The Thai Journal of Orthopaedic Surgery

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

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The Official Journal of Spine Society of Thailand
The Official Journal of Thai Orthopaedic Society for Sports Medicine
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สารบัญ

Editorial

This is the second issue of the Thai Journal of Orthopaedic Surgery by the current editorial board. The associate and co-editors worked very hard to send letters to all sub-specialty societies. The Thai Journal of Orthopaedic Surgery is the official journal of all societies under the Royal College of Orthopaedic Surgeons of Thailand including: Thai Hip & Knee Society, Spine Society of Thailand, Thai Orthopaedic Society for Sports Medicine, Thai Society for Hand Surgery of RCOST, Thailand Orthopaedic Foot and Ankle Society, Pediatric Orthopaedic Society, Metabolic Bone Disorder and Orthogeriatrics, Thai Musculoskeletal Tumor Society, and Thailand Orthopaedic Trauma. We also encourage all residents who submitted their theses for board examination to publish in our journal. Unfortunately, most of the papers were sent to journals with impact factors and under proper databases. We also encourage orthopaedic surgeons who work in provincial and regional hospitals to submit their work to fulfill their requirement for academic evaluation in their endeavorto gain a higher rank in their work position.

In reviewing this issue, we need to ask some authors of the papers to revise their manuscripts. We are in the process of finding support from the Royal College to support editing of the papers as well as helping all research processes. In this volume, there are 6 articles, 5 research articles and 1 review article, published:

1. Midterm result of total knee arthroplasty in the young osteoarthritis patients
2. Comparison between percutaneous needle release and local corticosteroid injection for the treatment of tennis elbow
3. Area of skin numbness after less invasive surgery total knee arthroplasty: A prospective study
4. Infrapatellar branch of the saphenous nerve: cadaveric study
5. Association between the size of humeral head cysts and the extension of rotator cuff tears
6. Elastic stable intramedullary nail: The viable technique for pediatric long bone fixation.

We are confident that in the next volume, which will be distributed during the 51st annual meeting of the Asia Pacific Orthopaedic Association (APOA) meeting this coming October 2014 in Pattaya, Thailand, we will have more original articles, review articles, and case reports.

Pongsak Yuktanandana, MD.

Mid-term Result of Total Knee Arthroplasty in the Young Osteoarthritis Patients

Viroj Kawinwonggowit, MD, Siwadol Wongsak, MD, Prachya Padungpak, MD

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Background: *The primary goals of total knee arthroplasty (TKA) are to relieve pain and improve function in inflammatory and degenerative knee arthritis. Long-term clinical success has been shown in elderly patients.*
Objective: *The purpose of this study was to evaluate the clinical and radiographic results of TKA in patients with advanced stage osteoarthritis of the knee joints where the patients were younger than fifty-five years of age at the time of operation.*
Materials and methods: *The authors retrospectively reviewed the results of 70 patients with osteoarthritis who were 55 years or younger (mean age, 52.2 years) and who had received a fixed-bearing cemented TKA prosthesis and patellar resurfacing. The patients were assessed with regard to clinical, radiographic and knee motion assessment. Kaplan-Meier analysis of implant survival was performed.*
Results: *The mean preoperative and postoperative knee motion was 97.0° and 119.8°, respectively (P < 0.01). At the latest follow-up, Knee Society knee clinical scores improved from 45.6 to 83.3 points (P < 0.01) and Knee Society knee functional scores improved from 45.9 to 72.6 points (P < 0.01). There were three revision TKA that included aseptic loosening for two knees and septic loosening for one knee. The mean follow-up was 8.7 years (range, 5.0-16.0). The Kaplan-Meier survivorship analysis of implants showed that the rate of survival was 97.9% (95% CI, 90 to 99) at 10 years postoperatively and 96.9% (95% CI, 80 to 98) at 15 years postoperatively when revision was defined as the end point.*
Discussion: *The study showed improvement of functional and clinical knee scores at mid-term follow-up in patients with advanced stage osteoarthritis of the knee where the patients were younger than fifty-five years of age. However, there is concern in the findings of previous literature regarding the success of TKA in young patients. It will be important to determine the functional outcome and ability to return to an active lifestyle in younger patients. Long-term follow-ups in the second decade should be performed because younger patients will likely live long enough to require revision surgery.*

Keywords: *total knee arthroplasty, cemented, young patients, osteoarthritis, results*

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Introduction

The primary goals of total knee arthroplasty (TKA) are to relieve pain and improve function in advanced stage osteoarthritis of the knee. Long-term clinical success has been shown in elderly patients with implant survivorship of as much as 94-98% between 15 and 20 years after surgery when loosening or revision is used as the end point[1-3]. The factors affecting the good results of TKA included improvements in surgical technique, polyethylene durability and prosthesis design[4]. These factors have allowed indications of TKA to expand for all ages and it can be performed with increasing frequency in younger and more active patients. The data from the Swedish knee arthroplasty registry show an increased proportion of TKA in patients who are younger than 55 years old in 2000 and actual numbers of patients between 45-65 years of age having a TKA were three times more than unicompartmental knee arthroplasty. This can be explained with increased confidence that TKA is beneficial for younger patients[5].

Because of concerns regarding survivorship and functional outcome of TKA in younger patients, who have a higher level of activity, higher demand of pain-relief and a state of health that more often allows for revision surgery[5-7], TKA in younger patients have always been challenging and controversial[8].

Most mid-term and long-term studies on TKA in younger patients have included patients who have preoperative diagnosis of rheumatoid arthritis and who were in the inactive life style or heterogeneous group of patients with respect to diagnosis, activity levels, and surgical technique[6,7,9-12]. There are relatively few studies that focused specifically on younger patients with advanced stage primary osteoarthritis.

The purpose of this study was to evaluate the clinical and radiographic results, and survivorship of TKA in advanced stage

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osteoarthritis patients who were younger than fifty-five years of age at the time of operation.

Materials and Methods

Participants

Between 1997-2008, 1,998 patients underwent TKA in Ramathibodi Hospital. One hundred and twenty seven patients were younger than fifty-five years of age. Of these patients, thirty-nine were excluded due to being diagnosed with secondary osteoarthritis (27 rheumatoid arthritis, 5 post-traumatic arthritis, 5 hemophiliac, 1 post septic arthritis, and 1 systemic lupus erythematous with osteonecrosis of the medial femoral condyle). Four other patients were excluded because TKA were performed with a mobile bearing design and a further two patients were excluded because a cementless fixation technique was used when performing the TKA. Therefore, 82 patients had been diagnosed with primary tricompartmental osteoarthritis of the knee (Ahlbäck grade III to V) and recieved TKA with fixed-bearings, a posterior stabilized design, cemented fixation and patella resurfacing. But twelve patients (twelve knees) were lost at follow-up. In summary, 70 patients (97 knees) were included in this study.

All surgeries were performed by one senior author with the posterior stabilized prosthesis design and cemented fixation consisting of Nexgen LPS, Nexgen LPS Flex,and Insall-burstein II: Zimmer. All knees had a standard medial-parapatellar approach. Patellar resurfacing was performed in all cases with a cemented all-polyethylene component. No defects in the tibial plateau needed supplemental support.

Clinical evaluation

The demographic data, Knee Society scores, clinical active range of motions and radiographs were obtained before the operations and at the latest follow-up. The Knee Society score, used for the assessment of clinical and functional outcomes separately for each knee, consist of distinct 100-points scales per knee. At the time of follow-up, all clinical data were recorded and complied with independent observer.

Radiological evaluation

Weight-bearing anteroposterior radiographs and lateral radiographs were used to determine the overall alignment of the limb (tibio-femoral angle). Postoperative radiographs were evaluated for alignment using tibial and femoral component position. The anteroposterior and lateral radiographs were analyzed for the presence and progression of radiolucency lines at the bone-cement and the prosthesis-cement interfaces by comparing with those on previous radiographs.

Statistical analysis

Statistical analysis was performed using the 2-sample test or Wilcoxon signed-rank sum test for comparison of continuous variables. Changes in the continuous variables were assessed using the paired t-test or signed rank test. Kaplan-Meier analysis of implant survival was performed. Failure was defined as revision of the femoral, tibial or patellar component for any reason. This included surgery for septic or aseptic loosening, instability, and fracture of the tibia, femur, and/or patella.

Results

A total of 70 patients (97 knees) were included in the study. The mean age of the patients at the time of surgery was 52.2 ± 3.9 years (range, 42-55). Sixty-one patients (87 knees) were women (87.1%), and nine (10 knees) were men (12.9%). The average weight at the time of surgery was 66.5 kg (range, 44.8-91.0). The mean height was 154.9 cm (range, 148-162). The mean body mass index was 27.7 kg/m^2 (range, 19.4-37.9). There were 56 right knees (57.7%) and 41 left knees (42.3%). Twenty-seven of the patients had staged bilateral knee arthroplasties (38.6%). All staged bilateral TKA were performed before patients were 55 years old. The average follow-up period was 8.7 years (range, 5-16 years). The mean thickness of the tibial polyethylene insert was 12 ± 2 mm.

Results of both preoperative and postoperative function were graded according to the Knee Society score (Table 1). The mean preoperative knee clinical score was 45.6 ± 7.7 points (range, 10.0-67.0), and the mean preoperative functional score was 45.9 ± 14.3 points (range, 0-82.0). At the latest follow-up, the mean knee clinical score was 83.3 ± 10.7 points (range, 18.0-95.0), and the mean functional score was 72.6 ± 10.8 points (range, 0-90.0). Wilcoxon signed-rank sum test was used to compare knee scores between preoperation and postoperation because the data were not normally distributed. There were statistically significant differences of both functional and clinical scores between preoperation and postoperation TKA in these groups of patients (P-value < 0.01).

Preoperative range of motion was increased from 97.0 ± 17.0 degrees (range, 60.0-135.0) to 119.8 ± 11.9 degrees (range, 75.0-135.0) postoperatively. Wilcoxon signed-rank sum test was used to compare knee range of motion between preoperation and postoperation because the data were not normally distributed either. There was a statistically significant difference between preoperation range of motion and postoperation range of motion in these groups of patients (P < 0.01).

Table 1 Clinical Results

	Pre-operative	Final follow-up	*P*-value
Mean Knee Society clinical score *(points)*	45.6 ± 7.7 (10-67)	83.3 ± 10.7 (18-95)	< 0.01
Mean Knee Society functional score *(points)*	45.9 ± 14.3 (0-82)	72.6 ± 10.8 (0-90)	< 0.01
Mean range of motions *(degrees)*	97.0 ± 17.0 (60-135)	119.8 ± 11.9 (75-135)	< 0.01

The average preoperative alignment was 1.6° varus (range, 16° varus to 20° valgus), and the average postoperative alignment was 2.8° valgus (range, 6° varus to 11° valgus). Four knees (4.1%) had radiolucent lines (> 2 mm in width) around the tibial component, and three of four tibial components showed evidence of loosening. Three knees (3.1%) had radiolucent lines (> 2 mm in width) around the femoral component (Table 2).

There were three revision TKA in the study. The first case occurred 4 years postoperation and was diagnosed with septic loosening acute hematogenous type (Segawa et al.)[13]. This patient was managed with intravenous antibiotics and a two-stage revision. One patient was revised TKA due to aseptic loosening in both knees, 7 and 10 years postoperatively.

Table 2 Radiographic Results

Tibial radiolucent lines *(knees) (%)*	
< 1mm	8 (8.2)
> 2mm	4 (4.1)
Femoral radiolucent lines *(knee) (%)*	
< 1mm	2 (2.1)
> 2 mm	3 (3.1)
Pre-operative tibio-femoral alignment *(degrees varus)*	1.6 (16 varus to 20 valgus)
Final follow-up tibio-femoral alignment *(degrees valgus)*	2.8 (6 varus to 11 valgus)

Survival analysis was performed with Kaplan-Meier survivorship curves (Fig. 1). The Kaplan-Meier survivorship analysis of implants showed that the rate of survival was 97.9% (95% CI, 90 to 99) at 10 years postoperatively and 96.9% (95% CI, 80 to 98) at 15 years postoperatively when revision was defined as the end point.

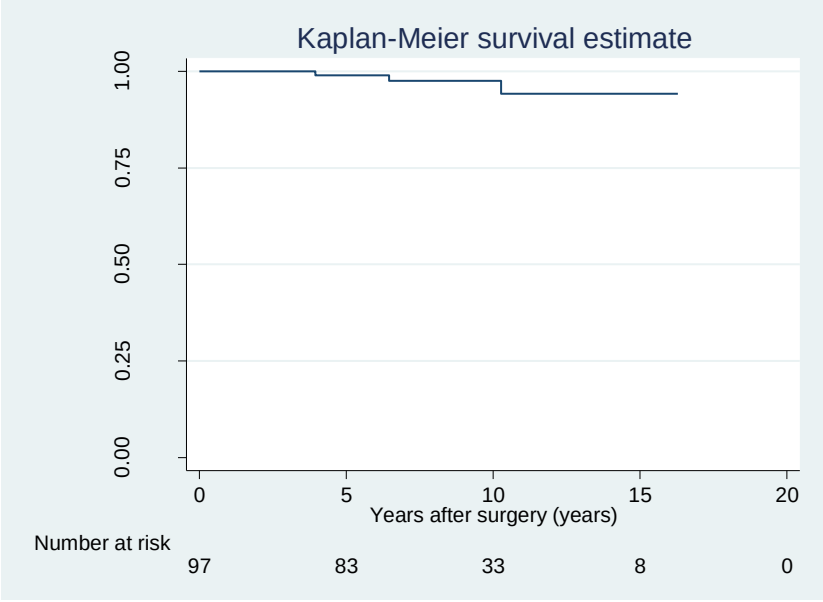

Fig. 1 The Kaplan-Meier survivorship analysis of implants.

Discussion

TKA is one of the surgical managements of multi-compartment advanced stage knee osteoarthritis in elderly patients. Improvements in surgical techniques, fixation methods, implant design and bearing surfaces have allowed TKA to be a successful procedure for elderly patients and expanded indications to younger patients[5,14]. The primary goals of performing TKA in younger patients are the same as in elderly patients, i.e., to relieve pain, increase function and improve quality of life[1].

In younger osteoarthritic patients, nonoperative treatments should be considered before surgical decision. When nonoperative treatments fail, the choices of operation include arthroscopy, knee arthrodesis, proximal tibial or distal femoral osteotomy, and unicompartmental knee arthroplasty, but in the setting of advanced disease, these often do not provide adequate pain relief, and may be at higher risk of complications when converted to total knee arthroplasty. However, there are significant functional limitations after knee arthrodesis.

For advanced stage knee disease in younger patients, it is important to recognize that not all patients have the same functional demands following arthroplasty as elderly or low demand patients. There are early concerns that knee arthroplasty would prove to be less durable and have a lower patient satisfaction in patients with higher levels of activity or higher demand patients than the TKA in the elderly patients, including concerns regarding wear, instability, loosening and the potential need for multiple revision surgeries in the whole life of younger patients[5,6,15-17].

