะผู้วิจัยทำการแปล *Forgotten Joint Score* ฉบับภาษาไทย ตามระเบียบวิธีที่ได้รับการยอมรับตามมาตรฐานสากล จากนั้นทำการประเมินความถูกต้องและความน่าเชื่อถือของ *Forgotten Joint Score* ฉบับภาษาไทย การศึกษาความถูกต้องนั้น ผู้เข้าร่วมวิจัยต้องตอบแบบสอบถาม *Forgotten Joint Score* ฉบับภาษาไทย, *Oxford Knee Score (OKS)* และ *Western Ontario & McMaster Universities Osteoarthritis Index (WOMAC)* การศึกษาความน่าเชื่อถือ ใช้การประเมิน *test-retest reliability* โดยให้ผู้ป่วยตอบแบบสอบถามซ้ำอีกครั้งที่เวลาอย่างน้อยสองสัปดาห์จากแบบสอบถามครั้งแรก การประเมิน *ceiling effect* ของแบบสอบถาม ใช้เกณฑ์ที่คะแนนอยู่ภายใน 15% ของคะแนนเต็มของแบบสอบถามนั้น

**ผลการศึกษา:** ระหว่างเดือนพฤศจิกายน 2560 ถึง มิถุนายน 2561 มีผู้เข้าร่วมวิจัย 85 คน (อายุเฉลี่ย 71 ปี) การประเมิน *test-retest reliability* ได้ค่าที่สูง จากค่า *intraclass correlation coefficient (ICC)* = 0.95 (95% CI 0.9, 0.97) อีกทั้งยังพบค่า *internal consistency* ที่สูงเช่นกัน โดยคำนวณค่า *Cronbach's  $\alpha$*  = 0.92 การประเมิน *ceiling effect* พบว่า *Forgotten Joint Score* ฉบับภาษาไทยมีค่า *ceiling effect* 28% เปรียบเทียบกับ OKS ซึ่งมีค่า 49% และ WOMAC ซึ่งมีค่า 58%

**สรุป:** *Forgotten Joint Score* ฉบับภาษาไทย มีค่า *internal consistency* ที่สูง อีกทั้งยังเป็นเครื่องมือที่ใช้ในการประเมินผู้ป่วยเปลี่ยนข้อเข่าเทียมที่มีความน่าเชื่อถือ ค่า *ceiling effect* ที่ต่ำของแบบสอบถามนี้ยังช่วยให้แพทย์สามารถแยกความแตกต่างของผู้ป่วยกลุ่มที่ได้ผลลัพธ์หลังการผ่าตัดที่ดีและดีมากได้อีกด้วย

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# Intramedullary Versus Extramedullary Tibial Alignment Guides in Total Knee Arthroplasty: A Radiographic Analysis

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**Purpose:** to evaluate the postoperative radiographic position of the TKA components and compare the difference in the accuracy of positioning of tibial components between Intramedullary guides tibia and extramedullary guides tibia.

**Methods:** An intramedullary guide was used in 50 cases and extramedullary guide was used in another 50 cases. A radiographic study was performed after 3 month of follow up to evaluate postoperative component position and compare the difference in the tibiofemoral angle and the tibial component angle between 2 groups.

**Results:** Radiographic analysis showed that satisfactory position was achieved using both types of instrumentation. No statistically significant difference was observed in the tibiofemoral angle. However the coronal plane positioning of the tibial component revealed a statistically significant difference ( $p < 0.01$ ), with intramedullary guides being superior to extramedullary guides. Both groups were within the percentage of outlier ( $< 3$  degree varus). The mean surgery time and the drainage blood loss in intramedullary guides was more than extramedullary guides with statistically significant difference ( $p < 0.01$ ).

**Conclusion:** Both techniques allowed satisfactory alignment. It is important for the surgeon to appreciate the benefits and deficiencies of each guide and to use whichever is suited most properly in each particular case.

**Keywords:** Intramedullary versus extramedullary tibial alignment guides

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## Introduction

Fundamental objectives of total knee arthroplasty (TKA) include relieve of pain, correction of deformity and restoration range of motion and function near normal of activity daily living. The prosthetic placement and overall limb alignment correlate with long-term clinical success. Positioning of the implant is felt to be the most important factor and significant increase in loosening when the tibial implant was placed more than 3 degree of varus<sup>(1-8,11-14)</sup>. The purpose of this study was to evaluate the postoperative radiographic position of the TKA components and compare the difference in the accuracy of positioning of tibial components between Intramedullary guides tibia and extramedullary guides tibia.

## Materials and Methods

At the King Narai Hospital in Lopburi, Thailand, 100 cemented posterior stabilized design (PFC sigma Depuy Synthes) TKA were implanted in 61 left knees and 39 right knees by a single surgeon. A block randomization technique was applied. A computer randomization system was

used to allocate each patient to either the extramedullary guides tibia or intramedullary guides tibia. Prior to each surgery, the surgeon opened an opaque sealed envelope to determine the allocation. The femoral component was positioned using intramedullary guides in both groups.

## Radiographic Analysis

After surgery, each patient was evaluated using a standing long-leg alignment radiographs. All radiograph were performed at the distance of 190 cm. Angular measurements include

1. The tibiofemoral angle is the angle between the anatomic axis of the tibia and the anatomic axis of the femur. (optimal value =  $7 \pm 5$  degree)<sup>(6)</sup>

2. The tibial component angle is the angle between a line drawn from the exact middle of the talus to the exact middle of the proximal tibial cut. A second line was drawn along the underface of the tibial component. The angle formed by the intersection of these lines was named the tibial component angle. (optimal value =  $90 \pm 4$  degree)<sup>(9)</sup>

To measure these angles, the mechanical and anatomic axis must be identified.

The anatomic axis of the femur was drawn from the midpoint of the femoral shaft center (bisecting the proximal-to-distal length of the femur) to the midpoint 10 cm proximal to the joint

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line. The anatomic axis of the tibia was drawn from the center of the prosthesis at the joint to the center of the ankle. The mechanical axis of the tibia was defined to coincide with its anatomic axis<sup>(10)</sup>.

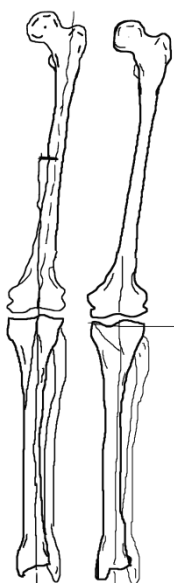
Two independent radiographic reviewer, blinded to the surgical technique, independently measured all radiographic measurements 2 times and the results were assessed for inter-observer reliability.



**Fig.1** Extramedullary guides tibia tool



**Fig.2** Intramedullary guides tibia tool



**Fig.3** A: The tibiofemoral angle, B: The tibial component angle

Statistical analysis was carried out using the chi-square method and Student's t test with the Yates and Fisher correction.

### Surgical Technique

Similar surgical techniques were used in both groups. For the femoral cut, a 10-mm pilot hole was created in the distal femur just above the insertion of the posterior cruciate ligament. The femoral canal was decompressed and an 8-mm intramedullary rod combined with a distal femoral cutting block was inserted. A femoral valgus angle was 5 degree.

For the tibial cut, in the intramedullary guides, a pilot hole was created in the articular surface approximately in the midmedial and lateral positions, near the base of the anterior tibial spine. This usually was located in the anterior one-third of the tibial articular surface. Pilot hole placement was adjusted and passage of the 8-mm intramedullary rod. Rotational alignment was referenced to both the tibial tubercle and the transmalleolar axis. Target alignment on the tibia was 90 degree to the longitudinal axis in the coronal plane, with a 3 degree posterior slope in the sagittal plane.

For the tibial cut, in extramedullary guides, the alignment instrument was positioned in the center of the tibia just anterior to the tibial spine, with rotation also being set referencing the tibial tubercle and transmalleolar axis.

### Results

The preoperative diagnosis was primary osteoarthritis. The demographic data include a mean age, a mean weight, a mean height, the body mass index (BMI), the degree of the preoperative tibiofemoral angle, the degree of the preoperative proximal tibial angle showed no statistically significant differences.

Results of postoperative showed the mean values for the postoperative tibiofemoral angle in intramedullary group was 4.98 +/- 1.91 degree. This compared to 4.58 +/- 1.51 degree in extramedullary group. This difference was not statistically significant. The tibial component angle in coronal plane showed a mean value of 88.48 +/- 1.32 in intramedullary group. The extramedullary group showed a mean value of 87.72 +/- 1.40. This difference was statistically significant ( $p < .01$ ). Both groups were within the percentage of outlier ( $< 3$  degree varus).

The mean surgery time and the drainage blood loss in intramedullary group was more than extramedullary group. The mean surgery time was 97.04 +/- 1.70 min in the intramedullary group and 94.66 +/- 1.74 min in extramedullary group. The drainage blood loss as measured by suction drainage, was 440.80 +/- 17.12 ml in the intramedullary group and 419.80 +/- 13.62 ml in the extramedullary group. Both these difference were statistically significant.