The decision to proceed with TKA in younger patients is a difficult one. Diduch et al.[15] reported a 94% survival rate at eighteen years on patients < 55 years of age with post-traumatic arthritis or osteoarthritis, with use of revision as an end point. When the exchange of the spacer was also included in the failures, the survival rate was 87% at eighteen years. Dixon et al.[18] reported a 92.6% survival rate at fifteen years in younger patients with an average age of sixty-seven years, using revision as an end point. Duffy et al.[7] reviewed TKA in patients aged under 55 years, most of whom were diagnosed with inflammatory arthritis, noted 96% implant survival at 10 years but an increase in polyethylene wear-related failures at 15 years (85% survival). Ewald et al.[4] reviewed TKA in patients aged under 45 years, 58% of the patients had rheumatoid arthritis, and 29% had juvenile rheumatoid arthritis. There were no revisions of these knees for a loose prosthesis at an average follow-up period of 7.2 years.

The purpose of this study was to assess the performance and durability of the TKA when performed in patients younger than 55 years of age. The strength of the study encompasses a large number of patients who are specific to advanced stage primary osteoarthritis. TKA were performed on these patients by a single surgeon and the surgical techniques limited to cemented fixation, posterior stabilized implant design, and patellar resurfacing.

This study showed improvements of functional and clinical knee scores at mid-term follow-up and supported the findings of the previous reports in the literature. Concerning the success of TKA in the young, it would be important to determine functional outcome and ability to return to an active lifestyle in younger patients.

There are some limitations in this study. First, this retrospective study lacked the documentation of the activity level of the patients and radiographic protocol to complete an assessment of polyethylene wear. Second, there was a relatively large number of patients who were lost to follow-up (12 from 82 patients, 14.6%) which may result in an underestimate of the revision rate. Third, the Kaplan-Meier survival analysis is normally used to measure the fraction of the subjects living for a certain amount of time but the follow-up time of each patient in this study ranged from 5 to 16 years, mean follow-up time was 8.7 years. The survival rate of the patients in this study should be 96.9% at mean follow-up 8.7 years.

Further study on assessment of the activity level or sport activity of the patients will be needed for comparison between preoperation and postoperation using the assessment tools e.g., SF-36, WOMAC, KOOS, and Tegner activity level scale. It would be better to follow-up for a longer period because younger patients are more likely to live long enough to require revision surgery[9].

References

1. Ranawat CS, Flynn WF Jr, Saddler S, Hansraj KK, Maynard MJ. Long-term results of the total condylar knee arthroplasty. A 15-year survivorship study. Clin Orthop Relat Res 1993; 286: 94-102.
2. Pagnano MW, Levy BA, Berry DJ. Cemented all polyethylene tibial components in patients age 75 years and older. Clin Orthop Relat Res 1999; 367: 73-80.
3. Ritter MA. The Anatomical Graduated Component total knee replacement: a long-term evaluation with 20-year survival analysis. J Bone Joint Surg Br 2009; 91: 745-9.
4. Ewald F, Christie MJ. Results of cemented total knee replacement in young patients. Orthop Trans 1987; 11: 442.
5. W-Dahl A, Robertsson O, Lidgren L. Surgery for knee osteoarthritis in younger patients. Acta Orthop 2010; 81: 161-4.
6. Crowder AR, Duffy GP, Trousdale RT. Long-term results of total knee arthroplasty in young

patients with rheumatoid arthritis. J Arthroplasty 2005; 20: 12-6.
7. Duffy GP, Trousdale RT, Stuart MJ. Total knee arthroplasty in patients 55 years old or younger. 10- to 17-year results. Clin Orthop Relat Res 1998; 356: 22-7.
8. Stern SH, Bowen MK, Insall JN, Scuderi GR. Cemented total knee arthroplasty for gonarthrosis in patients 55 years old or younger. Clin Orthop Relat Res 1990; 260: 124-9.
9. Keeney JA, Eunice S, Pashos G, Wright RW, Clohisy JC. What is the evidence for total knee arthroplasty in young patients?: a systematic review of the literature. Clin Orthop Relat Res 2011; 469: 574-83.
10. Ranawat CS, Padgett DE, Ohashi Y. Total knee arthroplasty for patients younger than 55 years. Clin Orthop Relat Res 1989; 248: 27-33.
11. Ranawat AS, Mohanty SS, Goldsmith SE, Rasquinha VJ, Rodriguez JA, Ranawat CS. Experience with an all-polyethylene total knee arthroplasty in younger, active patients with follow-up from 2 to 11 years. J Arthroplasty 2005; 20: 7-11.
12. Ewald FC. The Knee Society total knee arthroplasty roentgenographic evaluation and scoring system. Clin Orthop Relat Res 1989; 248: 9-12.
13. Segawa H, Tsukayama DT, Kyle RF, et al. Infection after total knee arthroplasty: a retrospective study of the treatment of eighty - one infections. J Bone Joint Surg Am 1999; 81: 1434-45.
14. Kurtz SM, Lau E, Ong K, Zhao K, Kelly M, Bozic KJ. Future young patient demand for primary and revision joint replacement: national projections from 2010 to 2030. Clin Orthop Relat Res 2009; 467: 2606-12.
15. Diduch DR, Insall JN, Scott WN, Scuderi GR, Font-Rodriguez D. Total knee replacement in young, active patients. Long-term follow-up and functional outcome. J Bone Joint Surg Am 1997; 79: 575-82.
16. Dalury DF, Ewald FC, Christie MJ, Scott RD. Total knee arthroplasty in a group of patients less than 45 years of age. J Arthroplasty 1995; 10: 598-602.
17. Lonner JH, Hershman S, Mont M, Lotke PA. Total knee arthroplasty in patients 40 years of age and younger with osteoarthritis. Clin Orthop Relat Res 2000; 380: 85-90.
18. Dixon MC, Brown RR, Parsch D, Scott RD. Modular fixed-bearing total knee arthroplasty with retention of the posterior cruciate ligament. A study of patients followed for a minimum of fifteen years. J Bone Joint Surg Am 2005; 87: 598-603.

ผลการรักษาระยะกลางในผู้ป่วยอายุน้อยที่ได้รับการผ่าตัดเปลี่ยนผิวข้อเข่าเทียม

วิโรจน์ กวินวงศ์โกวิท, พบ, ศิวดล วงค์ศักดิ์, พบ, ปรัชญา ผดุงพรรค, พบ

เป้าหมายของการผ่าตัดเปลี่ยนผิวข้อเข่าเทียมในผู้ป่วยสูงอายุที่มีโรคข้อเข่าเสื่อมคือลดอาการปวด เพิ่มการใช้งานข้อเข่า และทำให้คุณภาพชีวิตดีขึ้น ปัจจัยที่มีผลต่อการรักษาที่ดีคือ การเลือกผู้ป่วยที่เหมาะสม เทคนิคการผ่าตัดที่ดี และการพัฒนาข้อเข่าเทียมที่สามารถใช้งานได้ทนทานตลอดอายุขัยของผู้ป่วย เนื่องจากผลการรักษาที่ดีมากในผู้ป่วยสูงอายุ จึงมีการผ่าตัดเปลี่ยนผิวข้อเข่าเทียมมากขึ้นในผู้ป่วยอายุน้อย วัตถุประสงค์ของการศึกษานี้เพื่อศึกษาผลการผ่าตัดเปลี่ยนผิวข้อเข่าเทียม ในผู้ป่วยอายุน้อยกว่า 55 ปี ที่มีโรคข้อเข่าเสื่อมระยะสุดท้ายจำนวน 70 ราย ติดตามการรักษาเป็นระยะเวลาเฉลี่ย 8.7 ปี โดยทำการศึกษาทางคลินิกและภาพถ่ายรังสี ผลการรักษาพบว่าหลังผ่าตัดเปลี่ยนผิวข้อเข่าเทียมในผู้ป่วยที่มีอายุน้อยกว่า 55 ปี ผู้ป่วยมีพิสัยการเคลื่อนไหวของข้อเข่าดีขึ้น จาก 97.0 องศา เป็น 119.8 องศา Knee Society Clinical Score เพิ่มขึ้นจาก 45.6 เป็น 83.3 และ Knee Society Functional Score เพิ่มขึ้นจาก 45.9 เป็น 72.6 จากผู้ป่วยทั้งหมด 70 ราย มีผู้ป่วยจำนวน 3 ราย ที่ต้องผ่าตัดซ่อมข้อเข่าเทียม ซึ่งเกิดจากข้อเทียมหลวม 2 ราย และภาวะติดเชื้อ 1 ราย การศึกษาทางสถิติโดยใช้ Kaplan-Meier survivorship analysis พบว่า ถ้าติดตามการรักษาเป็นเวลา 10 ปี จะมีข้อเข่าเทียมจำนวนร้อยละ 97.9 ที่ยังสามารถใช้งานได้ดี และถ้าติดตามการรักษาเป็นเวลา 15 ปี จะมีข้อเข่าเทียมจำนวนร้อยละ 96.9 ที่ยังคงสามารถใช้งานได้ กล่าวโดยสรุปคือ ผลการรักษาโรคข้อเข่าเสื่อมในผู้ป่วยที่มีอายุน้อยกว่า 55 ปี โดยการผ่าตัดเปลี่ยนผิวข้อเข่าเทียมให้ผลการรักษาที่ดี ผู้ป่วยหายปวด สามารถใช้งานของข้อเข่าได้ดี และมีคุณภาพชีวิตที่ดีขึ้น อย่างไรก็ตาม ผู้ป่วยอายุน้อย ใช้งานข้อเข่าเทียมที่หนักและมีการใช้งานที่ยาวนานขึ้นจึงต้องมีเทคนิคการผ่าตัดที่ดี และมีการพัฒนาคุณภาพของข้อเข่าเทียมให้ทนทานต่อการใช้งานในระยะยาว

Comparison between Percutaneous Needle Release and Local Corticosteroid Injection for the Treatment of Tennis Elbow

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Purpose: *The goal of treatment of tennis elbow is to treat tendinosis. Percutaneous needle release is one of the treatment options but does not have comparative outcomes with standard treatments. To compare the clinical outcomes between percutaneous needle release and local corticosteroid injection in tennis elbow disease.*
Methods: *A prospective randomized controlled study was conducted. Forty-nine tennis elbow patients were divided into two groups by randomization. Twenty-four patients were assigned to the corticosteroid injection group and 25 patients were assigned to the percutaneous needle release group. Both groups were assessed for visual analog scale (VAS), grip strength, and infection before treatment and 2 weeks, 1, 2, 3, and 6 months after the procedures.*
Results: *All demographic data, baseline VAS, and grip strength were not statistically different between groups. The difference of VAS compared to baseline at 2 weeks, 1, 2, 3, and 6 months were 5.86, 6.14, 5.57, 5.09, and 4.85 for the corticosteroid group and 2.68, 3.93, 4.74, 4.38, and 4.35 for the percutaneous needle release group, respectively. The difference of grip strength compared to baseline at 2 weeks, 1, 2, 3, and 6 months were 8.73, 10.42, 10.83, 9.55, and 8.55 for the corticosteroid group and 3.43, 4.65, 7.80, 6.88, and 7.06 for the percutaneous needle release group, respectively. The improvement of VAS and grip strength in the corticosteroid group was superior to the percutaneous needle release group, but there was statistical significance only at 2 weeks and 1 month follow ups (P = <0.001, <0.001, 0.001, 0.005, respectively). No case of infection was detected during the follow up period.*
Conclusion: *A corticosteroid injection improved pain and grip strength in tennis elbow disease more than percutaneous needle release, but was statistically significant only at 2 weeks and 1 month after treatments.*

Keywords: *Tennis elbow disease, lateral epicondylitis, percutaneous needle release, tenotomy, pain, grip strength*

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Introduction

Tennis elbow is lateral elbow pain from tendinosis at the extensor carpi radialis brevis (ECRB) origin. It is caused by repetitive trauma at the ECRB origin leading to a degenerative process and tendinosis. Patients usually present with pain at the lateral of the elbow and weakness of grip strength. First line of treatment for tennis elbow begins with medication. If medical treatment has failed, a corticosteroid injection is one of the treatment options. However, it has side effects such as local skin atrophy, depigmentation of skin, and muscle wasting[1-3]. Percutaneous needle release is an alternative treatment option; however, it breaks up scar tissue, creates bleeding, and stimulate healing process[4-6]. It had good results under ultrasound guide from John M, et al.'s data in 2008[7] and Jiaan Z, et al.'s data in 2008[8] and a prospective study in 2012[9]. There was a retrospective study in 2007, they used percutaneous needle release by 18-gauged needles to make the surface at the ECRB origin raw and they had excellent results in 76% of participants and 66% were completely pain free[10] as in Grundberg's prospective cohort study in 2000[11]. The previously mentioned study was a retrospective study and did not compare to other treatments. Therefore, we created a randomized controlled study to compare outcomes of percutaneous needle release with the standard treatment, corticosteroid injection.

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Objective

The primary objective of this study was to compare the improvement of pain measured by the visual analog scale (VAS) between percutaneous

needle release and corticosteroid injection in treatment outcomes of tennis elbow disease.

The secondary objective was to compare the improvement of grip strength and serious complications such as infection between two groups.

Materials and Methods

The study participants were patients diagnosed with tennis elbow disease in the outpatient department, Faculty of Medicine, Srinakharinwirot University, between May 2011 and May 2013. Inclusion criteria were participants older than 18 years with lateral elbow pain, tenderness at the lateral epicondyle, and for whom pain occurs at the lateral epicondyle of a fully extended elbow with resisted wrist extension or positive Cozen's test[12] and failure from medical treatment for 1 month. Exclusion criteria were participants who had elbow stiffness, inflammatory arthropathy at the elbow, have a history of injection, surgery, fracture, or deformity of the elbow joint, and individuals who were diagnosed with cervical radiculopathy or cervical disc disease. Informed consent of the study was obtained before all procedures were initiated. Participants were interviewed with a case record form for demographic data which composed of sex, age, education, occupation, location, religion, height, weight, and duration of the symptoms. Visual analog scale and grip strength were recorded before the procedure.

Subsequently, all participants were randomized into two groups by a randomization protocol to undergo treatment with either percutaneous needle release or steroid injection. All procedures were performed by the same physician of the Department of Orthopedic Surgery, Faculty of Medicine, HRH Princess Maha Chakri Sirindhorn Medical Center. A flow chart of patients' allocation and follow up, as per the CONSORT statement, is shown in Figure 1.