**Table1** Demographic data

	Intramedullary Mean (SD)	Extramedullary Mean (SD)	<i>p</i> -value
Age (year)	63.76 (4.59)	62.26 (4.36)	0.09
Weight (kg)	65.95 (13.71)	66.28 (12.95)	0.90
Height (cm)	153.62 (6.50)	152.38 (6.03)	0.36
BMI	27.90 (4.56)	28.25 (5.76)	0.39
Pre-op Tibiofemoral angle	8.54 (5.15)	6.92 (5.10)	0.11
Pre-op proximal tibial angle	78.32 (5.14)	78.28 (4.50)	0.70

**Table 2** Result

	Intramedullary Mean (SD)	Extramedullary Mean (SD)	<i>p</i> -value
Post op Tibiofemoral angle	4.98 (1.91)	4.58 (1.51)	0.24
Post op Tibial component angle	88.48 (1.32)	87.72 (1.40)	$<0.01^*$
The mean surgery time (min)	97.04 (1.70)	94.66 (1.74)	$<0.01^*$
The drainage blood loss (ml)	440.80 (17.12)	419.80 (13.62)	$<0.01^*$

\* significant

## Discussion

Since alignment and positioning of the prosthetic components of TKA critically influence its longevity and survivorship, it is possible to obtain optimal postoperative position<sup>(1-8,11-14)</sup>. In this study, intramedullary group gave a slightly more valgus postoperative tibiofemoral angle alignment (4.98 +/- 1.91 versus 4.58 +/- 1.51) the difference was not statistically significant. However, several studies of TKA longevity have pointed out that a wide margin of tibiofemoral alignment and limb angulation can be tolerated, varying between 0 and 12 degree of overall valgus alignment and not accept varus alignment. Regarding tibial component positioning in the coronal plane, we did find a statistically significant improvement of position using intramedullary instrumentation (88.48 +/- 1.32 versus 87.72 +/- 1.40), several investigators have shown that a more varus alignment of the tibial component leads to poor results due to loosening, and therefore improvement in this positioning would seem desirable<sup>(1-8,11-14)</sup>.

Review of the suboptimal results using intramedullary guides found that the medullary canals appeared rather wide in general with thin cortices and a poorly defined isthmus. It could be postulated that entry hole placed in the proximal tibia for intramedullary rod was poorly placed, allowing for lateral drift of the intramedullary rod, thereby resulting in a more varus cut.

Review of the suboptimal results using extramedullary guides found that same wide intramedullary canal and distal jig positioning at the ankle is less precise in the obese due to the loss of accuracy in palpating and sitting the bony landmarks. We would favor intramedullary guides in general for all knees if possible, difficulties may be encountered in localizing the exact point of entry in the tibial articular surface. In case of extreme deformity such as with prior fracture, prior osteosynthesis, prior osteotomy, marked bowing, and extraarticular deformity, extramedullary instrumentation be well appropriate. In this study not found complication from use intramedullary guides such as embolization of medullary contents.

## Conclusion

Both techniques allowed satisfactory alignment. It is important for the surgeon to appreciate the benefits and deficiencies of each guide and to use whichever is suited most properly in each particular case.

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**การประเมินผลภาพถ่ายทางรังสีของตำแหน่งข้อเข่าเทียม เปรียบเทียบระหว่างวิธีการผ่าตัดข้อเข่าเทียม 2 วิธี  
คือ *Intramedullary guides tibia* กับ *Extramedullary guides tibia***

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**วัตถุประสงค์:** ศึกษาประเมินภาพถ่ายทางรังสีของตำแหน่งข้อเข่าเทียม เปรียบเทียบระหว่างการผ่าตัด 2 วิธี คือ *Intramedullary guides tibia* กับ *Extramedullary guides tibia*

**วิธีการศึกษา:** ผ่าตัดข้อเข่าเทียมที่โรงพยาบาลพระนารายณ์มหาราชจำนวน 100 เข่า แบ่งผู้ป่วยเป็นกลุ่มละ 50 คน ด้วยวิธีแบบ *Randomized* หลังการผ่าตัดประเมินภาพถ่ายทางรังสีได้แก่ *tibiofemoral angle* กับ *tibial component alignment*

**ผลการศึกษา:** ค่าเฉลี่ยหลังการผ่าตัดของมุม *tibiofemoral angle* ไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ แต่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของมุมข้อเข่าเทียมส่วนกระดูก *tibia* ในแนว *coronal* ส่วนค่าเฉลี่ยเวลาการผ่าตัดและปริมาณการสูญเสียเลือดหลังการผ่าตัดพบว่ากลุ่ม *Intramedullary guides* ใช้เวลาการผ่าตัดนานกว่า และเสียเลือดหลังการผ่าตัดมากกว่า

**สรุป:** ทั้ง 2 เทคนิคการผ่าตัด ทำให้ได้มุมหลังการผ่าตัดเป็นอยู่ในเกณฑ์ที่น่าพอใจทั้งมุม *tibiofemoral* และมุม *tibial component* สำคัญที่แพทย์ผู้ผ่าตัดที่จะต้องทราบข้อดี ข้อเสีย ของแต่ละวิธี และเลือกใช้ให้เหมาะสมกับผู้ป่วยในแต่ละราย

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# Comparison of Simultaneous Bilateral with Unilateral Total Knee Arthroplasty in Thabo Crown Prince Hospital

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**Purpose:** The purpose of this study was to compare patient demographics and results between simultaneous bilateral total knee arthroplasty (SBTKA) and unilateral total knee arthroplasty (UTKA) in Thabo Crown Prince Hospital. All operations were performed by a single surgeon.

**Methods:** 153 patients who underwent simultaneous bilateral total knee arthroplasty (SBTKA group,  $n = 48$ , 96 knees) and unilateral total knee arthroplasty (UTKA group,  $n = 105$ ) between 1 January 2013 - 31 May 2017 were recruited. Both groups were compared for postoperative complication, rate of blood transfusion, need for intensive care unit (ICU) admission, length of stays, time from surgery to initial physical therapy and mortality rate.

**Results:** Patients undergoing SBTKA were older than UTKA group ( $65 \pm 8.6$  VS  $62.4 \pm 7.6$ ,  $p$ -value = 0.156), had higher proportion of female (87.50% VS 80%,  $p$ -value = 0.408), and higher frequency of having comorbid condition (81.25% VS 70.47%) but not significantly different ( $p$ -value > 0.05). The mean of length of hospital stay was 7.70 days for UTKA group and 8.40 days for the SBTKA group but there was no difference between two group ( $p$ -value = 0.17). The blood transfusion requirement was higher in the SBTKA group than in the UTKA group (4.2% VS 2.9%) but was not different between groups ( $p$ -value = 0.672). No significant differences in the time from surgery to initial physical therapy between two groups ( $p$ -value = 0.465). Superficial wound infection were occurred only 1 cases in both groups. No serious postoperative complication, no death or need for ICU admission were encountered in both groups.

**Conclusion:** SBTKA seems to be safe procedure and is not associated with increase of surgical risk for patient in Thabo Crown Prince Hospital.

**Keywords:** Bilateral Knee, Unilateral knee, Total knee arthroplasty, postoperative complication

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## Introduction

Osteoarthritis (OA) is one of the most prevalent condition resulting to disability particularly in elderly population. Incidence of knee OA is rising by increasing average age of general population. About 13% of women and 10% of men aged 60 years and older have symptomatic knee OA<sup>(1)</sup>. An epidemiological study of 392 elderly Thai patients with OA of the knee, 86 males and 306 females, with a mean age of 67.8 years<sup>(2)</sup>. The economic costs of OA are high including those relate treatment and those due to lost work productivity<sup>(3)</sup>. Pain and other symptoms of OA may have a profound effect on quality of life affecting both physical function and psychological parameters<sup>(1)</sup>. Pain from OA is a key symptom for decision to seek medical care and is an important antecedent to disability. Two thirds of the patient who undergo total knee arthroplasty have bilateral degenerative disease and 20% of them will undergo surgery of the second knee within 2 years after

first<sup>(4)</sup>. Total knee arthroplasty (TKA) can provide reliable pain relief in patients with moderate to severe degenerative joint disease<sup>(5)</sup>. Patient who have bilateral knee arthritis are candidates for TKA may be decide between simultaneous or staged bilateral TKA and orthopedic surgeon should have participate in decision making whether to pursue a bilateral knee replacement under a single anesthetic or two separate unilateral TKA<sup>(6)</sup>. Although arthroplasty of both knee under one session carries several advantages that included bilateral function recovery, single hospital stays, lower medical costs, single anesthetic and quicker return to function<sup>(4,7)</sup>. There is still concern about the safety of the operation and the procedure might be associated with higher cardiopulmonary complication<sup>(8)</sup>. Several reports in the literature have shown that SBTKA may be associated increase risks of postoperative complication and mortality rate than unilateral TKA<sup>(7-8)</sup>. In contrast several reports have shown similar rates of postoperative complication between 2 procedures<sup>(6,9-12)</sup>. Thus, the choice of surgical management remains a subject of debate. Author retrospectively analyzed all SBTKA and UTKA surgeries performed by a single orthopedic surgeon in Thabo Crown Prince Hospital between 1

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January 2013 - 31 May 2017. The aim of this study was to compare patients undergoing SBTKA and those undergoing UTKA in terms of postoperative complications, need for intensive care unit (ICU) admission, rate of blood transfusion, length of hospital stays, time from surgery to initial physical therapy and mortality rate.