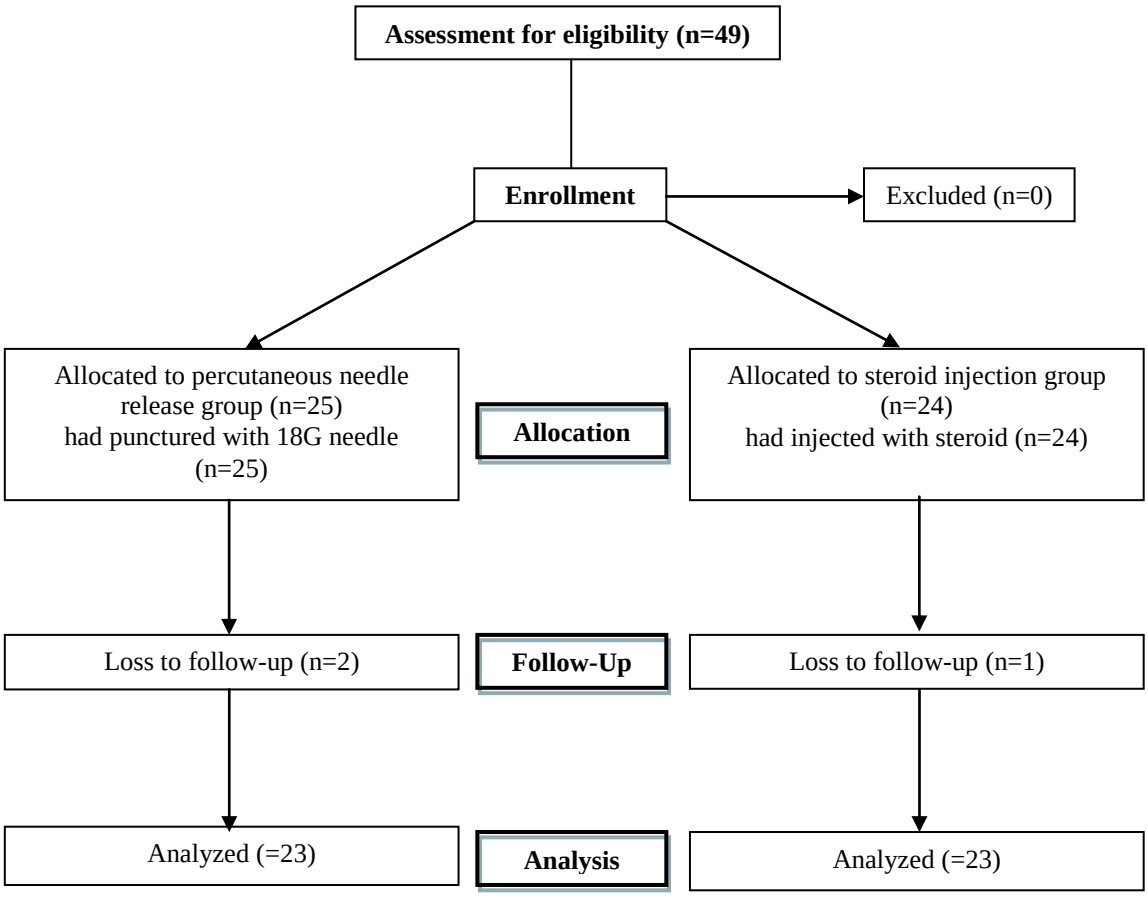

Fig. 1 Flowchart of patients' allocation and analysis (as per CONSORT statement)

Percutaneous needle release was done by using an 18 gauge needle punctured 1 time through the skin at the lateral epicondyle on the area of maximal tenderness, and then punctured 5 times at the extensor carpi radialis brevis origin to create bleeding. This procedure was performed after 1% lidocaine without adrenaline injection. Corticosteroid injections were administered by 10 mg of triamcinolone with 1 ml. of 1% lidocaine without adrenaline injected at the extensor carpi radialis brevis origin.

After the procedure all participants were educated with forearm extensor stretching exercises and prescribed 1 gram per dose and 4 grams per day of paracetamol for pain control.

We followed up at 2 weeks, 1, 2, 3, and 6 months to evaluate pain with visual analog scale and grip strength with a digital hand dynamometer. All data of each follow up were compared to baseline data then recorded. The incidence of infection was recorded at every visit.

The sample size calculation was based on data from a previous study (Espanda et al., 2010)[13]. The authors reviewed that the mean of the VAS of the control group was 2.84 (SD 2.02), and the mean in the treatment group was 1.19 (SD 1.43). The calculated sample size was 24 subjects per group with a power of 80% and type I error of 5%. Statistical analyses were performed using SPSS of Windows version 20.0.

Demographic data was divided into quantitative data and qualitative data. Quantitative data distributions were analyzed with Kolmogorov-Smirnov test. If data was normally distributed, it would be presented with mean±standard deviation (SD). If data did not have a normal distribution it would be presented with median (Interquartile range). Data in this category were age, height, weight, duration, VAS, and grip strength. Qualitative data were presented as a percentage. Data in this category were sex, education, occupation, location, and religion.

The differences between quantitative demographic data were tested by independence *t*-test or Wilcoxon Rank Sum test depending on the distribution of the data; qualitative demographic data were tested by Chi-square test.

Results of treatment in both groups were VAS, grip strength and incidence of infection. We compared the improvement of VAS and grip strength at 2 weeks, 1, 2, 3, and 6 months with independence *t*-test or Wilcoxon Rank Sum test depending on distribution of data. A P-value < 0.05 was considered statistically significant. Incidence of infection was presented as a percentage.

Results

During the study period, 49 tennis elbow participants were recruited and randomized into 2 groups, percutaneous needle release and corticosteroid injection. The patients' demographic data were summarized in table1 and table 2. Mean age, height, weight, duration of disease, baseline VAS, and baseline grip strength were 43.76 years, 161 centimeters, 56.8 kilograms, 9.92 weeks, 6.64, and 19.21 kilograms in the percutaneous needle release group, and were 49.04 years, 160 centimeters, 57.58 kilograms, 8.17 weeks, 7.43, and 16.62 kilograms, respectively (Table 1). Other demographic data were sex, education, occupation, location, and religion. All data were not significantly different between groups.

Table 1 Demographic data of the population

Characteristics	Needle release (n=25)	Steroid injection (n=24)	Mean difference	95%CI	*P*-value
Age (years) (Mean±SD)	43.76±7.74	49.04±10.68	5.28	-0.061-10.625	0.053
Height (cm) (Mean±SD)	161±7.7	160±7.62	0.83	-5.240-3.573	0.705
Weight (kg) (Mean±SD)	56.8±13.0	57.58±10.90	0.78	-6.129-7.695	0.821
Duration (Mean±SD)	9.92±10.0	8.17±5.48	-1.75	-6.414-2.908	0.453
VAS (Mean±SD)	6.64±1.84	7.43±1.39	-0.80	-0.141-1.736	0.094
Grip strength (Mean±SD)	19.21±10.0	16.62±7.07	-2.60	-7.590-2.408	0.302

Two participants in the percutaneous needle release group were lost to follow up at 3 months and one participant in the steroid injection group was lost to follow up at 2 months.

Pain perception was assessed by visual analog scale (VAS) and compared to baseline data before the procedure, the mean difference between the 2 groups at 2 weeks, 1, 2, 3, and 6 months follow up were 3.19, 2.21, 0.38, 0.70, 0.50 respectively. The improvement of VAS was superior in the corticosteroid group at 2 weeks and 1 month follow up (P<0.001), but were the same at 2, 3, and 6 months follow up (P=0.194, 0.343, 0.535) (Table 2).

Grip strength was assessed by a digital hand dynamometer and compared to baseline data before the procedure in the same way as VAS. The mean difference between the 2 groups at 2 weeks, 1, 2, 3, and 6 months follow up were 5.31, 5.77, 2.03, 2.66, 1.49 kilograms, respectively. The improvement of grip strength was superior in the corticosteroid group at 2 weeks and 1 month follow up (P=0.001, 0.005), but not statistically significant at 2, 3, and 6 months follow up (P=0.057, 0.145, 0.369) (Table 3). There was no incidence of infection at all follow ups in both groups.

Table 2 Visual analog scale improvement (Compared to baseline data)

VAS Difference	N	Mean±SD	Mean difference	95%CI	*P*-Value
2 weeks					
-Needle	25	2.68±1.62	3.19	2.23-4.15	<0.001
-Steroid	24	5.86±1.72			
1 month					
-Needle	25	3.94±1.97	2.21	1.15-3.26	<0.001
-Steroid	24	6.14±1.68			
2 months					
-Needle	25	4.74±2.50	0.83	-0.44-2.09	0.194
-Steroid	23	5.57±1.82			
3 months					
-Needle	23	4.38±2.73	0.70	-0.78-2.18	0.343
-Steroid	23	5.09±2.39			
6 months					
-Needle	23	4.35±2.99	0.50	-1.12-2.12	0.535
-Steroid	23	4.85±2.61			

Table 3 Grip strength improvement (Compared to baseline data)

Grip strength Difference	N	Mean±SD	Mean difference	95%CI	*P*-Value
2 weeks					
-Needle	25	3.43±4.77	5.31	2.24-8.37	0.001
-Steroid	24	4.85±2.61			
1 month					
-Needle	25	4.65±7.90	5.77	1.83-9.71	0.005
-Steroid	24	10.42±5.55			
2 months					
-Needle	25	7.80±5.03	3.03	-0.09-6.14	0.057
-Steroid	23	10.83±5.81			
3 months					
-Needle	23	6.88±5.58	2.66	-0.95-6.27	0.145
-Steroid	23	9.55±6.94			
6 months					
-Needle	23	7.06±5.93	1.49	-1.81-4.79	0.369
-Steroid	23	8.55±5.55			

Discussion

The improvement of VAS and grip strength was superior in the corticosteroid group but statistically significant only at 2 weeks and 1 month follow up. After 2 months follow up the data did not show any significant difference between the groups. Percutaneous needle release could improve the pain and grip strength as effectively as corticosteroid injection, but not before 2 months after treatment because the treatment of tendinosis with percutaneous needle release took about 6 weeks to heal due to the pathophysiology of the healing process.

Tendinosis is caused by chronic overuse injuries that were the result of multiple microtrauma events leading to disruption of the internal structure of tendons and degeneration of the cells and matrix which failed to mature into normal tendon. The main principle for treatment of tendinosis is to stimulate neurovascularization by producing focused local bleeding as in percutaneous needle release to create a healthy scar with the least possible structural damage to surrounding tissues[(1)]. On the other hand, corticosteroid may not correct this condition with the same mechanism, it acts directly by decreasing the inflammation at the site of tendinosis with a shorter period of time compared with the percutaneous needle release method[(2)].

Lakhey S et al.[(10)] found 76.20% of patients had excellent or good outcomes, may be because of the pre-operative steroid injection (average 2.90 mg) and a post-operative wrist brace that was applied until the pain was resolved. The time to achieve a completely pain free elbow ranged from 1 day to 3 months (average 60.30 days) which were very close to outcomes from percutaneous needle release in this study.

Pain from tendinosis at the lateral epicondyle or extensor carpi radialis brevis origin can be treated with laceration and bleeding[(1)] from needle puncture, but it takes time for the healing process that is composed of the clotting phase, inflammatory phase, proliferative phase, and ends with remodeling or maturation that comes with neovascularization and healthy scarring[(1)].

Percutaneous needle release could be an alternative low invasive treatment option for patients who failed conservative treatments and who were not ready for surgery or did not want to take the risks of corticosteroid injections which have the side effects such as local skin atrophy, skin depigmentation, and muscle wasting that can increase bony prominence from lateral epicondyle of humerus. Additionally, the percutaneous needle release procedure is not expensive.

The advantage of this study is that it is a randomized controlled trial. The limitations of this study are that the results in the percutaneous needle release group were limited to individuals who had no history of steroid injections before. Furthermore, the follow up period time was only 6 months, and so might not reflect long term outcomes and relapse of disease.

Based on our study, future research should be performed to investigate the recurrence rate from percutaneous needle release in long term follow ups, incidence of other complications, such as extensor origin rupture, and percutaneous needle release outcomes in post-corticosteroid injection patients.

Conclusion

Improvements of pain and grip strength from corticosteroid injection were superior to percutaneous needle release, but statistically significant only at 2 weeks and 1 month in a total of 6 months follow up. Percutaneous needle release is one treatment option for tennis elbow patients who do not want to take risks from corticosteroid injection.

Conflict of interest

We declare that we have no conflict of interest.

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References

1. Barry S, Kraushaar BS, Nirschl RP. Tendinosis of the elbow (tennis elbow). Clinical features and findings of histological, immunohistochemical, and electron microscopy studies. J Bone Joint Surg Am 1999; 81: 259-78.
2. Canale ST, Beaty JH. Campbell's Operative Orthopaedics, 11th ed. Philadelphia: Mosby Elsevier; 2008.
3. Altay T, Günal I, Oztürk H. Local injection treatment for lateral epicondylitis. Clin Orthop Relat Res 2002; 398: 127-30.
4. Dunkow PD, Jatti M, Muddu BN. A comparison of open and percutaneous techniques in the surgical treatment of tennis elbow. J Bone Joint Surg Br 2004; 86: 701-4.
5. Solheim E, Hegna J, Øyen J. Extensor tendon release in tennis elbow: results and prognostic factors in 80 elbows. Knee Surg Sports Traumatol Arthrosc 2011; 19: 1023-7.
6. Nirschl RP, Pettrone FA. Tennis elbow. The surgical treatment of lateral epicondylitis. J Bone Joint Surg Am 1979; 61: 832-9.
7. John M. McShane, MD, Vinil N. Shah, MD, Levon N. Nazarian, MD Sonographically Guided Percutaneous Needle Tenotomy for Treatment of Common Extensor Tendinosis in the Elbow J Ultrasound Med 2008; 27: 1137-4.

8. Jiaan Z, Bing H, Chunyan X, Jia L. Ultrasound-guided, minimally invasive, percutaneous needle puncture treatment for tennis elbow. Advances in Therapy. 2008; 25: 1031-6.
9. Kayastha N, Joshi A, Chand P, Thapa B, Rana S, Singh B, et al.Treatment Outcome of Tennis Elbow by Percutaneous Needle Tenotomy. MJSBH 2012; 11: 32-5.
10. Lakhey S, Mansfield M, Pradhan RL, Rijal KP, Paney BP, Manandhar RR. Percutaneous extensor tenotomy for chronic tennis elbow using an 18G needle. Kathmandu Univ Med J (KUMJ) 2007; 5: 446-8.
11. Grundberg AB, Dobson JF. Percutaneous release of the common extensor origin for tennis elbow. Clin Orthop 2000; 376: 137-40.
12. Malanga, GA and Nadler S. Musculoskeletal Physical Examination: an Evidence-based Approach. Philadelphia, PA: Elsevier Mosby, 2006.
13. Espandar R, Heidari P, Rasouli MR, Saadat S, Farzan M, Rostami M, et al. Use of anatomic measurement to guide injection of botulinum toxin for the management of chronic lateral epicondylitis: a randomised controlled trial. CMAJ 2010; 182: 749-50.

การศึกษาเปรียบเทียบผลของการรักษาโรคจุดเกาะเอ็นที่ข้อศอกด้านนอกอักเสบ โดยใช้วิธี เลาะจุดเกาะเอ็นที่ข้อศอกด้านนอกผ่านทางผิวหนัง เทียบกับวิธีฉีดสารคอร์ติโคสเตียรอยด์

เกรียงศักดิ์ เล็กเครือสุวรรณ, พบ, ยิ่งยง ต่ออุดม, พบ

วัตถุประสงค์: *เพื่อเปรียบเทียบระดับความเจ็บปวดและกำลังในการบีบมือที่ดีขึ้นหลังจากการรักษาด้วยวิธี เลาะจุดเกาะเอ็นที่ข้อศอกด้านนอกผ่านทางผิวหนัง เทียบกับวิธีฉีดสารคอร์ติโคสเตียรอยด์ ในโรคจุดเกาะเอ็น ที่ข้อศอกด้านนอกอักเสบ*

วิธีการศึกษา: *ทำการศึกษาในผู้ป่วยโรคจุดเกาะเอ็นที่ข้อศอกด้านนอกอักเสบจำนวน 49 รายที่เข้ารับการรักษา ที่โรงพยาบาลศูนย์การแพทย์สมเด็จพระเทพรัตนราชสุดาฯ สยามบรมราชกุมารี โดยได้แบ่งกลุ่มตัวอย่างเป็น 2 กลุ่ม ได้แก่ กลุ่มที่ 1 (กลุ่มทดลอง) คือกลุ่มที่ได้รับการรักษาโดยการเลาะจุดเกาะเอ็นที่ข้อศอกด้านนอกผ่านทางผิวหนัง กลุ่มที่ 2 (กลุ่มควบคุม) คือกลุ่มที่รักษาโดยการฉีดสารคอร์ติโคสเตียรอยด์ที่ตำแหน่งจุดเกาะของกล้ามเนื้อ extensor carpi radialis brevis หลังจากนั้นนัดหมายผู้ป่วยเพื่อประเมินผลการรักษาที่ 2 สัปดาห์และ 1,2,3,6 เดือนตามลำดับ โดยใช้แผนภูมิ " visual analog scale" (VAS) เพื่อบอกระดับความเจ็บปวดของผู้ป่วย ออกมาเป็นตัวเลข และทดสอบกำลังในการบีบมือโดยเครื่องวัดกำลังการบีบมือที่แสดงผลเป็นตัวเลข (หน่วยเป็นกิโลกรัม) และวิเคราะห์ผลทางสถิติ*

ผลการศึกษา: *ผู้ป่วยที่เข้าร่วมการศึกษาทั้งหมด 49 รายแบ่งเป็นกลุ่มที่ได้รับการรักษาโดยการเลาะจุดเกาะเอ็นที่ข้อศอกด้านนอกผ่านทางผิวหนัง 25 ราย และกลุ่มที่รักษาโดยการฉีดสารคอร์ติโคสเตียรอยด์ 24 ราย พบว่าระดับความเจ็บปวดที่ลดลงและกำลังในการบีบมือที่ดีขึ้นในกลุ่มที่รักษาโดยการฉีดสารคอร์ติโคสเตียรอยด์ที่ 2 สัปดาห์ และ 1 เดือนดีกว่ากลุ่มที่ได้รับการรักษาโดยการเลาะจุดเกาะเอ็นที่ข้อศอกด้านนอกผ่านทางผิวหนัง แต่หลังจาก 2 เดือน ผลการรักษาไม่แตกต่างกัน*

สรุป: *การรักษาโรคจุดเกาะเอ็นที่ข้อศอกด้านนอกอักเสบโดยวิธีการเลาะจุดเกาะเอ็นที่ข้อศอกด้านนอก ผ่านทางผิวหนังให้ผลการรักษาเทียบเท่ากับการฉีดสารคอร์ติโคสเตียรอยด์ซึ่งเป็นการรักษาตามมาตราฐาน หลังจากการรักษา 2 เดือน*

Infrapatellar Branch of the Saphenous Nerve: A cadaveric study

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Purpose: *Total knee arthroplasty (TKA) is one of the most successful procedures and widely performed in orthopedic surgery. Among concerned complications of TKA, lateral skin numbness has been reported as a result of infrapatellar branch of the saphenous nerve (IPBSN) injuries which may affect the outcome and satisfaction of patients. The study on the distribution of the IPBSN related to anatomical landmarks in TKA may provide knowledge to avoid or minimize injury to this nerve. The aim of this study was to examine the distribution of IPBSN in relation to anatomical landmarks used for skin incision in TKA.*

Methods: *This study was a descriptive study on 15 soft cadaveric adult knees. The infrapatellar branch of the saphenous nerve was identified and its distribution was studied. The exit point of the IPBSN from adductor's canal was examined and reported in relation to the sartorius muscle. The distance from the IPBSN to the medial border of the patella at the mid patellar bone and the vertical distance from the main branch of the IPBSN to the inferior patellar pole when the nerve crossed the knee midline were measured.*

Results: *We observed that the distribution of the IPBSN traveled from proximal toward distal direction and from the medial side across the knee midline toward the lateral side. All branches of the IPBSN crossed the knee midline between the superior patellar pole and the tibial tubercle with variation of the branching pattern, including a single nerve in 20 % (3/15), 2 branches in 67% (10/15), and 3 branches in 13 % (2/15). There were 2 patterns of exit point of the IPBSN from adductor's canal related to the sartorius, including posterior to the muscle in 27% (4/15) and piercing through the muscle in 73% (11/15). The average distance of the nerve from the medial border of the patella at the mid patellar bone was 6.7 ± 0.99 cm (range 4.8 – 8.8 cm) and the average vertical distance from the inferior patellar pole and the main branch of the nerve was 2.4 ± 0.85 cm. (range 1.1 – 3.0 cm).*

Conclusion: *The distribution of IPBSN traveled from proximal toward distal direction and from the medial side across the knee midline toward the lateral side with variation of pattern. As all branches of IPBSN passed the knee midline between the upper patellar pole and the tibial tubercle, our study implied that the IPBSN injury related to skin incision between standard and less invasive skin incisions in TKA might not be different.*

Keywords: *Infrapatellar branch of the saphenous nerve, total knee arthroplasty, TKA, lateral skin numbness*

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Introduction

Total knee arthroplasty (TKA) is one of the most successful procedures and widely performed in orthopaedic surgery. However, common complications related to TKA, including lateral skin numbness[1-3] from infrapatellar branch of saphenous nerve (IPBSN) injuries[3,4] have been reported which may affect the outcome and satisfaction of patients. Several previous studies on the distribution of IPBSN related to skin incisions have been performed; however, most of them addressed the course of this nerve in an aspect of the arthroscopic stab incision[4-7] rather than the longitudinal open incision. The contemporary skin incision in TKA has become a less invasive type, of which the incision is much shorter proximally than distally. Thus, it is questionable that the injury to the IPBSN may be less than that of the standard incision of TKA. The purpose of the present study was to evaluate the course and distribution of the IPBSN in relation to anatomical landmarks used for skin incision in TKA.

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Materials and Methods

This study was a descriptive study on 15 soft cadaveric adult knees. There were 8 male knees and 7 female knees, and 8 right knees and 7 left knees. All cadavers had full arc of knee motion with no lower limb malalignment and no surgical scar at the knee. Permission to study was approved by the Department of Anatomy, Faculty of Medicine, Chulalongkorn University. All cadaveric

knees were carefully dissected to determine the distribution of the IPBSN.

A skin incision was made from 10 cm. above to the superior pole of patella to 5 cm. below the tibial tubercle (Fig. 1). The saphenous nerve and infrapatellar branch were carefully identified from the adductor's canal toward the distal direction. The relationship of the exit point of the nerve from adductor's canal to the sartorius muscle was identified and reported as posterior to, anterior to, or piercing from the sartorius muscle (Fig. 2). The nerve distribution and its branches were identified and evaluated in relation to the superior patellar pole and the tibial tubercle, which are the common anatomical landmarks of both standard and less invasive approaches in TKA. The mediolateral distance between the medial border of the patella and the IPBSN at the mid patellar bone was measured. The vertical distance from the inferior patellar pole and the main branch of the nerve was measured when the nerve crossed the knee midline (Fig. 3).

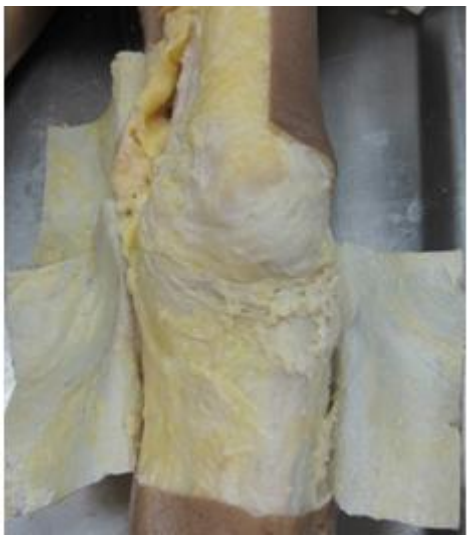

Fig. 1 Dissection was made from 10 cm. above the superior pole of patella to 5 cm. below the tibial tubercle.

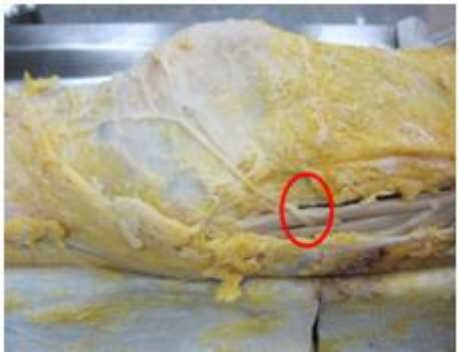

Fig. 2 The exit point of the IPBSN from adductor's canal

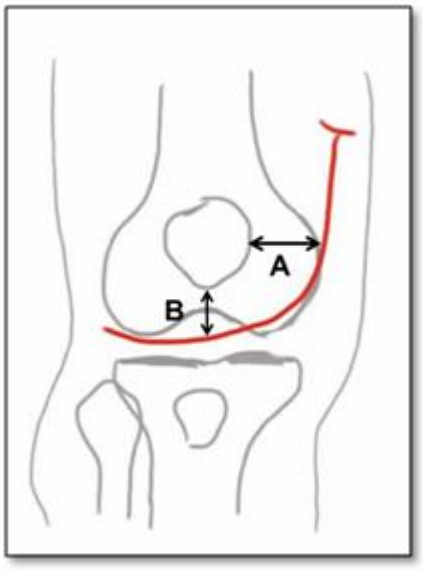

Fig. 3 Distance A: Measured from IPBSN to the medial border of the patella at the level of mid patella

Distance B: Measured from the main branch of IPBSN which crossed the knee midline

Results

At proximal to the adductor's canal, the IPBSN ran longitudinally. After exiting the adductor's canal, the IPBSN ran transversely and gave branches before it went across the midline of the knee. There were 2 patterns of exit point of the IPBSN from adductor's canal related to the sartorius, including posterior to the muscle in 27% (4/15) and piercing through the muscle in 73% (11/15). The IPBSN was identified as a single nerve in 20% (3/15 knees), as 2 branches in 67% (10/15 knees), of which 90% (9/10 knees) had an inferior branch that was smaller than the superior branch, and as 3 branches in 13 % (2/10 knees), of which the largest branch was the middle one. All branches of IPBSN passing across the knee midline were found between the superior patellar pole and the tibial tubercle.

The average horizontal distance from the medial border of the patella to the nerve in mid patellar level was 6.70 ± 0.99 cm. (range 4.80 – 8.80 cm) and the average vertical distance from the inferior patellar pole to the main branch of the nerve was 2.40 ± 0.85 cm (range 1.10 – 3.00 cm). In one cadaver, the main branch of the nerve went across the midline at the level of the patella bone.

Discussion

Lateral skin numbness is a common complication after TKA[1-3] which has been reported as results of injury to the IPBSN[3,4]. In fact, lateral skin numbness could affect clinical outcomes and satisfaction of patients[1]. The results of the present study of the IPBSN were similar to the previous studies, in terms of the course of nerve

in adductor's canal which ran longitudinally and after exiting the adductor's canal which ran transversely and gave branches towards the midline of the knee. However, the pattern of branching in the present study varied in number and location of branching. There were single nerves, 2 branches and 3 branches of the IPBSN found in the present study.

Sundaram et al.[9] reported that the patients who underwent TKA through a medial parapatellar skin incision, which was medial to a midline skin incision, had a higher mean area of sensory loss than the patients who underwent surgery through a midline skin incision. However, the difference was not statistically significant. Similarly, Berg et al.[8] showed that the lateral skin incision produced less dysaesthesia than that of medial incision. The study of Subramanian et al.[10] reported that more laterally placed incisions related to a better skin sensation, postoperatively. As the distribution of the IPBSN in the present study traveled from proximal toward distal and from the medial side, across the knee midline toward the lateral side where it branched, it confirmed findings reported by previous investigators that with the same length of skin incision, a larger medial incision should relate to a greater area of numbness, postoperatively.

Regarding the course and distribution of the IPBSN in the relation to the anatomical landmarks, Kartus et al.[7] found that the nerve passed the knee midline between the inferior patellar pole and the tibial tubercle in all 60 studied cadavers, except one. With slight difference to Kartus and his co-authors, all branches of IPBSN in the present study that ran across the knee midline between the superior patellar pole and the tibial tubercle, which had a wider range than their study. However, both our and Kartus' studies implied that the midline skin incision for TKA would inevitably injure the IPBSN. As the less invasive skin incision for TKA begins from the superior patellar pole to the tibial tubercle and the IPBSN in our study crossed the knee midline not proximal to the superior patellar pole, we postulate that the nerve injury should not be different between standard and less invasive skin incisions.

In accordance with our findings, Mochida et al.[5] reported that a blind stab incision to the knee was safe from nerve injury if it was within an approximate 3-cm area from the medial margin of the patella at the level of mid patella. According to our study, the average distance between the medial border of the patella and the nerve at the level of mid patella was 6.70 cm, which allowed a safe range of area for a stab incision. Thus, clinical applications of both studies confirmed that a stab incision within a few centimeters medial to the medial border of the patella at the mid patellar level could avoid injury to the nerve.

The limitation of the present study was the small number of cadavers; however, clinical applications of the present study could be made in terms of understanding the cause and area of nerve injury related to standard or less invasive skin incisions.

Conclusion

The distribution of the IPBSN traveled from proximal toward distal and from the medial side, across the knee midline toward the lateral side. All branches of the IPBSN passed the knee midline between the superior patellar pole and the tibial tubercle with a variation in the pattern of branching. For clinical application, our study implied that the IPBSN injury related to skin incisions between standard and less invasive skin incisions in TKA might not be different. Further clinical studies should be performed to better understand the distribution of the infrapatellar branch of the saphenous nerve.

References

1. Borley NR, Edwards D, Villar RN. Lateral Skin Flap numbness after total knee arthroplasty. J Arthroplasty 1995; 10: 13-4.
2. Johnson DF, Love DTT, Love RT, Lester K. Dermal hypoesthesia after total knee arthroplasty. Am J Orthop 2000; 29: 863-6.
3. Hopton BP, Tommichan MC, Howell ER. Reducing lateral skin flap after total knee arthroplasty. Knee 2004; 11: 289-91.
4. Tennent TD, Birch NC, Holmes MJ, Birch R, Goddard NJ. Knee pain and the infrapatellar branch of the saphenous nerve. J R Soc Med 1998; 91: 573-5.
5. Mochida H, Kikuschi S. Injury to infrapatellar branch ofsaphenous nerve in arthroscopic knee surgery. Clin Orthop 1995; 320: 88-94.
6. Ebraheim NA, Mekhail AO. The infrapatellar branch of the saphenous nerve: An anatomic study. J Orthop Trauma 1997; 11: 195-9.
7. Kartus J, Ejerhed L, Eriksson BI, Karlsson J. The localization of the infrapatellar nerves in the anterior knee region with special emphasis on central third patellar tendon harvest: a dissection study on cadaver and amputated specimens. Arthroscopy 1999; 15: 577-86.
8. Berg P, Mjoberg B. A lateral skin incision reduces peripatellar dysaesthesia after knee surgery. J Bone Joint Surg Br 1991; 73: 374-6.
9. Sundaram RO, Ramakrishnan M, Harvey RA, Parkinson RW. Comparison of scars and resulting hypoaesthesia between the medial parapatellar and midline skin incisions in total knee arthroplasty. Knee 2007; 14: 375-8.
10. Subramanian S, Lateef H, Massraf A. Cutaneous sensory loss following primary total knee arthroplasty. A two years follow-up study. Acta Orthop Belg 2009: 75: 649-53.