## Patients and Methods

This study was a retrospective study that included 153 osteoarthritis knee patients (201 knees) from 1 January 2013 - 31 May 2017. The patient were categorized into two groups; simultaneous bilateral total knee arthroplasty (SBTKA) and unilateral total knee arthroplasty (UTKA). The SBTKA in this study were performed sequentially by a single surgeon, with the patient under a single anesthetic. All surgeries were performed in Thabo Crown Prince Hospital. None of patient had history of knee joint infection or history of trauma which need required previous knee surgery. Each patient's comorbidity of cardiovascular, renal disease, pulmonary disease, DM and HT was reviewed. All patients underwent a preoperative assessment by an anesthesiology to ensure suitability for surgery. A patient was excluded from SBTKA only if the medical or anesthesiology consultant deemed the patient too high risk for bilateral procedures. HCT was measured in all patients just prior to arthroplasty. Blood transfusion was performed if preoperative HCT below 30%. All the operations were performed by a singer surgeon. The prosthesis were used Stryker scorpioflex or scorpio NRG for all procedure. The same surgical technique with extramedullary tibia alignment and intramedullary guide femoral alignment. Tourniquet applications were conducted in the same fashion in both groups of patients. After skin closure, the tourniquet was released. In the SBTKA, the procedure for second knee was initiated upon skin closure of the other knee. A hemovac drain was placed until 24<sup>th</sup> postoperative hour. All patients received prophylactic antibiotic administered one hour prior to incision and all patients received routine tranexamic acid intravenously before surgery and continued for the next 24 hours (1 gram before skin incision and 250 mg every six hours). Analgesic regimen included use of non-steroid anti-inflammatory drugs and opioids on the first postoperative day and only upon request. The patients were transferred from the postoperative recovery room to patient ward after a few hours. On the first postoperative day, patient were mobilized, partial to fully weight bearing under the supervision of physiotherapist and continue until discharge. They are fit for discharge when the patients is medically stable, walking independently with the help of appropriate walking aids and that their functional ability is sufficient to allow

discharge to their home. A transfusion was applied when HCT below 30%.

Retrospective review of the patient demographics, including age, gender, body weight, height and body mass index (BMI), was conducted using data retrieved from medical record. Comorbidities recorded were DM, hypertension, stroke, pulmonary, renal and cardiovascular disease. In addition, preoperative diagnosis, The American Society of Anesthesiologists classification (ASA class), anesthesia type, preoperative HCT, postoperative intraarticular drainage volume and duration of operation were assessed. The postoperative outcomes that were followed included blood transfusion requirements, surgical wound infection, surgery-related complication, postoperative complication, need for intensive care unit (ICU) admission, mortality during the hospital stays, time for surgery to initial physical therapy, the length of stay, Cardiac event after postoperative 30 days and deep surgical wound infection after postoperative 90 days were assessed and compared between two groups.

## Statistical analysis

Statistical analysis was performed using SPSS ver. 14.0. Continuous variables were compared using t-test. Mann-Whitney test was used to compare for nonparametric data for independent samples. Chi square test or Fisher's exact test for the proportion preexisting medical condition, intraoperative and postoperative complications in the two groups were used. A *p*-value of less than 0.05 was considered statistically significant.

## Results

153 total knee arthroplasty patients were included. Of those patients, 105 underwent UTKA, the mean age of the patients was  $62.40 \pm 7.66$  years (range 50-79 years) and the percentage of female was 80% and 48 underwent SBTKA (96 knee), the mean age of the patients was  $65.06 \pm 8.58$  years (range 50-80 years) and the percentage of female was 87.50%. The patient's height, weight and BMI were similar between the two groups (Table 1). The most common indication for surgery was primary osteoarthritis in both groups. Patients in SBTKA group were older and had higher numbers of comorbidity than those UTKA group (81.25, 70.47% respectively) but patients SBTKA group had a lower prevalence of cardiovascular disease than UTKA group (6.67% in UTKA, 2.88% in BTKA). Hypertension was the most prevalence morbidity for all two groups, affecting 41.67% of SBTKA group and 30.48% of UTKA group. Medical comorbidities are summarized in Table 2. The mean ASA score in SBTKA group was not significant differ from the UTKA group, ( $p = 0.056$ ). Preoperative HCT level were  $37.55 \pm$

5.58% and  $35.97 \pm 4.21\%$  in the UTKA and SBTKA group respectively.

In the analysis of intraoperative clinical data, significant longer operation ( $p < 0.000$ ) was demonstrated in the SBTKA group. The length of hospital stay was longer for SBTKA (average, 8.4 days). Patient were hospitalized an average of 7.7 days for UTKA group. One patient in UTKA group had prolonged hospital stay for 17 days due to a perioperative fracture tibia and subsequent superficial wound infection. Postoperative blood loss in drain was  $252.11 \pm 127.32$  ml for UTKA and  $432.91 \pm 223.21$  ml for SBTKA but the total drainage of the UTKA group was not significantly different when compared to unilateral side of the SBTKA group ( $p > 0.05$ ). The UTKA patients were received blood transfusion 2.9% compare to 4.2% for the SBTK patients but were not found

significant difference ( $p = 0.67$ ). No differences existed in the time from surgery to initial physical therapy between two groups ( $p = 0.465$ ).

No incidence of major postoperative complication in both groups. Procedure-related complication occurred in one patient in UTKA group had fracture tibia. There was no death related to surgery. No patients in both groups required intensive care unit (ICU) admission. Analysis for superficial wound infection did not reveal difference between two groups, ( $p = 0.539$ ). Wound redness that did not meet criterion for superficial infection was lower in the UTKA group (15.20% VS 18.75%). No patient in either group presented with cardiac event within 30 days or presented with deep wound infection within 90 days after discharge. The full list of postoperative complications summarized in Table 3.

**Table 1** Demographic and Clinical data

Characteristics	UTKA (N=105)	SBTKA (N=48)	p-value
<b>Age (year)</b>			
Mean $\pm$ SD	$62.40 \pm 7.66$ (50-79)	$65.06 \pm 8.58$ (50-80)	0.156
Median (year)	63	65	
<b>Sex</b>			
male	21 (20%)	6 (12.50%)	0.408
female	84 (80%)	42 (87.50%)	
Body weight (Kg)	$65.54 \pm 10.96$	$63.49 \pm 9.09$	0.175
Height (cm)	$156.27 \pm 8.60$	$155.00 \pm 6.56$	0.760
BMI (kg/m <sup>2</sup> )	$26.87 \pm 3.92$	$26.47 \pm 3.45$	0.191
<b>Diagnosis</b>			
Primary OA	92 (87.60%)	44 (91.70%)	0.460
Secondary OA			
Rheumatoid arthritis	13 (12.40%)	4 (8.30%)	
Pre-op HCT (%)	$37.55 \pm 5.58$	$35.97 \pm 4.21$	0.083
Pre-op blood Transfusion	5 (4.76 %)	3 (6.25%)	0.701
<b>ASA class</b>			
ASA I	5 (4.80%)	0	0.056
ASA II	80 (76.20%)	32 (66.67%)	
ASA III	20 (19%)	16 (33.33%)	
<b>Anesthesia</b>			
Spinal block	93 (88.60%)	32 (66.70%)	0.001
GA	12 (11.40%)	16 (33.30%)	
<b>Operation time (min)</b>	$76.05 \pm 11.02$	$138.45 \pm 18.69$	0.000
Left knee		$70.71 \pm 7.28$	0.030
Right knee		$69.74 \pm 10.82$	0.020
<b>Blood in drainage (ml)</b>	$252.11 \pm 127.32$	$432.91 \pm 223.21$	0.000
Drain left		$212.06 \pm 105.95$	0.060
Drain right		$223.04 \pm 151.03$	0.230
<b>Length of stay</b>			
Mean $\pm$ SD	$7.70 \pm 2.97$ (3-17)	$8.40 \pm 2.85$ (5-15)	0.170
Median	7	7	
<b>Physical therapy</b>			
Postoperative day 1	100 (95.24%)	45 (93.75%)	0.465
Postoperative day 2	5 (4.76%)	3 (6.25 %)	

**Table 2** Preoperative comorbidities

Comorbidities	UTKA (N=105)	SBTKA (N=48)	p-value
DM	4 (3.80%)	2 (4.17%)	0.916
HT	32 (30.48%)	20 (41.67%)	0.175
DM and HT	14 (13.33%)	4 (8.33%)	0.525
Dyslipidemia	11 (10.48%)	4 (8.33%)	0.215
Cardiovascular disease	7 (6.67%)	1 (2.08%)	0.237
Renal disease	1 (0.95%)	2 (4.17%)	0.183
COPD/asthma	3 (0.86%)	1 (2.08%)	0.237
Thyrotoxicosis	1 (0.95%)	2 (4.17%)	0.331
Cerebrovascular disease	1 (0.95%)	3 (6.25%)	0.317
<b>Total</b>	<b>74 (70.47%)</b>	<b>39 (81.25%)</b>	

**Table 3** Intraoperative and postoperative complications of SBTKA and UTKA

Complication	UTKA (N=105)	SBTKA (N=48)	p-value
Postoperative transfusion	3 (2.9%)	2 (4.2%)	0.672
Wound redness	16 (15.20%)	9 (18.75%)	0.393
Superficial surgical wound infection	1 (0.95%)	1 (2.08%)	0.539
Deep wound infection	0	0	-
Bowel ileus/Constipation	1 (0.95%)	3 (6.25%)	0.125
Hyponatremia	1 (0.95%)	0	-
ICU admission	0	0	-
Cardiopulmonary Complication	0	0	-
CNS complication	0	0	-
<b>Surgical complication</b>			
Fracture tibia plateau	1 (0.95%)	0	-
Cardiac event after postoperative 30 days	0	0	-
Deep wound infection after postoperative 90 days	0	0	-
Mortality	0	0	-

## Discussion

This study reports a comparison of outcomes of 153 patients (201 knees) who underwent SBTKA or UTKA at Thabo Crown Prince hospital by a single surgeon. Total knee arthroplasty (TKA) is the treatment of choice for advanced knee degenerative joint disease that aims to relieve pain and movement limitation caused by degenerative disorder such as gonarthrosis. It is estimated that 80% of these age 65 are affected by osteoarthritis in the knee and this is only projected to increase with an aging and overweight population and that of these, one third present with bilateral symptoms<sup>(12)</sup>.