การศึกษาลักษณะทางกายวิภาคของเส้นประสาทใต้สะบ้าแขนงของเส้นประสาทซาฟีนัสในศพ

ปฐมพร วีระเศรษฐ์ศิริ, พบ, อารี ตนาวลี, พบ

วัตถุประสงค์: *การศึกษาถึงลักษณะทางกายวิภาค เส้นทางและการแตกแขนงของเส้นประสาทใต้สะบ้าแขนงของเส้นประสาทซาฟีนัสมีประโยชน์อย่างมากในการหลีกเลี่ยงการบาดเจ็บต่อเส้นประสาทนี้ในขณะทำการผ่าตัดเปลี่ยนข้อเข่าเทียม การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาลักษณะทางกายวิภาค เส้นทางและการแตกแขนงของเส้นประสาทใต้สะบ้าแขนงของเส้นประสาทซาฟีนัสและทำการศึกษาโดยประเมินกายวิภาคของเส้นประสาทเชื่อมโยงกับจุดสังเกตสำคัญทางกายวิภาคที่ใช้เป็นขอบเขตอ้างอิงในการผ่าตัดเปลี่ยนข้อเข่าเทียม*

วิธีการศึกษา: *ศึกษาแบบพรรณนาในศพอาจารย์ใหญ่ โดยทำการชำแหละเข่าของอาจารย์ใหญ่ 15 เข่าซึ่งเก็บรักษาด้วยวิธีที่เนื้อเยื่ออ่อนนุ่มอย่างระมัดระวัง เพื่อศึกษาลักษณะทางกายวิภาค เส้นทางและการแตกแขนงของเส้นประสาทใต้สะบ้าแขนงของเส้นประสาทซาฟีนัส ศึกษาจุดที่เส้นประสาทใต้สะบ้าแขนงของเส้นประสาทซาฟีนัสออกมาจาก adductor canal (รายงานผลเป็นออกหน้าต่อกล้ามเนื้อ sartorius, หลังต่อกล้ามเนื้อ sartorius หรือออกทะลุกล้ามเนื้อ sartorius) ผู้วิจัยทำการศึกษาระยะห่างระหว่างเส้นประสาทกับขอบในสุดของกระดูกสะบ้าในแนวนอนระดับเดียวกับกึ่งกลางของกระดูกสะบ้าและระยะห่างระหว่างเส้นประสาทกับขอบล่างสุดของกระดูกสะบ้าในแนวตั้งแนวเดียวกับจุดกึ่งกลางของกระดูกสะบ้า*

ผลการศึกษา: *เส้นประสาทใต้สะบ้าแขนงของเส้นประสาทซาฟีนัสมีเส้นทางตามกายวิภาคโดยออกจาก adductor canal แล้ววางตัวลงมาส่วนปลายถึงบริเวณเข่า จากนั้นวิ่งจากด้านในข้อเข่าผ่านกึ่งกลางเข่าไปทางด้านนอกของข้อเข่า โดยแขนงของเส้นประสาทที่ผ่านกึ่งกลางข้อเข่าทุกแขนงจะอยู่ระหว่างขอบบนของกระดูกสะบ้าและปุ่มจุดเกาะของเส้นเอ็นสะบ้าบนกระดูกหน้าแข้ง ส่วนการแตกแขนงของเส้นประสาทนั้นไม่มีแบบแผนที่ชัดเจนและมีความแตกต่างกันในแต่ละตัวอย่าง ในแง่ของจุดที่เส้นประสาทออกมาจาก adductor canal พบว่าแบ่งได้เป็นสองกลุ่ม คือ กลุ่มที่ออกหลังต่อกล้ามเนื้อ sartorius พบร้อยละ 27 (4/15) และกลุ่มที่ออกทะลุกล้ามเนื้อ sartorius พบร้อยละ 73 (11/15) ในแง่ของการแตกแขนงและทอดผ่านกลางเข่า พบว่าร้อยละ 20 (3/15) ไม่แตกแขนงและทอดผ่านกึ่งกลางเข่าในลักษณะเป็นเส้นเดี่ยว ร้อยละ 67 ของตัวอย่าง (10/15) เส้นประสาทจะแตกแขนงและทอดผ่านกึ่งกลางเข่าสองแขนง และร้อยละ 13 (2/15) เส้นประสาทจะแตกแขนงและทอดผ่านกึ่งกลางเข่าสามแขนง สำหรับค่าเฉลี่ยของระยะห่างระหว่างเส้นประสาทกับขอบในสุดของกระดูกสะบ้าในแนวนอนระดับเดียวกับกึ่งกลางของกระดูกสะบ้า ทำการวัดได้ 6.70 ± 0.99 ซม. (อยู่ระหว่าง 4.80 – 8.80 ซม.) และวัดค่าเฉลี่ยของระยะห่างระหว่างเส้นประสาทกับขอบล่างสุดของกระดูกสะบ้าในแนวตั้งแนวเดียวกับจุดกึ่งกลางของกระดูกสะบ้าได้ 2.40 ± 0.85 ซม. (อยู่ระหว่าง 1.10 – 3.00 ซม.) (ยกเว้นตัวอย่างหนึ่งเข่าที่เส้นประสาทวางตัวอยู่บนกระดูกสะบ้า)*

สรุป: *เส้นประสาทใต้สะบ้าแขนงของเส้นประสาทซาฟีนัสมีเส้นทางตามกายวิภาคโดยออกจาก adductor canal แล้ววางตัวลงมาส่วนปลายถึงบริเวณเข่า จากนั้นวิ่งจากด้านในข้อเข่าผ่านกึ่งกลางเข่าไปทางด้านนอกของข้อเข่า โดยแขนงของเส้นประสาทที่ผ่านกึ่งกลางข้อเข่าทุกแขนงอยู่ระหว่างขอบบนของกระดูกสะบ้าและปุ่มจุดเกาะของเส้นเอ็นสะบ้าบนกระดูกหน้าแข้ง ส่วนการแตกแขนงของเส้นประสาทนั้นไม่มีแบบแผนที่ชัดเจนและมีความแตกต่างกันในแต่ละตัวอย่าง*

Association between the Size of Humeral Head Cysts and the Extension of Rotator Cuff Tears

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Purpose: *To evaluate the association between the size of humeral head cysts and the number of rotator cuff tears.*
Methods: *A retrospective study of 115 patients who had a diagnosis of rotator cuff tear by magnetic resonance imaging (MRI) were reviewed and analyzed. The diameters of the cysts were measured using a calibrated digital caliper. Pearson's correlation test was used to identify the correlation between the number of rotator cuff tears and the diameter of cysts.*
Results: *A total of 115 shoulder MRIs from 115 patients were included in the present study. The average diameter of cysts was 6.7±2.9 mm. The average diameter of cysts for the group of one, two and three rotator cuff tendon tears was 6.2±3.0, 7.2±2.7, and 7.8±2.9 mm, respectively. There was no statistically significant difference of cyst diameters between the groups of rotator cuff tears. There was no statistically significant correlation between cyst diameters and the number of rotator cuff tears (r = 0.2, P = 0.1).*
Conclusion: *There was no correlation between the number of rotator cuff tears and cyst size. However, we observed a trend in which the cyst size was slightly larger when the number of tendon tears increase. This finding indicated that the diameter of subchondral bone cysts might be greater in patients with massive rotator cuff tears. Large humeral head cysts may cause unsecure fixation for suture anchor placement. The orthopaedic surgeon must be aware of and prepare for large subchondral bone cysts during the arthroscopic rotator cuff repair.*

Keywords: *Rotator cuff tear, humeral head cyst, diameter*

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Introduction

Rotator cuff disorder is a common cause of shoulder pain in the elderly population. The specific etiology of a rotator cuff tear has not been fully elucidated, but it has been considered to result from a combination of intrinsic and extrinsic factors. Intrinsic factors include degenerative change[(1)], hypovascularity[(2)], and microstructural collagen fiber abnormalities[(3)]. Recognized extrinsic factors include subacromial impingement[(4,5)], tensile overload[(6)], and repetitive use[(7)].

Magnetic resonance imaging (MRI) is a standard investigation to detect the rotator cuff tear and associated findings. Several literatures found strong associations between the rotator cuff tear and cysts in the humeral head by an MRI[(8-10)]. The size of cysts varies from 2 – 14 mm[(9,10)]. The etiology of the humeral head cyst is still largely unknown.

During arthroscopic rotator cuff repair, a large humeral head cyst can result in unsecure fixation for suture anchor placement[(11,12)]. Even though the size of the humeral head cyst has its clinical meaning during arthroscopic surgery, the factors which associate to the size of the cyst have never been studied before in the English literature database.

Upon our knowledge, there is no study regarding the association between the extension of rotator cuff tears and the size of humeral head cysts. We hypothesized that cyst size would be larger when the number of rotator cuff tendon tears is increased. The objective of this study was to evaluate the association between diameters of cysts and the number of full-thickness rotator cuff tendon

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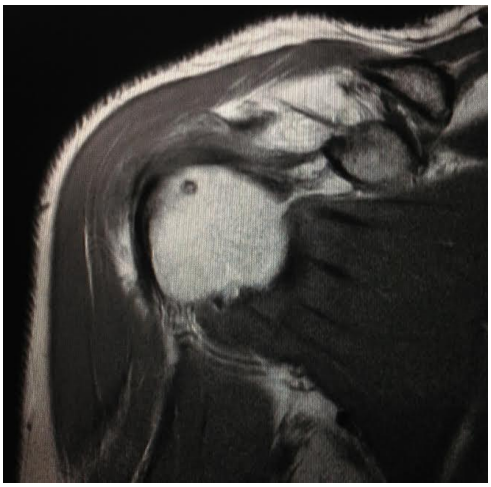
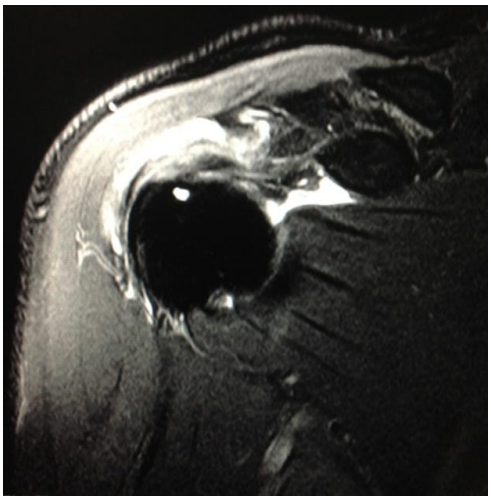
tears - supraspinatus, infraspinatus, and subscapularis tendons.

Patients and Methods

Data collected from 115 patients who had a diagnosis of rotator cuff tear by 3.0 Tesla MRI from September 2010 to February 2014 were retrospectively reviewed. The study was approved by the institutional review board at our hospital. MRI images were examined by two examiners.



(a)



(b)

Fig. 1 Coronal oblique views of MRI demonstrate a round-shape cyst (arrow) of the greater tuberosity with low signal intensity in proton density weighted image (a) and high signal intensity in fat suppressed T2 weighted image (b).

The diagnosis of a cystic lesion was made with visualization of the lesion on at least two pulse sequences and in two different imaging planes[13]. The cysts had sharp sclerotic margins, and they were in round or elliptical shape with low signal intensity on T1-weighted and proton density weighted images. On T2-weighted images, the cysts had either high signal intensity which indicated fluid, or mixed signal intensity[14] (Fig. 1). The diameters of cysts were measured by using a calibrated digital caliper. In elliptically–shaped cysts, the longest diameter was measured.

The location of cysts was separated into three areas; the lesser tuberosity, and anterior and posterior parts of the greater tuberosity. We divided the greater tuberosity into anterior and posterior parts with a line drawn parallel to the humeral shaft that starts from the 12 o'clock position on the greater tuberosity in sagittal oblique images. Axial images were used in determining the cysts at the insertion site of the subscapularis tendon on the lesser tuberosity. The location, number, and diameter of the cysts in the anterior/posterior greater tuberosity and lesser tuberosity were recorded for each shoulder.

The integrity of the supraspinatus, infraspinatus and subscapularis tendons were evaluated. Full-thickness tears were defined as having a fluid-filled gap through the entire thickness of the tendon on fat-suppressed, fast spin-echo (**FSE**) T2-weighted images. The rotator cuff tear data were collected only for full-thickness tear types. We did not include partial thickness tear and neither bursal-sided nor articular-sided tears into the study.

Patients with rheumatoid arthritis, glenohumeral osteoarthritis, previous shoulder surgery, and infection were excluded from the study.

Mean and standard deviation (SD) were used for describing continuous data. One-way analysis of variance (ANOVA) was used for comparisons of the means of cyst diameters between different numbers of rotator cuff tears. Pearson's correlation test was performed to identify the correlation between the numbers of rotator cuff tears and the diameters of cysts. P-value < 0.05 was considered statistically significant for differences and correlations. Data collection and calculations were performed using SPSS 17.0 for Windows (SPSS Inc, Chicago, IL, USA).

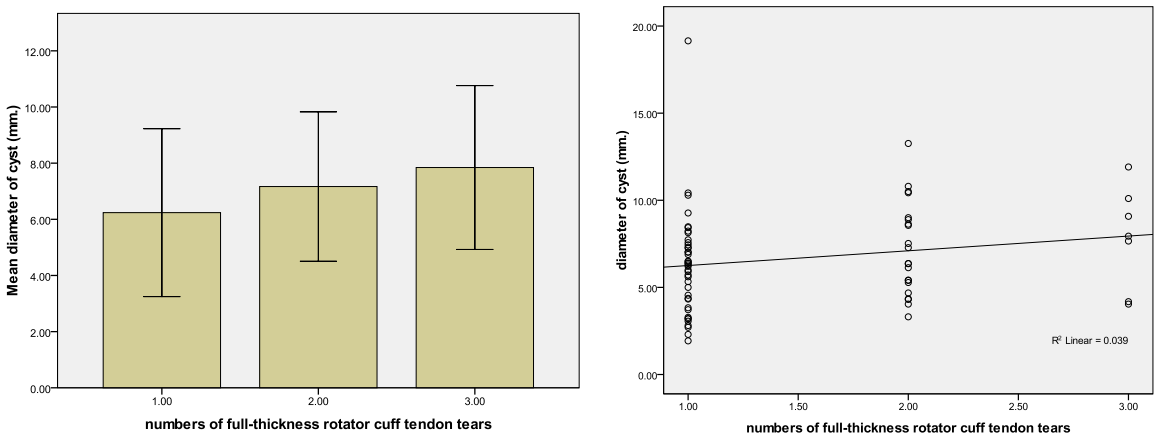
Results

A total of 115 shoulder MRIs from 115 patients were included in the study. There were 51 males and 64 females. The mean age of the patients was 67.8 (range 46-88 years of age). The median of the number of cysts was 1 (range 0-3) (Table 1). There were 69 patients (60%) having at least one cysts in the humeral head and 46 patients (40%) having no cyst (Table 2). The average diameter of cysts was 6.7±2.9 mm (range 1.9-19.1 mm).