The observation in this study that the patient were older in SBTKA group 65.1 years (range: 50-80) than in UTKA group 62.4 years (range: 50-79) is not consistent with the results of previous studies. Eric R Bohm et al<sup>(13)</sup> reported that SBTKA patients were younger than patients were underwent UTKA, 64 and 68 years, respectively. Mean age was reported as 61.9 years in SBTKA group and 62.9 years in UTKA group by Joseph et

al.<sup>(14)</sup> In the absence of consensus on the safety of SBTKA Young-Joon et al.<sup>(9)</sup> reported that no significant difference in the complication rate was observe with comparison between SBTKA and UTKA in patients aged 75 years and older. Lynch et al.<sup>(15)</sup> identified a greater proportion of postoperative congestive heart failure in the SBTKA cohort examined a population aged older than 80 years which was markedly older than the mean age of this study. Surgeons may offer SBTKA procedures to younger patients, thus creating a selection bias and possibly contributing to better outcomes for SBTKA. There is no study that can define an absolute or set of medical comorbidities that places a patient at increased risk for morbidity or mortality of the SBTKA. However we believe that pre-existing comorbidity a more important factor than biological age in patient selection.

When both joints are affected SBTKA reduce overall cost of care and length of the hospital stay by approximately 4 to 6 days<sup>(16)</sup>. The numbers of total knee arthroplasty is going to

increase in the future. The association between SBTKA and the incidence of morbidity and mortality has not been clearly defined not only in advanced age patients but also in young patients. Despite these advantage, the safety of SBTKA remains controversial. In this study there was no significant difference in postoperative complication rates after surgery between the SBTKA and UTKA groups and are consistent with those other study. Walmsley et al.<sup>(17)</sup> found no difference in 90 day mortality between patients with SBTKA and patient with bilateral total knee arthroplasty staged within 5 years and patients with UTKA. Scott et al.<sup>(18)</sup> found no significant difference in post operative complication rate between SBTKA and staged BTKA group. Young-Joon et al.<sup>(10)</sup> reported that the complication rate of the bilateral group was slightly higher than that of unilateral group, the difference was not statistically meaningful (3.8% vs 2.4%,  $p = 0.438$ ). Qi Y et al.<sup>(19)</sup> reported the rate of complication between SBTKA and UTKA is similar. Erin et al.<sup>(20)</sup> reported rates of intraoperative and postoperative complication including cardiovascular, thromboembolic and neurologic complication and mortality did not differ significantly between two groups. Shin Y H et al.<sup>(21)</sup> reported that the rates of postoperative complication, such as myocardial infarction and deep vein thrombosis, were not different between the groups.

The available studies provide conflicting results. Stavros G. et al.<sup>(16)</sup> reported the prevalence of procedure-related complication was higher for SBTKA (12.2%) compared to UTKA (8.2%) and in hospital mortality was highest for patients undergoing SBTKA (SBTKA 0.5%, UTKA 0.3%) and reported that patients undergoing SBTKA had 1.6 higher rate of procedure-related complication and mortality compared with those undergoing UTKA.

The relationship between surgical volume and outcome following TKA has been previously suggested. Azeem T et al.<sup>(22)</sup> defined high-volume by setting the mark at 50 TKAs/year. SooHoo et al.<sup>(23)</sup> have indicated that surgical volume is one factor that predicts the rate of complication, infection and mortality following TKA. Odum SM et al.<sup>(24)</sup> compared with hospital with high of TKA procedures performed, lower-volume hospitals had significantly increased odds of minor complications and mortality. Approximately 50 case of TKA are performed in author's hospital per year was included in the high volume of TKA procedures. The rates of postoperative complication and patient's satisfaction following TKA are also related to the level of experience of the surgeon. As a community hospital, it is therefore important for author's hospital to evaluate the outcomes of SBTKA vs UTKA. However, it is our understanding that rigorous preoperative

assessment and proper patient's selection are essential to prevention of cardiovascular complications and mortality rate following SBTKA.

Previous studies have shown a greater volume of blood transfusion with SBTKA, Yakup et al.<sup>(25)</sup> reported transfusion need was 1.5 fold greater in the SBTKA group which is consistent with the previous study shown that SBTKA patients generally had higher rates of blood transfusion may be due to the bilateral bone and soft tissue cuts<sup>(13,19,26)</sup>. The amount of blood transfusion in this study was no significant between two groups ( $p = 0.672$ ). The use of tranexamic acid is effective tool in reducing the transfusion rates by almost 70% in SBTKA<sup>(27-28)</sup>. When tranexamic acid was administered in multiple dose indicating the possibility of reducing transfusion<sup>(27-28)</sup>. However, these results should be interpreted with caution because blood transfusion protocol and transfusion requirement threshold may vary between hospital and between surgeons<sup>(29)</sup>.

It has been suggested that patients undergoing SBTKA experience a delay in rehabilitation, including a longer duration of physical therapy and length of hospital stay. Time from surgery to initial physical therapy between two groups in this study were not significantly different ( $p = 0.465$ ) that suggests that persons with SBTKA do not require more physical therapy to achieve similar functional outcomes. This lends further support to the argument that SBTKA is a cost-effective surgical intervention for bilateral disease. If a person were to undergo a staged bilateral TKA procedure separated by a period greater than a few months, they would likely require twice the amount of rehabilitation services to achieve the same outcome.

Postoperative infection however is multifactorial and contributory factors may have included longer operation time, more personnel in operating room, and rescrubbing, redraping, and changing of instruments between SBTKA procedures<sup>(12)</sup>. However, in this study has found no significant difference between two groups in rate of surgical wound infection. Same as previous study, Eric R et al.<sup>(13)</sup> showed that knee infection between BTKA and UTKA group were 0.5% and 0.7% respectively ( $p = 0.3$ ). Poutsides LA et al.<sup>(30)</sup> reported that the rate of deep infection was similar among the group and the rate of superficial infection was lower in the SBTKA cohort (0.28% VS 0.87%).

In this study patients undergoing SBTKA had a higher rate of gastrointestinal complications but not significantly different ( $p = 0.125$ ). Lombardi et al.<sup>(31)</sup> found the gastrointestinal complication, mainly ileus, in 8.1% and 4.4% of patients who underwent SBTKA and UTKA respectively. Higher postoperative ileus in patients

undergoing SBTKA may be due to a larger amount of postoperative opioids prescribed to control pain. Yakup et al.<sup>(25)</sup> reported a mean hospital stay  $7.5 \pm 1.84$  (5-16) in SBTKA patients and  $6.1 \pm 1.24$  (4-13) in UTKA patients. Herseki et al.<sup>(32)</sup> reported a mean hospital stay length of 17.19 days in SBTKA and 10.48 days in UTKA patients. Shin Y H et.al.<sup>(21)</sup> reported a mean hospital stay length of  $9.8 \pm 6.5$  in SBTKA patients and  $8.8 \pm 2.3$  in UTKA patients. Stavros et al.<sup>(33)</sup> suggested that the same day BTKA would shorten the total length of hospitalization by 4-6 days resulting in 18-36% of medical cost reduction. In this study, the length of hospital stay of the SBTKA was higher than UTKA group but was no significant different, which is not more notable considering the need for the future hospitalization for another TKA of the contralateral knee in the unilateral group. This longer length of stay (two hospitalizations) for UTKA has been shown to provide the health care system with a higher cost. However, studies have reported different length of hospital stays due to the variation in discharge criteria.

## Conclusion

The outcomes of SBTKA and UTKA have been studied previously. In this study has shown similar outcome between SBTKA and UTKA group for requirement of blood transfusion, infection rate, postoperative complication, length of stay, time to rehabilitation and mortality rate. SBTKA seems to be safe procedure and is not associated with increase of surgical risk in Thabo Crown Prince Hospital.

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## การศึกษาเปรียบเทียบระหว่างการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบพร้อมกันสองข้างและการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบข้างเดียวในโรงพยาบาลสมเด็จพระยุพราชท่าบ่อ

วรรณ วิจารณ์, พบ

**วัตถุประสงค์:** เพื่อเปรียบเทียบระหว่างการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบพร้อมกันสองข้างและการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบข้างเดียวโดยศัลยแพทย์คนเดียวกันใน โรงพยาบาลสมเด็จพระยุพราชท่าบ่อ

**วิธีการศึกษา:** การศึกษานี้เป็นการศึกษาย้อนหลังในผู้ป่วยจำนวน 153 ราย ที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมในระหว่าง 1 มกราคม 2556 ถึง 31 พฤษภาคม 2560 โดยแบ่งผู้ป่วยเป็น 2 กลุ่ม กลุ่มแรกได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบพร้อมกันสองข้าง จำนวน 48 ราย (96 เข่า) กลุ่มที่สองได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบข้างเดียว จำนวน 105 ราย โดยผู้ป่วยทั้งสองกลุ่มได้รับการผ่าตัดโดยศัลยแพทย์ออร์โธปิดิกส์คนเดียวกันใน โรงพยาบาลสมเด็จพระยุพราชท่าบ่อ ทำการศึกษาเปรียบเทียบภาวะแทรกซ้อนหลังผ่าตัด, การได้รับเลือดหลังผ่าตัด, การเข้ารับการรักษาในไอซียู, ระยะเวลาที่ได้รับการทำกายภาพบำบัดหลังผ่าตัด, ระยะเวลาในการนอนโรงพยาบาลและอัตราตายระหว่างผู้ป่วยทั้งสองกลุ่ม

**ผลการศึกษา:** ผู้ป่วยที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมทั้ง 2 วิธีเป็นเพศหญิงมากกว่าเพศชาย ผู้ป่วยที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบพร้อมกันสองข้างมีอายุเฉลี่ย  $65 \pm 8.6$  ปี โดยมากกว่าผู้ป่วยที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบข้างเดียวที่มีอายุเฉลี่ย  $62.4 \pm 7.6$  ปี แต่ไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติระหว่างทั้งสองกลุ่ม ( $p\text{-value} = 0.156$ ) และมีโรคประจำตัวก่อนผ่าตัดมากกว่า (80.25% และ 70.47% ตามลำดับ,  $p\text{-value} > 0.05$ .) การได้รับเลือดหลังผ่าตัดในทั้งสองกลุ่มไม่มีความแตกต่างกัน ( $p\text{-value} = 0.672$ ) ระยะเวลาในการนอนโรงพยาบาลในกลุ่มที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบพร้อมกันสองข้างมากกว่ากลุ่มที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมข้างเดียวแต่ไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ (8.4 และ 7.7 วัน,  $p\text{-value} = 0.17$ ) วันที่ได้รับการทำกายภาพบำบัดหลังผ่าตัดในผู้ป่วยทั้งสองกลุ่มพบว่าไม่มีความแตกต่างกัน ( $p\text{-value} = 0.465$ ) เช่นเดียวกับอัตราการเกิดการติดเชื้อแผลผ่าตัดพบเพียง 1 ราย ในผู้ป่วยแต่ละกลุ่ม ในผู้ป่วยทั้ง 2 กลุ่ม ไม่มีรายใดที่ต้องเข้ารับการรักษาในไอซียูหรือมีภาวะแทรกซ้อนรุนแรงหลังผ่าตัดหรือเสียชีวิตทั้งในขณะและหลังผ่าตัดเปลี่ยนข้อเข่าเทียม

**สรุป:** การผ่าตัดเปลี่ยนข้อเข่าเทียมแบบพร้อมกันสองข้างใน โรงพยาบาลสมเด็จพระยุพราชท่าบ่อมีความปลอดภัยและเป็นทางเลือกที่ดีในผู้ป่วยที่มีภาวะโรคข้อเข่าเสื่อมทั้งสองข้าง



# Anteromedial and Anterolateral Dynamic Compression Plating in Tibial Diaphyseal Fractures

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**Rational:** Treatment of tibial shaft fractures with dynamic compression plates provides results equal to closed interlocking nails but results in a lower incidence of malalignment. Anteromedial plating offers a biomechanical advantage because the plate is fixed on the tension side of the tibia. A disadvantage of anteromedial dynamic compression plates, however, is a higher infection rate than with anterolateral plating.

**Objectives:** This research aimed to compare the results and complications of treatment of tibial diaphyseal fractures with anteromedial and with anterolateral plating.

**Methods:** This retrospective study compared patients with tibial shaft fractures who had undergone surgery between 1 January 2010 and 31 December 2014 using dynamic compression plates: 96 with anteromedial plating and 84 with anterolateral plating.

**Results:** Of anteromedial plating cases, two were found to have non-union, eight had infection, and there were no instances of malalignment. Among the cases of anterolateral plating, there was one non-union, one case of infection, and no cases of malalignment. There were no significant differences in rates of non-union or malalignment between the two plating methods ( $p < 0.05$ ). The infection rate in the anterolateral group, however, was significantly lower than that in the anteromedial group ( $p < 0.05$ ).

**Conclusions:** Treatment of tibial diaphyseal fractures both with anterolateral and with anteromedial dynamic compression plates show an equally satisfactory union rate and incidence malalignment; however, anterolateral plating has a significantly lower infection rate.

**Keywords:** Anteromedial plating, anterolateral plating, dynamic compression plate, diaphyseal fracture, tibia

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## Introduction

Tibial diaphyseal fractures are the most common type of shaft fracture. The current gold standard treatment for this type of fracture is closed interlocking nailing<sup>(1)</sup>. That treatment destroys less tissue and results in fewer complications than dynamic compression plates, so patients recover sooner. However, malalignment is more likely to occur with interlocking nails than with plates and screws, especially on the proximal and distal tibia<sup>(1-4)</sup>. Additionally, using interlocking nails requires fluoroscopy, resulting in radiation exposure. The operation also takes longer than with plates and screws.

Treatment of tibial diaphyseal fractures with a dynamic compression plate (DCP), which was developed before intramedullary nailing, provides fairly good results<sup>(16)</sup>. Dynamic compression plates are the preferred treatment for patients with tibial diaphyseal fractures in Asia and South Africa, in young patients, and in patients with small or deformed intramedullary cavities, especially those with compartment syndrome<sup>(4)</sup>.

According to Ruedi, Webb and Allgower (1976), the results of treatment with AO/ASIF dynamic compression plates among the patients with acute fractures are satisfactory: a success rate of 98.1% in closed fractures and 88.4% in open fractures. As for complication rates, in closed-fracture tibias the non-union rate and the infection rate were both 1%, while in open-fracture tibias, the non-union rate was 5.3% and the infection rate was 1.6%<sup>(5)</sup>.

In simple fractures, anteromedial plating is applied because plating on the tension side enhances the coordination between the tension-band and compression plates. However, in comminuted fractures, plates are fixed to function as bridging plates. In those cases, as little tissue and periosteum as possible is removed. Nevertheless, anteromedial plating has a high incidence of complications, especially soft-tissue problems and infections<sup>(1,4)</sup> because the tissues on that side are quite thin. Presently, locking compression plates (LCP) are commonly used for treatment of tibial diaphyseal fractures because they are strong fixed-angle devices with high pullout strength. In addition, since they do not press against the periosteum, blood can flow freely to the fractured parts, especially when the minimally invasive plate osteosynthesis<sup>(7-15)</sup> (MIPO) technique is used. One drawback of LCP is that the cost is higher than

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dynamic compression plates. Fixation of plates on the anterolateral side, or submuscular plating, probably reduces the incidence of complications caused by plating. This study compared the results of treatment of tibial diaphyseal fractures with anteromedial and with anterolateral plating using dynamic compression plates including subsequent complications, e.g., infection rates, non-union rates, and malalignment.

## Materials and Methods

In this retrospective study, the subjects were tibial diaphyseal fracture patients who had undergone treatment at Sunprasitthiprasong Hospital in Ubon Ratchathani province between 1 January 2009 and 31 December 2015. The research was approved by the Sunprasitthiprasong Hospital Ethics Committee for Human Research. One requirement for inclusion in the study was that the patient had been given definitive treatment with dynamic compression plates (DCP) and received follow-up care until healing or for at least 9 months with no indications of nonunion as defined by the

U.S. FDA. This research excluded patients who had undergone other treatment procedures prior to the definitive treatment, e.g., external fixators. Also excluded were patients with a high risk of infection, e.g., immune deficiency, uncontrolled diabetes, venous ulcer, and arterial insufficiency, as well as patients treated for non-union with dynamic compression plates, those with skin infection or skin diseases, e.g., cellulitis, psoriasis, dermatitis, and dermatophyte, and patients with pathological fractures. The Sunprasitthiprasong Hospital treats about 120 cases of tibial shaft fracture per year. The author recruited cases with ICD 10: S82.2\* from the hospital database. Two groups of 150 patients each were retrospectively studied: Group I was patients treated with anteromedial DCP and Group II was patients treated with anterolateral DCP. The orthopedist performing the surgery selected the plate position based on the degree of soft tissue injuries. Each patient's previous medical records and X-ray films, information on non-union, deep infection, and malalignment (>10 degrees) were also collected and analyzed (Figure 1).



**Fig. 1** Treatment of tibial diaphyseal fractures with anteromedial (A) and anterolateral (B) dynamic compression plates

## Results

**Table 1** General Information

Demographic Data	Anteromedial group	Anterolateral group	<i>p</i> -value
Sex (Total)	96	84	
- Male	66	30	0.07
- Female	49	35	0.07
Age (mean) yrs.			
- Male	32.74	38.34	0.07
- Female	33.15	38.13	0.73
Comorbidity			
- Diabetes mellitus	6	9	0.152
Fracture type			
- Closed fracture			
- Open fracture Gr.I	76	62	0.12
- Open fracture Gr.II	19	15	0.12
	1	7	0.02*

\*Statistically significant

**Table 2** Results of the study

Study group	No. patients	Non-union	Infection	Malalignment
Anteromedial DCP	96	2	8	0
Anterolateral DCP	84	1	1	0

The author initially recruited 150 cases in each groups, but some patients were lost to follow-up (54 cases in anteromedial group and 66 case in anterolateral group) due to economic problems or migration.