The average diameter of cyst for the group of one, two and three rotator cuff tendon tears was

6.2±3.0, 7.2±2.7, and 7.8±2.9 mm, respectively (Fig. 2a). There was no statistically significant difference of cyst diameters between the groups of rotator cuff tears. No statistical significance for the correlation between cyst diameter and number of rotator cuff tears was observed (r = 0.2, P = 0.1) (Fig. 2b).

The number and mean diameter of cysts categorized by the location were shown in Table 3. There was no correlation between cyst diameter and number of rotator cuff tears in the lesser and anterior/posterior greater tuberosities (P = 0.8, 0.1, and 0.2).



(a) (b)

Fig. 2 (a) Comparison between different numbers of rotator cuff tears and cyst size. (b) There was no correlation between numbers of rotator cuff tears and cyst size (r = 0.2, P = 0.1).

Table 1 Demographic data and pathology characteristics of rotator cuff tear patients

	Total	Male	Female
No. of patients	115	51	64
Age (years ± SD)	67.8±9.4	67.6±9.4	67.7±9.5
Cyst size (mean ± SD)	6.7±2.9	7.1±2.5	6.3±3.2
Number of cysts (median)	1 (range 0-3)	1 (range 0-3)	1 (range 0-3)
Number of rotator cuff tears (median)	1 (range 1-3)	1 (range 1-3)	1 (range 1-3)

Table 2 Patients with different numbers of cysts and rotator cuff tears

	Number of Patients (%)
Number of Cysts	
0	46 (40 %)
1	35 (30 %)
2	26 (23 %)
3	8 (7 %)
Number of Rotator cuff tears	
1	69 (60 %)
2	31 (27 %)
3	15 (13 %)

Table 3 Number and mean diameter of cysts classified by the location

Location	Number of patients having cysts (%)	Diameter of cysts
LT	13 (11.3 %)	5.2 ± 1.6
Anterior GT	32 (27.8 %)	6.7 ± 2.6
Posterior GT	43 (37.4 %)	6.5 ± 3.2

LT lesser tuberosity, *GT* greater tuberosity

Discussion

Subchondral cysts can be found in many articular diseases[15]. Etiology of cyst formation is controversial. In osteoarthritis, theories of subchondral cyst formation are the bone contusion theory and the synovial fluid intrusion theory[16]. Because of the lacking of the epithelial lining, subchondral cysts are classified as pseudocysts[10].

The presence of cysts in the humeral head near the rotator cuff foot print is a supportive evidence of rotator cuff disorders[8,9,13,15]. Cyst formation may occur from the lacking of the rotator cuff tendon covering the humeral head. Subsequently, synovial fluid will intrude into subchondral bone and formation of the cyst occurs.

Jin et al. revealed one to three cystic lesions in the humeral head in 9 cadaveric shoulders and their mean diameter of cysts was 2.5 mm.[10] In comparison to our study, we also found one to three cystic lesions but our mean diameter was 6.7 mm. Wissman et al. studied the occurrence of cysts in the lesser tuberosity in forty–eight patients and observed one to three cysts in this area and the mean diameter was 3.0 mm (range, 2-8 mm)[9].

Our hypothesis is that an exposed area of the humeral head occurs after the rotator cuff tendon tears. This will cause the absence of tendon coverage over the greater or lesser tuberosities. Thus, the bare subchondral surface will impinge to the subacromial bursa or enthesophyte. Therefore, we hypothesize that the more area of subchondral bone exposed from a torn rotator cuff tendon, the larger the diameter of the cyst would be observed near the tendon footprint.

In this study, we found no correlation between the number of tendon tears and the diameter of cysts from Pearson's correlation test. However, we observed a trend in which the cyst size was slightly larger when the number of tendon tears increased (Fig. 2). This finding indicated that the diameter of subchondral bone cysts might be greater in patients with massive rotator cuff tears. Large humeral head cysts may cause unsecure fixation for suture anchor placement and failed rotator cuff repair. The surgeon must be aware of and prepare for large subchondral bone cysts during arthroscopic rotator cuff repair.

However, the current study has some limitations. First, the study was retrospective in design with a relatively small sample size due to a recent problem of being unable to access the MRI database of our hospital. Consequently, we were unable to demonstrate statistical significance of the relationship between the number of torn tendons and cyst size. Reduced data limited the statistical power of these results. Furthermore, there is no MRI of the control group that demonstrates the percentage of humeral head cyst in the intact rotator cuff patients. For future study, a prospective study should be conducted with a greater sample size to demonstrate the association between the number of rotator cuff tears and the diameter of cysts.

Conclusion

There was no correlation between the number of rotator cuff tears and cyst size. However, we observed a trend in which the cyst size was slightly larger when the number of tendon tears increased. This finding indicated that the diameter of subchondral bone cysts could be greater in patients with massive rotator cuff tears. Large humeral head cyst may result in the unsecure fixation for suture anchor placement. The orthopaedic surgeon must be aware of and prepare for large subchondral bone cysts during the arthroscopic rotator cuff repair.

References

1. Ozaki J, Fujimoto S, Nakagawa Y, Masuhara K, Tamai S. Tears of the rotator cuff of the shoulder associated with pathological changes in the acromion: a study in cadavera. J Bone Joint Surg Am 1988; 70: 1224-30.
2. Chansky HA, Iannotti JP. The vascularity of the rotator cuff. Clin Sports Med 1991; 10: 807-22.
3. Nixon JE, DiStefano V. Ruptures of the rotator cuff. Orthop Clin North Am 1975; 6: 423-47.
4. Bigliani LU, Morrison DS, April EW. The morphology of the acromion and its relationship to rotator cuff tears. Orthop Trans 1986; 10: 228.
5. Toivonen DA, Tuite MJ, Orwin JF. Acromial structure and tears of the rotator cuff. J Shoulder Elbow Surg 1995; 4: 376-83.
6. Hayes PR, Flatow EL. Attrition sign in impingement syndrome. Arthroscopy 2002; 18: E44.

7. Ouellette H, Labis J, Bredella M, Palmer WE, Sheah K, Torriani M. Spectrum of shoulder injuries in the baseball pitcher. Skeletal Radiol 2008; 37: 491-8.
8. Pearsall AW, Bonsell S, Heitman RJ, Helms CA, Osbahr D, Speer KP. Radiographic findings associated with symptomatic rotator cuff tears. J Shoulder Elbow Surg 2003; 12: 122-7.
9. Wissman RD, Kapur S, Akers J, Crimmins J, Ying J, Laor T. Cysts within and adjacent to the lesser tuberosity and their association with rotator cuff abnormalities. AJR Am J Roentgenol 2009; 193:1603-6.
10. Jin W, Ryu KN, Park YK, Lee WK, Ko SH, Yang DM. Cystic lesions in the posterosuperior portion of the humeral head on MR arthrography: correlations with gross and histologic findings in cadavers. AJR Am J Roentgenol 2005; 184: 1211-5.
11. Denard PJ, Burkhart SS. Techniques for managing poor quality tissue and bone during arthroscopic rotator cuff repair. Arthroscopy 2011; 27: 1409-21.
12. Levy DM, Moen TC, Ahmad CS. Bone grafting of humeral head cystic defects during rotator cuff repair. Am J Orthop (Belle Mead NJ) 2012; 41: 92-4.
13. Fritz LB, Ouellette HA, O'Hanley TA, Kassarjian A, Palmer WE. Cystic changes at supraspinatus and infraspinatus tendon insertion sites: association with age and rotator cuff disorders in 238 patients. Radiology 2007; 244: 239-48.
14. Wright T, Yoon C, Schmit BP. Shoulder MRI refinements: differentiation of rotator cuff tear from artifacts and tendonosis, and reassessment of normal findings. Semin Ultrasound CT MR 2001; 22: 383-95.
15. Zlatkin MB, Chao P. The shoulder. In: Mink JH, Deutsch AL, eds. MRI of the musculoskeletal system. New York, NY: Raven, 1990: 19-84.
16. Resnick D, Niwayama G, Coutts RD. Subchondral cysts (geodes) in arthritic disorders: pathologic and radiographic appearance of the hip joint. AJR Am J Roentgenol 1977; 128: 799-806.

ความสัมพันธ์ระหว่างขนาดของซีสต์ในกระดูกต้นแขนกับจำนวนเส้นเอ็น rotator cuff ที่ฉีกขาด

ไตร พรหมแสง, พบ, สมศักดิ์ คุปต์นิรัติศัยกุล, พบ, กิตติพงษ์ คงรักเกียรติยศ, พบ, มนชยา ไพสินสมบูรณ์

วัตถุประสงค์: *เพื่อศึกษาความสัมพันธ์ระหว่างขนาดของซีสต์ในกระดูกต้นแขนกับจำนวนเส้นเอ็น rotator cuff ที่ฉีกขาด*
วิธีการศึกษา: *งานวิจัยชนิดเก็บข้อมูลย้อนหลัง โดยทำการศึกษาเอกซเรย์คลื่นแม่เหล็กไฟฟ้าของข้อไหล่ในผู้ป่วยที่มีเส้นเอ็นข้อไหล่ฉีกขาดจำนวน 115 ราย วัดขนาดของซีสต์โดยใช้เครื่องมือในคอมพิวเตอร์ แล้วทำการเปรียบเทียบจำนวนเส้นเอ็นข้อไหล่ที่ฉีกขาดกับขนาดของซีสต์ โดยใช้วิธีวิเคราะห์ทางสถิติ และศึกษาความสัมพันธ์โดยใช้ Pearson correlation test*
ผลการศึกษา: *ภาพถ่ายคลื่นแม่เหล็กไฟฟ้าของข้อไหล่ 115 ชุด จากผู้ป่วยทั้งหมด 115 ราย พบค่าเฉลี่ยของเส้นผ่านศูนย์กลางของซีสต์เท่ากับ 6.7±2.9 มิลลิเมตร โดยขนาดของซีสต์ในกลุ่มที่มีเส้นเอ็น rotator cuff ขาดจำนวน 1, 2 และ 3 เส้น เท่ากับ 6.2±3.0, 7.2±2.7 และ 7.8±2.9 ตามลำดับ การศึกษานี้ไม่พบนัยสำคัญทางสถิติของความสัมพันธ์ระหว่างจำนวนเส้นเอ็น rotator cuff ที่ฉีกขาดกับขนาดของซีสต์ในกระดูกต้นแขน (r = 0.2, P = 0.1)*
สรุป: *ไม่พบความสัมพันธ์ทางสถิติระหว่างขนาดของซีสต์ในกระดูกต้นแขนและจำนวนเส้นเอ็น rotator cuff ที่ฉีกขาด อย่างไรก็ตามพบว่าอาจมีแนวโน้มที่ซีสต์จะมีขนาดใหญ่ขึ้นเมื่อจำนวนเส้นเอ็นที่ขาดเพิ่มมากขึ้น*

Area of Skin Numbness after Less Invasive Total Knee Arthroplasty Surgery: A prospective study

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Purpose: *The objective of this study was to assess the area of skin numbness after less invasive total knee arthroplasty (TKA) surgery and to compare the area of skin numbness between groups in which the skin incision length was less than or equal to 10 cm and more than 10 cm.*

Methods: *A prospective study was conducted. 58 TKAs who had undergone primary TKA for osteoarthritis were recruited into this study. All patients were performed by a less invasive surgical technique. The necessity for extending the incision length depended on skin tension, intraoperatively of each patient. Based on the skin incision length, the population was categorized into two groups. Patients with skin incision lengths of less than or equal to 10 cm formed group A (29 patients), whereas patients with a skin incision length of more than 10 cm formed group B (29 patients). The areas of skin numbness were measured with the knee in full extension using a blunt pin for pin-prick sensation. The measurement area of skin numbness was performed at 2 weeks, 1 month, 3 months, and 6 months postoperatively.*

Results: *In group A, the mean area of skin numbness was 31.74 cm^2, 30.94 cm^2, 29.58 cm^2 and 9.60 cm^2 at 2 weeks, 1 month, 3 months, and 6 months postoperatively, respectively. In group B, the mean area of skin numbness was 51.14 cm^2, 39.50 cm^2, 27.67 cm^2 and 11.83 cm^2 at 2 weeks, 1 month, 3 months, and 6 months postoperatively, respectively. The area of skin numbness decreased over time in both groups.*

Conclusions: *This study demonstrated the area of skin numbness after TKA depends on the length of skin incision and that the skin sensation improved with time.*

Keywords: *Area, skin numbness, less invasive surgery, total knee replacement, length of skin incision.*

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Introduction

Nowadays, primary total knee arthroplasty (TKA) has proved to be an excellent and successful clinical procedure for relieving pain in patients with degenerative joint diseases. The 10- to 15-year survivorship of primary TKA is more than 90%.[1,2] Although excellent results have been achieved, several complications after TKA were reported such as loosening, periprosthetic fracture, and infection. In addition, skin numbness is a common symptom, which occurs after TKA. However, it was less recognized. Previous studies[3-5,7] reported about the area of skin numbness after TKA with a conventional surgical approach. To our knowledge, there has been no study in skin numbness after TKA with a less invasive surgical approach. The purpose of our study was to assess the area of skin numbness after less invasive TKA and compare the area of skin numbness between groups with skin incision lengths of less than or equal to 10 cm and those with more than 10 cm.

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Methods

Between June 1, 2009 and December 31, 2009, we performed a prospective study of 58 TKAs who have undergone primary TKA for osteoarthritis by one surgeon. (AT). The inclusion criteria were primary TKA in patients with degenerative osteoarthritis of the knee. Exclusion criteria were previous knee surgery, previous impaired sensation of the knee, and history of diabetes mellitus. All surgeries were performed using a less invasive surgical technique. The necessity for extending the skin incision depended on skin tension, intraoperatively of each patient[6]. Based on the length of the skin incision, the studied group was categorized into two groups, including patients with skin incisions of less than or equal to 10 cm (group A), and patients with skin incision lengths of more than 10 cm (group B). The surgical procedure was similar in both groups. All surgical exposures were performed through a medial parapatellar skin incision and midvastus arthrotomy. All TKAs were performed using a measured resection technique and a single prosthetic design (NexGen LPS–flex, Zimmer, Warsaw, IN, USA).

The area of skin numbness was measured with the knee in full extension using a blunt pin for pin-prick sensation. The area was mapped out on the patient and transferred to paper for measurement. This measurement was done by a single observer. The measurement area of skin numbness was performed at 2 weeks, 1 month, 3 months, and 6 months postoperatively.