Of the tibial diaphyseal fractures treated at Sunprasitthiprasong Hospital in Ubon Ratchathani province between 1 January 2009 and 31 December 2015, 96 cases were treated with anteromedial DCP and 84 cases with anterolateral DCP. Statistical analysis found no significant differences sex, age and comorbidity (diabetes mellitus) between the two groups.

In the anteromedial group, there were two cases of non-union and eight cases of infection; in the anterolateral group, there was one case of non-union and one case of infection. The difference in the non-union rate was not statistically significant (Z-score = 0.4668; *p*-value = 0.63836), but the infection rate in the anteromedial group was significantly higher than the anterolateral group (Z-score = 2.1936; *p*-value = 0.002852). No malalignment > 10° was found in either group (Table 2).

## Discussion

Tibial diaphyseal fractures are one of the most frequent shaft fracture. Although closed interlocking nailing is generally considered the gold standard treatment for this kind of fracture, it is usually accompanied by some issues including surgical equipment, longer operating time and radiation exposure from fluoroscopes. For that reason, treatment with dynamic compression plates (DCP) is widely applied because it provides equally good results while avoiding those issues. Dynamic compression plates are frequently applied for tibial diaphyseal fractures in Asia and South Africa probably because people in these regions, especially children, have smaller bones than Europeans. Additionally, in patients prone to compartment syndrome, intramedullary nails provide the result in higher pressure on the compartment which may can lead to compartment syndrome.

This research found infection rates lower than those reported by Ruedi, Webb and Allgower, that is, 8.3% (8/96) in the anteromedial plating group and 1.2% (1/84) in the anteromedial group. In this study, infected plates were found in both closed and open fractures. There were eight case of infection in the anteromedial group: five in closed fractures, two in grade I open fractures, and one in

a grade II open fracture. In the anterolateral group there was only one infection in a grade II open fracture. Reasons for this difference include that only closed tibial shaft fractures and open fractures grade I or II were included in the present study, there have been improvements in soft tissue preservation and surgical techniques, and more effective antibiotics have become available. The author excluded cases of open fractures of grade III as well as more complex comminuted fractures related with other which required additional procedures, e.g., locking compression plates, external fixation, and intramedullary nailing.

Anteromedial plating involves plating on the tension side of the tibial shaft where tissue coverage is thinner than of other muscle-covered bones. As dynamic compression plates are likely to press directly against the periosteum, tissue necrosis often occurs and patients are more infection prone, especially those with open fracture wounds as those are usually on the anteromedial side. The end result is that anteromedial plating in open fractures has a high incidence of infection. Patients with this type of fracture are usually treated with disinfection, debridement, long leg slab or external fixators, as well as later definite treatment; those patients were excluded from this study.

Several techniques, e.g., minimally invasive plate osteosynthesis (MIPO) and anterolateral plating, have been developed which reduce the incidence of infection and improve union rates. Those techniques also help preserve soft tissue.

Even though coverage of muscles with anterolateral plating helps reduce infection, one biomechanical drawback of this method is that plating on the compression side may cause varus deformity of the tibial shaft especially in comminuted fractures despite even with prebent plates. Thus it is advisable to treat with locking compression plates (LCP) in anterolateral plating which, in addition to helping prevent varus tibial shaft deformity, also provides angular stability. Another advantage of LCP is reduced incidence of infection because the plate does not press against the periosteum, allowing improved blood to flow to the fracture area and avoiding the occurrence of necrotic tissue. Disadvantages of this form of plating is high cost.

The incidence of infection among patients with diabetes was not significantly different between the two groups. Analysis of the

relationship of infections and other comorbidities, e.g., smoking, obesity, and medications, was not possible as the available data was not sufficiently reliable. This study tried to exclude factors that could potentially interfere with bone union and result in infection. For that reason, patients taking medications such as antiviral drugs and those receiving chemotherapy were excluded from the study.

The union rate with both anteromedial and anterolateral plating were very high, 97.9% and 98.8%, respectively. Soft tissue preservative surgical techniques such as those specified in the AO principles and dynamic compression plates were selected for use with simple bone fractures (AO Classification 42-A, 42-B1, 42-B2) to help ensure fractures healed before any implant failure occurred.

No malalignments  $> 10^\circ$  were found in either group. Alignment evaluation in open reductions was done by direct inspection. In cases using the MIPO technique, fluoroscopic intersurgical inspection was necessary.

## Conclusions

Although intramedullary nailing is the current gold standard for treatment of tibia diaphyseal fractures, treatment with plates and screws is effective in hospitals cases where insertion of intramedullary nailing is not possible. It is effective in patients who are well qualified and where soft tissue preservative surgical techniques (AO principles) are employed. Treatment of tibial diaphyseal fractures with dynamic compression plates provides satisfactory results in terms of union rate, incidence of malalignment, and infection rate. Anterolateral plating significantly reduces infection rates in tibial shaft fractures compared with anteromedial plating.

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## เปรียบเทียบผลการรักษากระดูกหน้าแข้งหักด้วยแผ่นโลหะตามกระดูกทางด้าน *Anteromedial* และ *Anterolateral*

รัฐศาสตร์ สุดหนองบัว, พบ

**วัตถุประสงค์:** *Dynamic compression plate* มีผลการรักษาที่ดีใกล้เคียงกับ *Closed Interlocking Nail* โดยเฉพาะการผิดรูปน้อยกว่าในการรักษากระดูกหน้าแข้งหัก การวางแผ่นโลหะตามกระดูกบริเวณ *Anteromedial* ในกระดูกหน้าแข้งมีข้อดีในเรื่อง *Biomechanics* เนื่องจากเป็นด้าน *Tension side* แต่มีข้อเสียคือมีการติดเชื้อสูงกว่าการวางด้าน *Anterolateral* การศึกษานี้จึงเป็นการศึกษาเปรียบเทียบผลการรักษากระดูกหน้าแข้งหักด้วยการวางแผ่นโลหะตามกระดูกด้าน *Anteromedial* และ *Anterolateral*

**วิธีการศึกษา:** *Retrospective study* ในผู้ป่วยกระดูกหน้าแข้งหักที่ได้รับการผ่าตัดใส่แผ่นโลหะตามกระดูกแบบ *Dynamic Compression Plate* ในระหว่างวันที่ 1 มกราคม พ.ศ. 2553 - 31 ธันวาคม พ.ศ. 2557

**ผลการศึกษา:** ผู้ป่วยกระดูกหน้าแข้งหักที่ได้รับการผ่าตัดวางแผ่นโลหะตามกระดูกแบบ *Dynamic Compression Plate* ทางด้าน *Anteromedial* จำนวน 96 ราย พบกระดูกไม่ติด 2 ราย ติดเชื้อที่โลหะตามกระดูก 8 ราย ไม่พบกระดูกผิดรูป ส่วนด้าน *Anterolateral* จำนวน 84 ราย พบกระดูกไม่ติด 1 ราย ติดเชื้อที่โลหะตามกระดูก 1 ราย และ ไม่พบกระดูกผิดรูป ผลการศึกษาพบว่า กระดูกไม่ติด และ กระดูกผิดรูป ทั้งสองกลุ่มไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ( $p < 0.05$ ) แต่การติดเชื้อที่โลหะตามกระดูก ในกลุ่ม *Anterolateral* ต่ำกว่ากลุ่ม *Anteromedial* อย่างมีนัยสำคัญทางสถิติ ( $p < 0.05$ )

**สรุป:** การรักษากระดูกหน้าแข้งหักด้วยแผ่นโลหะตามกระดูกแบบ *Dynamic compression plate* ให้ผลการรักษาที่ดีทั้งในด้านอัตราการติดของกระดูก การผิดรูปของกระดูก และอัตราการติดเชื้อ โดยเฉพาะการวางแผ่นโลหะตามกระดูกด้าน *Anterolateral* สามารถลดอัตราการติดเชื้อได้อย่างมีนัยสำคัญเมื่อเปรียบเทียบกับ การวางด้าน *Anteromedial*

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# Factors Affect Successful Fast-track Total Knee Arthroplasty

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*Fast-track total knee arthroplasty (TKA) has been reported to improve patient's clinical outcome, and decrease cost of treatment related to hospital stay. However, some drawbacks of early patient's discharge have been reported, which caused surgeons to hesitate whether or not to apply the fast-track protocol in their practices. Literature has shown that besides patient's factor which a decent patient selection played key role for successful fast-track TKA, other factors, including anesthesia factors and surgical factor, could facilitate the consistency of clinical outcome. The purpose of this review was to update and to determine factors which affected the fast-track protocol.*

**Keywords:** Fast-track, total knee arthroplasty, TKA, length of stay, LOS

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## Introduction

Total knee arthroplasty (TKA) is well accepted as the useful and effective surgical treatment for late stage knee osteoarthritis in terms of pain elimination and functional improvement. Currently, it has become a common orthopedic procedure worldwide. Before 1990, the literature has shown that the average length of stay (LOS) in the hospital of patients undergoing TKA was over 10 days<sup>(1)</sup>. Later on, the LOS was reduced to be less than 7 days<sup>(2)</sup>. Following the improvement of surgical technique towards the minimally invasive surgery, the anesthetic technique towards regional anesthesia, the comprehensive perioperative pain, and the early postoperative rehabilitation protocol, the LOS was markedly reduced. Following the fast-track TKA, which has been introduced by Husted et al.,<sup>(3)</sup> the LOS of TKA was limited within 3 days<sup>(3,4)</sup> and this new protocol has become very popular TKA management pathway in several orthopedic surgical centers. The fast-track TKA provides several advantages, including enhancing improvement of patient's clinical outcomes, reduction of infection rate, thromboembolism, urinary retention, and bowel paralytic ileus<sup>(5-7)</sup>. In fact, it also exhibited a decreased overall cost of treatment.

However, early discharge of patients in the fast-track TKA has raised some conflicts of clinical outcomes in the literature. Whilst a study reported increased readmission rate after fast-track TKA in comparison to that of standard TKA protocol<sup>(6)</sup>,

another study demonstrated no difference in readmission rate of both protocols. Although a recent study showed that shorter patient's LOS did not associate with the rate of manipulation under general anesthesia (MUA) after TKA<sup>(8)</sup>, another study reported in the opposite way<sup>(9)</sup>. These investigators found that the causes of postoperative knee stiffness were multifactors; however, early discharge program in TKA was one related factor<sup>(9)</sup>. According to several aspects of previous reports, it is controversial whether a shorter hospital stay following the fast-track TKA provided a reduction of mortality rate<sup>(6,10,11)</sup>. In fact, there has been unclear conclusion whether which patients should be the right candidate for a fast-track protocol in TKA<sup>(12-14)</sup>.

This review article collected the current studies and knowledge related to success fast-track TKA which the authors discussed in specific important factors, including patient factor, anesthesia factor and surgical factor.

## Patient factor

### Age

The current literature has shown that the higher patients' age undergoing TKA, the longer LOS did occur. Those patients whose ages were more than 80 years had significantly longer LOS over 4 days<sup>(5)</sup>. One study had found that the probability of more than 3-day LOS increased by 2.4% for each increment year of the patient's age<sup>(15)</sup>. However, the younger patients did not always have advantages over those who are older. The risk of manipulation under general anesthesia after fast-track TKA was found higher in the younger age group. The mean age of this at-risk younger patients was 59 years old<sup>(8)</sup>.

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### **Comorbidity**

Conditions or diseases, such as congestive heart failure, bleeding disorder, and prior operation within 30 days were found to cause significant risk for delay discharge<sup>(15,16)</sup>. Evaluation of patient's general condition before surgery is recommended in order to recognize patient's subclinical conditions or diseases, as well as to optimize the goal of fast-track protocol. Regarding the preoperative American Society of Anesthesiologists (ASA) score, studies has shown that patients with increased ASA score related to more LOS<sup>(15)</sup>, especially those who had ASA score more than class 3<sup>(16)</sup>.

### **Risk Assessment and Prediction Tool**

The risk assessment and prediction tool (RAPT) is a tool which evaluates several patient key factors and socioeconomic status, including age, sex, previous ambulation status, gait aid, social support, and caregiver (Table 1.). Before surgery, the RAPT is a useful tool to predict the successful of early patient's discharge. If the RAPT score is

higher than 9 points, it is highly predictable that the patient can be early discharged to home<sup>(17)</sup>. If the RAPT score is between 6 to 9 points (gray zone), health care provider team should consider and manage other factors which may delay early discharge. For those who have lower score than 6 points, there will be higher is for delay ambulation, such as, patients who preoperatively used a gait aid were reported to have a higher chance of poor ambulation with later MUA after fast-track protocol<sup>(9)</sup>.

As several oriental countries, including Thailand, it is quite common that the patient's family members or relatives always encourage and support the patients during hospital admission and after discharge as an additional care giver. Therefore, with a well pre-education to patient's family members or relatives who will be taking care the patient during the perioperative period will increase the success rate of fast-track protocol for TKA.

**Table 1** Risk assessment and prediction tool (RAPT) to predict patient disposition according to Hansen VJ. Et al.<sup>(17)</sup>

Item	Value	Score
Age group (years)	50-65	2
	66-75	1
	> 75	0
Sex	Male	2
	Female	1
Walking distance	Two blocks or more	2
	1-2 blocks	1
	Housebound	0
Use of gait aid	None	2
	Single-point stick	1
	Crutches/frame	0
Use of community supports	None or one per week	1
	Two or more per week	0
Caregiver at home	Yes	1
	No	0

### **Hemoglobin level**

Regarding the preoperative hemoglobin (Hb) level, the patients whose Hb level is less than 13 g/dL for male gender and less than 12 g/dL for female gender or hematocrit (Hct) level is less than 38% is considered as a anemia patient<sup>(15,16)</sup>. Several studies have shown that preoperative anemia related to increasing of LOS and higher re-admission rate<sup>(6,18)</sup>.

### **Preoperative usage of opioids**

Most studies reported that patients, who have prolonged usage of opioids before surgery, have increased LOS and worse postoperative outcomes<sup>(19-21)</sup>. However, some investigators emphasized that more attention on rehabilitation

should be focused before surgery, the preoperative rehabilitation could enhance patients' general condition, as well as encourage the patients to early ambulate in order to improve their postoperative clinical outcomes<sup>(22-24)</sup>.

### **Anesthesia Factor**

Although spinal anesthesia plays an important role for fast-track, as it relates to less systemic effects at perioperative period than general anesthesia. For those patients who have spinal disease which may preclude spinal anesthesia, general anesthesia with the combination with multimodal pain control is an alternative. However, the overall cost of anesthesia of general

anesthesia with multimodal pain control has a higher cost than spinal anesthesia<sup>(25,26)</sup>.

Currently, most fast-track protocols for TKA consist of multimodal perioperative pain control regardless of the type of anesthesia. The use of multiple drugs is aimed to reduce the overall usage of opioids, which results in less side effects and enhancing early ambulation<sup>(3,12-15)</sup>.

### Surgical Factor

#### *Less Invasive Surgery*

A minimally invasive surgery (MIS), which is a shorter skin incision in combination with less extensive exposure provided a reducing soft tissue injury relating to less prolonged postoperative knee pain, whilst improved early range of motion after surgery, has been evidenced<sup>(27,28)</sup>. Therefore, it can enhance the success rate of fast-track TKA.

#### *Same-day Bilateral TKA*

Current literature has shown that patients who underwent same-day bilateral TKA could have very satisfactory results which were not different from those who had a unilateral TKA<sup>(5)</sup>. However, it should be aware that in patients who have cardiopulmonary diseases and the ASA classification is more than class 3, there will be a high incidence of increasing LOS, as well as the rate of postoperative confusion, delirium, cardiovascular events, and re-admission rate<sup>(29,30)</sup>.

### *Revision surgery as a fast-track TKA*

Although a study reported that revision TKA from aseptic loosening had a similar fast-track result to those with primary TKA<sup>(31)</sup>, some unexpected complications, such as cortical fracture at the distal stem area had occurred after the full weight bearing according to the protocol. Therefore, for those surgeons who propose to use of fast-track protocol in revision TKA, increased risk of postoperative morbidity have to be considered.

### **Fast-track TKA in Thailand**

The fast-track TKA was first published by Tanavalee A. et al. in 2009<sup>(32)</sup> with a combination of MIS concept, multimodal pain control and early rehabilitation. With a well set up of patient care team, results of fast track TKA has shown a consistent results of 3-day admission protocol with a very satisfactory outcomes, regardless of patient's comorbidities<sup>(33)</sup>. Later on the modification of fast-track TKA tended to move towards the anesthesia protocol, which is a variation of peripheral nerve blocks in combination of periarticular cocktail injection<sup>(34,35)</sup>. With new improvement of anesthesia protocol, the rate of nausea and vomiting was less, as well as the rate of side effects related to the usage of opioids.

**Table 2** Characteristic of Fast-track TKA patients at our institution according Kampitak W. et al.<sup>(34,35)</sup>

Patient characteristic	Adductor block alone (N = 59)	Adductor block + local LIA (N = 30)	LIA alone (N = 28)
Age ± SD (year)	72.28 ± 7.95	69.1 ± 5.36	68.89 ± 5.65
Co-morbidity	ASA 1 = 0 ASA 2 = 57 (96.61%) ASA 3 = 2 ASA 4 = 0	ASA 1 = 0 ASA 2 = 28 (93.33%) ASA 3 = 2 ASA 4 = 0	ASA 1 = 0 ASA 2 = 28 (100%) ASA 3 = 0 ASA 4 = 0
RAPT score	<6 = 0% 6-9 = 46.67% >9 = 53.33%	<6 = 0% 6-9 = 13% >9 = 87%	<6 = 0% 6-9 = 13.8% >9 = 86.20%
Hemoglobin level			
Male (mean ± SD)	13.33 ± 0.78	13.05 ± 1.08	13.4 ± 1.95
>13 g/dl	66.67%	50%	50%
<13 g/dl	33.33%	50%	50%
Female (mean ± SD)	12.3 ± 1.12	12.69 ± 0.64	12.6 ± 1
>12 g/dl	76.47%	80%	70%
<12 g/dl	23.53%	20%	30%
Pre-operative opioid drug use	Yes = 0% No = 100%	Yes = 0% No = 100%	Yes = 0% No = 100%
Operation type	Primary TKR = 100%	Primary TKR = 100%	Primary TKR = 100%
LOS (days)	3	3	3

N = Number of patients, LIA = Local infiltration analgesia, ASA = American Society of Anesthesiologists physical status, RAPT = Risk Assessment and Prediction Tool, TKR = total knee replacement, LOS = length of hospital stays, SD = standard deviation



Since 2010, most institutions in Thailand have used their individual fast-track TKA protocol whilst the patient selection criteria has not been clarified. However, based on several international publications which the investigation were performed in Thailand, the mean LOS of patients who underwent primary TKA were reduced from those studies in the past, which was ranged from 3 to 6 days<sup>(34-38)</sup>.