Results

In group A, there were 29 patients with a mean age of 68.40 years. The male to female ratio was 0:29. The right side to left side ratio was 15:14. The mean length of the skin incision was 9.07 cm (range, 7.50-10.00 cm). In group B, there were 29 patients with a mean age of 71.40 years. The male to female ratio was 4:25. The right side to left side ratio was 21:8. The mean length of skin incision was 11.60 cm (range, 10.50-14.50 cm) as shown in Table 1.

All knees sustained an area of skin numbness lateral to the medial parapatellar incision. The area of skin numbness decreased over the time of follow-up in both groups. At postoperative evaluation, the mean area of skin numbness in group A was 31.74 cm^2 (range, 10-67.5), 30.94 cm^2 (range, 6-65), 29.58 cm^2 (range, 0-35.75), and 9.60 cm^2 (range, 0-17.5) at 2 weeks, 1 month, 3 months, and 6 months, respectively. In group B, the mean area of skin numbness was 51.14 cm^2 (range, 20-110.25), 39.50 cm^2 (range, 16-80), 27.67 cm^2 (range, 4-77), and 11.83 cm^2 (range, 1-17.5) at 2 weeks, 1 month, 3 months, and 6 months, respectively. Comparative parameters were shown in Fig. 1.

Table 1 Demographic data of all participants

	Group A (Skin incision length ≤ 10 cm)	**Group B (Skin incision length > 10 cm)**
N	29	29
Mean age (years)	68.40	71.40
Male/Female	-/29	4/25
Side (right/left)	15/14	21/8
Mean incision length (cm)	9.07 (7.50-10.00)	11.60 (10.50-14.50)

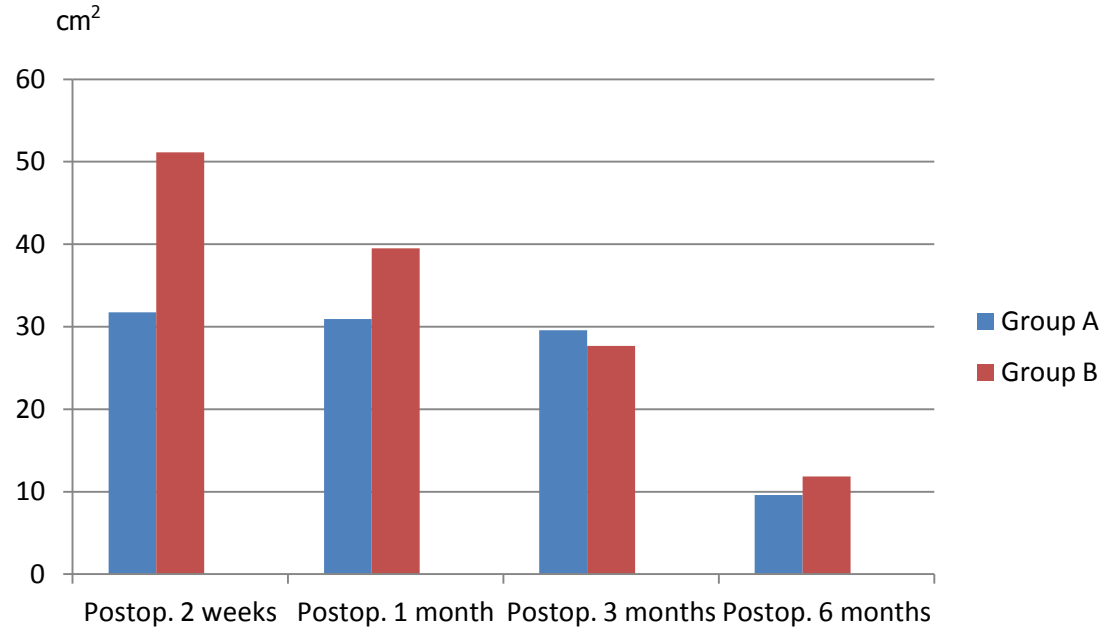

Fig. 1 The area of skin numbness (cm^2) showing decreasing over time in both groups. In Group A (skin incision length ≤ 10 cm), the area of skin numbness was smaller than group B (skin incision length > 10 cm)

Discussion

Skin numbness was a common symptom which patients complained of after knee arthroplasties. A few studies have reported this complication. Borley et al[3] reported results of the area of skin numbness in 25 consecutive primary TKAs following the use of a midline incision, they found the median for pin-prick loss was 86 cm^2 at the median, 11 months postoperatively. Johnson et al[4], study in 26 TKAs using a medial parapatellar skin incision. The mean residual area of skin numbness was 33 cm^2 at 2 years postoperatively. Sundaram et al[5], who compared the area of skin numbness between medial parapatellar and midline skin incisions in TKA, have not demonstrated a statistically significant difference in the area of numbness at a mean follow up of 2.5 years (28.9cm^2 VS 23.8 cm^2).

However, all previous studies were demonstrated using conventional skin incision techniques. To our knowledge, the current study is the first report in a less invasive surgical technique. We found all knees sustained an area of skin numbness lateral to the medial parapatellar incision and the numbness showed a decrease over time. The mean area of skin numbness at 6 months postoperatively was 9.60 cm^2 in group A and 11.83 cm^2 in group B. Our study demonstrated group A, in which the skin incision length was shorter, had a smaller area of skin numbness.

Compared to previous studies, which were performed using conventional skin incision techniques, and the less invasive surgery technique in the current study, the area of skin numbness was smaller in our study. It might be explained by less injury to the anterior and medial cutaneous branches of the femoral nerve or the infrapatellar branch of the saphenous nerve[8]. Similarly, Hopton et al report that patients with scars over 22 cm long had a mean numb area of 82.0 cm^2 as opposed to 31.7 cm^2 if their scar was less than 18 cm in length. Not only skin incision length, which influenced the area of skin numbness, but also the site of incision might be influence this complication. Berg et al[9], demonstrated the lateral incision produced less dysaesthesia than a medial incision.

This study demonstrated the area of skin numbness after TKA depends on the length of skin incision and that the skin sensation improved with time.

Acknowledgements

We are grateful for the time our patients devoted to us. That gives us new knowledge.

References

1. Stern SH, Insall JN. Posterior stabilized prosthesis: Result after follow-up of nine to twelve years. J Bone Joint Surg Am 1992; 74: 980-6.
2. Ritter MA, Herbst SA, Keating EM, Faris PM, Meding JB. Long-term survival analysis of a posterior cruciate-retaining total condylar total knee arthroplasty. Clin Orthop 1994; 309: 136-45.
3. Borley NR, Edwards D, Villar RN. Lateral skin flap numbness after total knee arthroplasty. J Arthroplasty 1995; 10: 13-4.
4. Johnson DF, Love DT, Love BR, Lester DK. Dermal hypoesthesia after total knee arthroplasty. Am J Orthop 2000; 29: 863-6.
5. Sundaram RO, Ramakrishnan M, Harvey RA, Parkinson RW. Comparision of scars and resulting hypoaesthesia between the medial parapatellar and midline skin incisions in total knee arthroplasty. Knee 2007; 14: 375-8.
6. Scuderi GR. Minimal invasive total knee arthroplasty:surgical technique. Am J Orthop 2006; 35: 7-11.
7. Hopton BP, Tommichan MC, Howell ER. Reducing lateral skin flap after total knee arthroplasty. Knee 2004; 11: 289-91.
8. Williams D, Warwick D, Dyson M, Bannister L. Gray's anatomy. 7th ed. Churchill Livingstone, New York, 1989.
9. Berg P, Mjoberg B. A lateral skin incision reduces peripatellar dysthesia after knee surgery. J Bone Joint Surg Br 1991; 73B: 374-6.

ขนาดพื้นที่ของผิวหนังที่มีอาการชาหลังผ่าตัดเปลี่ยนข้อเข่าเทียมแบบเนื้อเยื่อบาดเจ็บน้อย, การศึกษาแบบไปข้างหน้า

อารักษ์ ลิ่มตระกูล, พบ, อารี ตนาวลี, พบ, สีหธัช งามอุโฆษ, พบ, ศรัณย์ ตันติ์ทวิสุทธิ์, พบ

วัตถุประสงค์: *การศึกษานี้ต้องการศึกษาขนาดพื้นที่ของผิวหนังที่มีอาการชาหลังผ่าตัดเปลี่ยนข้อเข่าเทียมแบบเนื้อเยื่อบาดเจ็บน้อย และได้เปรียบเทียบขนาดพื้นที่ของผิวหนังที่มีอาการชาในผู้ป่วยที่มีแผลขนาดน้อยกว่าหรือเท่ากับ 10 ซม. และมากกว่า 10 ซม.*

วิธีการศึกษา: *การศึกษานี้เป็นการศึกษาแบบไปข้างหน้า ประกอบด้วยผู้ป่วยที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบเนื้อเยื่อบาดเจ็บน้อยจำนวน 58 ราย แบ่งผู้ป่วยเป็น 2 กลุ่ม คือ กลุ่ม A (ขนาดแผลน้อยกว่า 10 ซม.) 29 ราย และกลุ่ม B (ขนาดแผลมากกว่า 10 ซม.) 29 ราย ทั้งนี้การขยายขนาดแผลผ่าตัดขึ้นอยู่กับความตึงของผิวหนังของผู้ป่วยในระหว่างผ่าตัด การวัดขนาดพื้นที่อาการชาใช้ไม้ปลายทู่ ประเมิน pin-prick sensation ในขณะที่ผู้ป่วยอยู่ในท่าเข่าเหยียดและนำมาคำนวณขนาดพื้นที่ในกระดาษ โดยทำการประเมินพื้นที่หลังผ่าตัดที่สัปดาห์ที่ 2, เดือนที่ 1, เดือนที่ 3 และเดือนที่ 6 หลังผ่าตัด*

ผลการศึกษา: *ขนาดพื้นที่เฉลี่ยของผิวหนังที่มีอาการชาหลังผ่าตัดของผู้ป่วยกลุ่ม A คือ 31.74 ตร.ซม., 30.94 ตร.ซม., 29.58 ตร.ซม. และ 9.60 ตร.ซม. ที่สัปดาห์ที่ 2, เดือนที่ 1, เดือนที่ 3 และเดือนที่ 6 หลังผ่าตัด ตามลำดับ และในผู้ป่วยกลุ่ม B คือ 51.14 ตร.ซม., 39.50 ตร.ซม., 27.67 ตร.ซม. และ 11.83 ตร.ซม. ที่สัปดาห์ที่ 2, เดือนที่ 1, เดือนที่ 3 และเดือนที่ 6 หลังผ่าตัด ตามลำดับ ในขณะที่ขนาดพื้นที่ของผิวหนังที่มีอาการชาของทั้ง 2 กลุ่มลดลงตามระยะเวลา*

สรุป: *จากการศึกษาสรุปได้ว่าขนาดพื้นที่ของผิวหนังที่มีอาการชาหลังผ่าตัด ขึ้นกับขนาดความยาวของแผลผ่าตัดและขนาดพื้นที่อาการชาจะลดลงตามระยะเวลา*

Elastic Stable Intramedullary Nail:

The viable technique for pediatric long bone fixation

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Treatment options for a pediatric diaphyseal fracture have been debated for a long time. Cast immobilization is used as a nonsurgical treatment to avoid risks from operations. However, casting has disadvantages such as shortening or angulation of the fracture site, difficulty in nursing care, and a delay in the return to school. Internal fixation has been indicated for some patients who cannot encounter those drawbacks. Elastic stable intramedullary nailing (ESIN) is one of the fixations of choice. Rational, surgical techniques and possible complications of ESIN are reviewed in this article. Benefits from this treatment system are that it is a minimally invasive procedure, the promotion of callus formation, easier nursing care, and early ambulation. There are some complications from this technique which were proposed as minor and major complications. Soft tissue irritation around the entry point of the nail is the most common minor complication whereas unacceptable angulation has the highest incidence among major complications.

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Introduction

Non-surgical treatment for pediatric long bone diaphyseal fractures was accepted by orthopaedists for a long time. The reported nonunion rate was more than 90% and full functional recovery[1,2]. Early casting immobilization or traction followed by casting were the standard for children who suffered from fracture of the shaft of a long bone[3]. Presently, surgical treatments are generally indicated for an unstable fracture, an open fracture, a fracture associated with a neurovascular injury, or a multiple injury patient. Ideally, the internal fixation should be less invasive, provide immediate stability, and not interfere with the growth plate or blood supply[4,5]. Successful treatment with an external fixator, submuscular plating, and intramedullary nail were reported[4].

The advantages of having surgical treatment are as follows: children can regain function earlier than having a non-operative treatment, easier for nursing care, less psychological problems, and a shorter hospitalization period[5,6]. Disadvantages of the nonsurgical treatment were also reported, such as unacceptable shortening of the extremity, prolong duration of immobilization, delayed return to school, difficulty to transfer, and psychosocial disturbance; thus a surgical intervention may be needed to obviate those mentioned problems[2,7]. For some conditions, such as a fracture of the femoral shaft in adolescent or obese patients, an operative treatment was preferred[1,8,9]. Different options of management are available depending on various factors such as age, type of fracture, level of fracture, associated injuries, social issues, economical constraints, and psychological issues[10].

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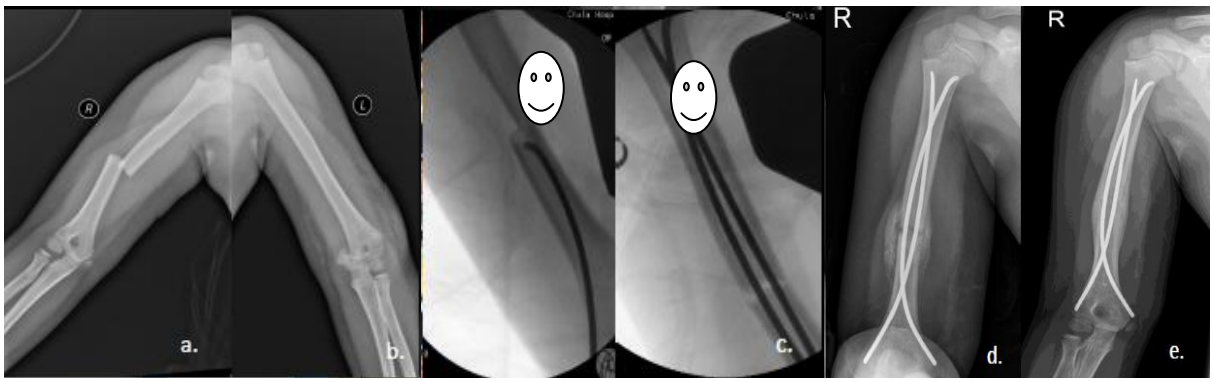
Evolution for intramedullary nail fixation

At least 5 types of intramedullary nail have been invented and used as a fixation material for a long bone diaphyseal fracture in children. The Küntscher nail, Hackethal's bundle nail, and Rush pin were among the first group developed. There were some complications reported associated with these instruments, such as growth plate injury or avascular necrosis of the femoral head[11]. The Sevilla-Eiffel Tower system, using multiple Kirschner wires (K-wires) inserted percutaneously into the femoral canal by a retrograde technique was proposed. Limiting of the wire length and thickness of custom-made K-wires caused poor acceptance for this technique[11].