Currently, the fast-track TKA protocol at our institution, King Chulalongkorn Memorial Hospital, includes admission the patient one day before surgery for preoperative anesthesiology visit, evaluation and management of any possible correctable patient's negative factors for fast-track protocol, such as hematocrit and hemoglobin. Regarding patient's selection, the ASA classification must be within class 3, and the RAPT score must be  $\geq 6$  points (Table 2.). However, minor degree of anemia is acceptable. With combined MIS surgical technique and peripheral nerve block & simple spinal anesthesia, all surgeries could be the opioid-sparing TKA. The overall immediate to short-term results were satisfied in terms of LOS, patient's satisfaction, functional improvement and unexpected complications<sup>(34,35)</sup>.

## Conclusion

Fast-track TKA seemed to provide more advantages over its disadvantages. Besides effective perioperative pain control, patients should be able to happily ambulate, which resulted in early discharge from the hospital. Several factors were reported to affect the fast-track pathway. Select the right patient into a well set-up patient care team with a multi-disciplinary care is mandatory for a consistent outcome.

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## ปัจจัยที่มีผลต่อความประสบความสำเร็จในการเปลี่ยนข้อเข่าเทียมแบบเชิงรุกเร็ว (*Fast-track Protocol*)

โชติตะวัน ณ นวล, พบ, สิริรัช งามอุโฆษ, พบ, วัชร วิไลรัตน์, พบ, อารี ณ นวล, พบ

การผ่าตัดเปลี่ยนข้อเข่าเทียมโดยการดูแลผู้ป่วยแบบเชิงรุกเร็ว (*fast-track protocol*) มีส่วนช่วยทำให้ผลการรักษาดีขึ้นและลดค่าใช้จ่ายขณะอยู่โรงพยาบาลของผู้ป่วย อย่างไรก็ตาม การจำหน่ายผู้ป่วยออกจากโรงพยาบาลภายในระยะเวลาสั้น อาจส่งผลให้เกิดปัญหาการเกิดภาวะแทรกซ้อนเมื่อกลับบ้าน ซึ่งอาจทำให้แพทย์ที่สนใจใช้ *fast-track protocol* เกิดความไม่มั่นใจที่จะใช้ หรือเกิดข้อจำกัดในการใช้ จากการทบทวนวรรณกรรม นอกจากปัจจัยจากตัวผู้ป่วย ซึ่งการเลือกผู้ป่วยและเตรียมผู้ป่วยล่วงหน้าอย่างเหมาะสมเป็นสิ่งสำคัญต่อความสำเร็จของ *fast track protocol* แล้ว ปัจจัยอื่นๆ คือ วิทยาวิสัญญีและการระงับปวดแบบต่าง ๆ และปัจจัยที่เกี่ยวกับการผ่าตัด ก็เป็นปัจจัยสำคัญที่ทำให้ *fast-track protocol* ประสบผลสำเร็จ การทบทวนวรรณกรรมนี้จะมุ่งเน้นไปที่ปัจจัยที่มีผลต่อความสำเร็จของ *fast track protocol*

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## 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.

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## Example of references:

### Journal articles.

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## 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 วิเคราะห์อาการทางคลินิกและผลตรวจทางห้องปฏิบัติการที่น่าสนใจ เรื่องที่ส่งมาต้องไม่เคยพิมพ์เผยแพร่มาก่อน กองบรรณาธิการขอสงวนสิทธิ์ในการตรวจทาน แก้ไขต้นฉบับ และพิจารณาตีพิมพ์ข้อคิดเห็นในบทความเป็นความเห็นและเป็นความรับผิดชอบของเจ้าของบทความโดยตรง

### การส่งบทความ

ทางราชวิทยาลัยฯ ขอแจ้งให้ทราบว่า เพื่อความสะดวกรวดเร็วและมีประสิทธิภาพในการส่งบทความ ราชวิทยาลัยฯ ผู้เขียนสามารถเสนอบทความเพื่อพิจารณาได้ทางจดหมายอิเล็กทรอนิกส์ 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 ภาควิชา หน่วยงาน หรือผู้เขียนทุกคน และระบุชื่อผู้วิจัยหลักให้ชัดเจน

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

- บทความที่ส่งมาจะต้องเป็นเรื่องที่ไม่เคยตีพิมพ์ที่ไหนมาก่อน และผู้เขียนจะต้องไม่ส่งบทความเพื่อไปตีพิมพ์ในวารสารฉบับอื่นในเวลาเดียวกัน

### หลักเกณฑ์สำหรับผู้เขียนบทความ

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

### ● หน้าแรก (Title page) เขียนเป็นภาษาไทยและภาษาอังกฤษ ประกอบด้วย

- (1) ชื่อ สกุลของผู้เขียน
- (2) ชื่อเรื่องอย่างย่อ ที่สื่อความหมายและชี้ให้เห็นสาระสำคัญของเนื้อหาในบทความ
- (3) สถานที่ทำงาน
- (4) เบอร์โทรศัพท์, เบอร์แฟกซ์ และ e-mail address ของผู้เขียน

### ● บทคัดย่อ (Abstract) ต้องมีทั้งภาษาไทยและภาษาอังกฤษมีความยาวไม่เกิน 250 คำ โดยเรียงลำดับเนื้อหา ดังนี้

- (1) วัตถุประสงค์ (Purpose)
- (2) วิธีการศึกษา (Methods)
- (3) ผลการศึกษา (Results)
- (4) สรุป (Conclusions)

### ● คำสำคัญ (Keyword) ระบุไว้ได้บทคัดย่อ 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) ไม่ใช่ “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)** ไม่ควรมีขนาดต่าง ๆ มากกว่า 3 ระดับ
  - **คำย่อ (abbreviations)** จะต้องมีคำเต็มเมื่อปรากฏเป็นครั้งแรกในบทความ หลังจากนั้นสามารถใช้คำย่อเหล่านั้นได้ตามปกติ
  - **เชิงอรรถ (footnotes)** คือ การอ้างอิงข้อความที่ผู้เขียนนำมากล่าวแยกจากเนื้อหาอยู่ตอนล่างของหน้า โดยใส่หมายเลขกำกับไว้ท้ายข้อความที่คัดลอกหรือเก็บแนวคิดมา และจะไม่เขียนเชิงอรรถเอาไว้ที่หน้าแรกของบทความ ถ้าต้องการแสดงที่มาของตารางหรือภาพประกอบให้ใช้เครื่องหมายแทนตัวเลข โดยเขียนไว้ที่ส่วนล่าง ของหน้า หรือใช้เครื่องหมายดอกจัน (\*) เพื่อแสดงความหมายของคำหรือข้อมูลทางสถิติ
  - **กิตติกรรมประกาศ (acknowledgements)** เป็นการแสดงความขอบคุณแก่ผู้ที่ช่วยเหลือในการทำวิจัย หรือผู้สนับสนุนทุนการวิจัย เป็นต้น โดยจะเขียนไว้ก่อนเอกสารอ้างอิงและควรเขียนชื่อสถาบันที่ให้การสนับสนุนทุนการวิจัยโดยใช้ชื่อเต็ม
  - **ตาราง (tables)**
    - (1) ให้เขียนหมายเลขตารางเป็นเลขอารบิก
    - (2) ให้เรียงตามลำดับที่ของตารางอย่างต่อเนื่องกันจาก 1, 2, 3, ....
    - (3) การอธิบายผลในตารางต้องไม่ซ้ำซ้อนกันและมีใจความกระชับรัดกุม และมีคำอธิบายกำกับไว้เหนือตาราง
    - (4) เขียนคำอธิบายเพิ่มเติมเกี่ยวกับแหล่งที่มาของเอกสารอ้างอิงไว้ที่ได้ตาราง
    - (5) เชิงอรรถ (footnotes) ของตารางจะเขียนไว้ใต้ตารางหรือใช้เครื่องหมายดอกจัน (\*) เพื่อแสดงความหมายของคำหรือข้อมูลทางสถิติ
  - **รูปภาพ (figures)**
    - (1) ให้ใช้โปรแกรมกราฟฟิคคอมพิวเตอร์ในการวาดรูป
    - (2) รูปภาพที่เป็นลายเส้นควรใช้รูปแบบ EPS ในการวาดเส้นรูปภาพและรูปภาพที่เป็นโทนสีควรใช้รูปแบบ TIFF ในการไล่เฉดสี
    - (3) รูปภาพทุกรูปจะต้องมีหมายเลขและคำบรรยายภาพกำกับไว้ใต้ภาพ โดยใช้ชื่อรูปภาพเป็น “Fig” ตามด้วยลำดับที่ของรูปภาพ เช่น “Fig.1” 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

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## Acknowledgements to Reviewers 2018

Theerachai Apivatthakakul  
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 2018.

### List of reviewers:

Apipop Kritsaneephaiboon  
Aree Tanavalee  
Artit Laoruengthana  
Chavarin Amarase  
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