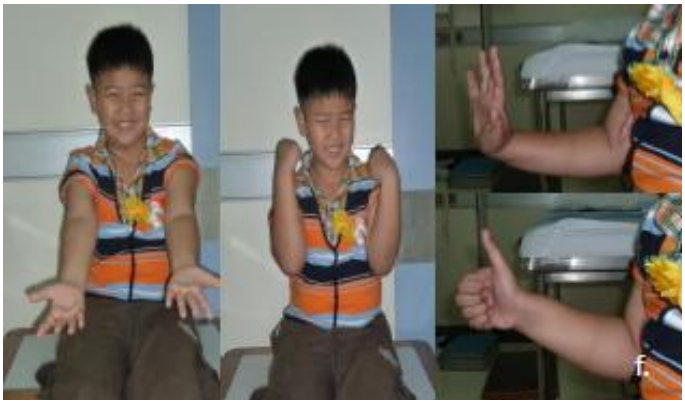
The Ender nail was introduced in 1970. The nail was designed initially for an adult femoral fracture. Then it was adapted to pediatric groups. The concept of the Ender nail is similar to elastic stable intramedullary nailing (ESIN). Some studies reported that the Ender nail had insufficient elasticity to control a fracture and may interfere with the normal bony curvature[12].

ESIN, Nancy nail, and titanium elastic nail

This intramedullary nail was developed in 1988 by Nancy, France, and was called by different names, e.g. Nancy nail or titanium elastic nail (TEN), and is available in stainless steel or titanium. It was described as embrochage centro mé-dullaire elastique stable (ECMES) system. It is one of the accepted minimally invasive treatment options for pediatric long bone fractures[13,14] which appropriates for children between 5-16 years of age. This system is slightly different from the Ender nail. The Ender nail was a "stack nailing" inside the medullary canal and is stiffer. ESIN is a "canal filling" and has more elasticity than the Ender nail. ESIN insertion by a minimally invasive technique was recommended. After close reduction is performed, nails are introduced into metaphyseal entry points; they create three point pressures to stabilize the long bone fracture. Following these techniques, patients would obtain benefits from minimal blood loss as well as the retainment of periosteum and fracture hematoma which promote the bone healing process[11] (Fig. 1). The system stimulates a rapid development of bridging callus and allows early weight bearing[15]. The rotational instability and an unequal limb length are the most major concerns associated with the ESIN. High cost for the material may affect patients in low socioeconomic areas[16-18]. Flexible intramedullary nails are manufactured in varying diameters and lengths. Surgeons must choose the proper nails for each patient[13].



(a) (b) (c) (d) (e)



(f)

Fig. 1 A 7 year old boy came following a car accident. He had multiple fractures and right radial nerve palsy after the car accident.
(a) Closed fracture shaft of the right humerus.
(b) Closed supracondylar fracture of the left humerus.
(c) ESIN was used for the right humeral fracture.
(d) 1 month after the operation, external callus was formed.
(e) 2 months after the operation, the humerus was completely healed.
(f) The patient's radial nerve function at 5 months follow up.

Biomechanics of the ESIN

The material properties of the ESIN are superior in various aspects compared with that of stainless steel nails. The modulus of elasticity of 316L stainless steel is 80% stiffer than titanium (187 Gpa for the former and 105 Gpa for the latter). The more favourable elasticity of titanium promotes callus formation by limiting stress shielding and allows micro-motion at the fracture site[4,13,18]. From several studies, they recommended using two symmetrical nails for occupying 80% "canal fill" of the fractured bone. Each nail should have a diameter of approximately 40% of the narrowest part of the intramedullary canal. Stability was tested using a synthetic femoral bone model and showed that at 78% of canal fill both axial rotation and compression stability were at the maximum increase. In contrast, the larger canal fill would improve only a rotational stability[19,20]. Hypertrophic nonunion was reported as the complication of using an undersized nail[21].

Fracture configurations affect the stability of the ESIN fixation system. An experiment was performed by creating 5 different fracture patterns on a synthetic femoral bone. Rotational stability was tested after the synthetic bones were reduced and ESIN was applied as a standard protocol. The oblique type fracture exhibited the strongest of torsion stiffness in an internal rotation, while the spiral fracture pattern was the largest for external rotation stiffness. Torsion stiffness between the transverse fracture and the comminuted fracture did not have a statistically significant difference. They concluded that the rotational stability did not differ in a variety of fracture patterns in these synthetic models[22]. Although increasing the nail diameter can improve the rotational stability, some authors believed that muscle around the fractured bone acts as "guy ropes" and the muscle action participates in spontaneous correction of angular deformity[4].

The torsion and axial compression testing in a femoral bone model did not show a difference between stainless steel and titanium nails. The author concluded that the stainless steel nail is significantly stiffer than titanium, but this is not related to the rotational stability[23]. Because of less stiffness, it is possible for the titanium nail to deform within the medullary canal. This increases the contact area leading to resistance of a compressive and torsional load. The finite element analysis study revealed a greater deformation and increased contact area of titanium nails than stainless steel nails. Moreover, the experiment showed a higher degree of slipping from the canal of stainless steel nails. The amount of fracture gap closure for the femur which was fixed with the titanium nail was maintained in the range of micromotion of normal bone healing[13].

One of the important risk factors for ESIN of the femoral shaft fracture is the patient's body weight. The average load required for a sagittal plane failure was 628 N and 596 N for a coronal plane. This corresponds with the bending moment of the femur during the gait in a patient who has a body weight of around 40-45 kg. Being overweight was proven to be a risk of fixation failure and loss of reduction or risk of angulation of at least 15 degrees, especially for midshaft femoral fractures[24].

Techniques for long bone diaphyseal fracture fixation

Pre-bending of the nail is the important step for ESIN (Fig. 2). A biomechanical study which compared the stability of bending nails to various degrees showed the result of the nail, which was pre-bent for 45 degrees, provided the greatest stability in both sagittal and coronal plane. When nails were pre-bent to 60 degrees the sagittal stability was decreased[25]. In some institutes, the surgeons recommended that a nail should be pre-bent over the length of the bone three times the diameter of the medullary canal.

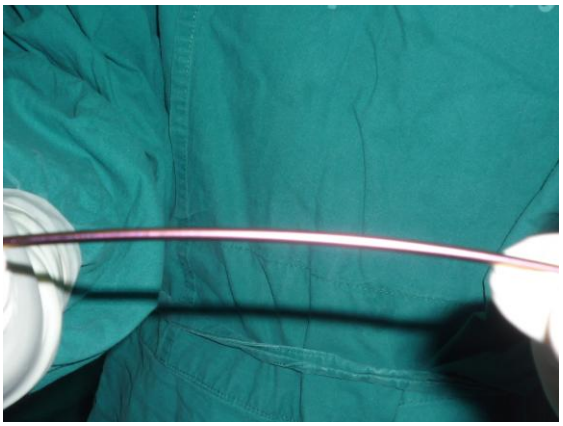


Fig. 2 A nail was pre-bent by a manual technique.

Two requirements for this technique are a fluoroscope and a radiolucent operative table or fracture table. The nails are gently contoured to a 45 degree angulation at about 2 cm from one end and are also contoured over their entire length. A hole is made at the distal femur metaphysis just proximal to the distal femoral growth plate by using an awl or drill bit. The fracture was reduced and checked for position by fluoroscope. Two nails are used, one for medial and another for lateral, then the contoured nails were inserted into the hole and passed into the medullary canal.

For femoral shaft fractures, a retrograde technique is used to prevent proximal growth plate or vascular injury. Both nails must be introduced at the same level and contoured to identical curvatures; these are the important techniques to prevent fracture malrotation. The nail ends are cut

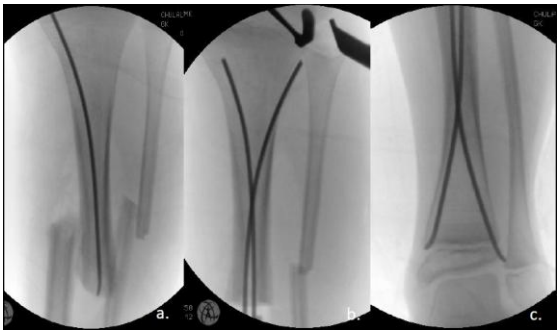
at about 1-1.5 cm distal to the bone cortex[15]. Antegrade nailing was properly used for distal femoral fractures. By the antegrade technique, the entry point is changed to the subtrochanteric area just below the greater trochanter. In other long bone fractures, the same principle is applied for intramedullary nailing. The entry point of nails can be changed depending on the anatomy and how to avoid injuring the growth plate[26].

Once they are in the medullary canal, the staggering pattern of both nails is another factor that may affect their fixation properties. Several studies suggested "C" shape contouring of the nails before they are applied. A divergent "C" configuration provided significantly greater rotation stability and compression stiffness[15,19,25]. For the divergent "C" construct, each nail has three points of fixation at the entry point, apex of the curve, which is the same level as the fracture site, and at the nail tip. This construct produces the most suitable "elastic stability" for the fractured bone. A two straight-nails construct showed less stiffness than the divergent "C" but was not statistically significant[25].

The tip of the nails is left outside the metaphyseal cortex. This may irritate the soft tissue around them and decrease the range of motion due to pain[4]. Various techniques were suggested to decrease this complication from nail irritation. An end cap for ESIN was proposed. A cylindrical hollow threaded end cap was easily applied by screwing into the cortical bone until it has a firm grip. However, using end caps may interfere with the bone healing process because it decreases the stability of the construct and limits micromotion of the fracture site. Some surgeons reported delaying of callus formation[27].

Complications

Complications related to the treatment of pediatric long bone diaphyseal fractures with ESIN were found in many reports, especially for femoral fracture treatment[4,12,14,28,29]. Minor complications include pain at the insertion area, acceptable degree of angulation and limb length discrepancy, inflammatory reaction due to nail tip irritation, and skin infection. The major complications which need a second operation are an unacceptable angulation, loss of reduction, severe limb length discrepancy, and deep infection[29]. A retrospective review of 234 femoral fractures revealed a 30.4% rate of minor complications with the most common being pain at the insertion site. This usually happened when the nail end was left too long or a nail slippage and back out occurred and thus led to an irritation of the soft tissue around it (Fig. 3). Superficial skin infection and a deep wound infection may occur. Limiting motion of the adjacent joint from pain and delaying of weight bearing relates to this problem[12].



(a) (b) (c)

Fig. 3 A 9-year-old boy, osteogenesis Imperfecta, came with malunion of the left tibia. Corrective osteotomy was performed and ESINs were used for fixation.
(a) The first nail was passed from the proximal part of the tibia.
(b) Both nails were passed across the osteotomy site.
(c) It was noticed that the first nail was too long. This leads to soft tissue irritation and the need to remove later.

As described in the previous part, end capping is a technique which decreases this complication[27]. However, there are various procedures described for preventing this minor complication. Cutting the end nail and keeping it close to the cortex without bending was suggested[30]. The length of the nail end left outside the metaphyseal cortex should be less than 1.0-1.5 cm to reduce the incidence. It should not advance into the medullary canal. Some surgeons suggested not leaving the end of nail distal to the growth plate[12,28]. For the back out nail, the end of the nail should be trimmed and advanced to the proper position. Flexible nails may need to be removed after the fractured bone has completed union[4,12,15,21,31].

A major complications rate of about 18%, of which the most common was an unacceptable angulation was reported[29]. The average degree of angulation after using ESIN for femoral shaft fractures is about 5-20 degrees in both the coronal and sagittal planes[8,32]. Closed reduction for the fracture site is one of the risks for malrotation because anatomical reduction was difficult to obtain[33]. The complications are commonly associated with children of more than 11 years of age, over 50 kg of body weight, and unstable fracture configuration[8]. Factors affecting the stability of the ESIN construct included mismatching of the nails size and using of too small diameter nails. The wrong technique for nail bending leads to a malrotation of the fracture bone. A previous study reported an association with an odd ratio of 19.4 between malunion and/or a loss of

reduction which required a second operation by using mismatched diameter nails[12].

Fracture configuration is another factor related to a malrotation after reduction. Almost 20% of complications occurred in "length-unstable" fractures such as long oblique or comminuted fractures[28]. Pulling of the thigh muscles can induce an external rotational malalignment of femoral fractures which were treated by ESIN[33]. Some authors suggested some form of postoperative immobilizations such as casting or bracing for the patient who had these risks of fracture malalignment until callus formed[4,15]. A small number of patients were reported to experience limb length discrepancy and need a second operation. The average discrepancy of limb length was between 1-1.5 cm. Causes of limb length unequal after ESIN are similar to those of malrotation which are fracture configuration and nail slippage[29,33].

In conclusion, the ESIN is the most recent advance in pediatric diaphyseal fracture care. Although not a totally new idea, the use of titanium and a better biomechanical study bring us the understanding of the proper use of this minimally invasive fracture fixation option. Meticulous care should be exercised in terms of patient selection and the most suitable fracture configuration before the ESIN should be chosen. Most of the complications can be avoided if the recommendation is strictly adhered and an excellent healing rate can be expected. Our children and society will have a benefit from this advance surgical technique.

References

1. Furlan D, Pogorelic Z, Biocic M, Juric I, Budimir D, Todoric J, et al. Elastic stable intramedullary nailing for pediatric long bone fractures: experience with 175 fractures. Scandinavian journal of surgery : SJS : official organ for the Finnish Surgical Society and the Scandinavian Surgical Society 2011; 100: 208-15.
2. Hughes BF, Sponseller PD, Thompson JD. Pediatric femur fractures: Effects of spica cast treatment on family and community. Journal of Pediatric Orthopaedics 1995; 15: 457-60.
3. Martinez AG, Carroll NC, Sarwark JF, Dias LS, Kelikian AS, Sisson Jr GA. Femoral shaft fractures in children treated with early spica cast. Journal of Pediatric Orthopaedics 1991; 11: 712-6.
4. Flynn JM, Hresko T, Reynolds RAK, Blasier RD, Davidson R, Kasser J. Titanium elastic nails for pediatric femur fractures: A multicenter study of early results with analysis of complications. Journal of Pediatric Orthopaedics 2001; 21: 4-8.
5. Heybeli M, Muratli HH, Celebi L, Gulcek S, Bicimoglu A. [The results of intramedullary fixation with titanium elastic nails in children with femoral fractures]. Acta orthopaedica et traumatologica turcica 2004; 38(3): 178-87.
6. Lee SS, Mahar AT, Newton PO. Ender nail fixation of pediatric femur fractures: A biomechanical analysis. Journal of Pediatric Orthopaedics 2001; 21: 442-5.
7. Karn MA, Ragiel CA. The psychologic effects of immobilization on the pediatric orthopaedic patient (continuing education credit). Orthopaedic nursing / National Association of Orthopaedic Nurses 1986; 5: 12-7.
8. Sink EL, Faro F, Polousky J, Flynn K, Gralla J. Decreased complications of pediatric femur fractures with a change in management. Journal of Pediatric Orthopaedics 2010; 30: 633-7.
9. Heinrich SD, Drvaric D, Darr K, MacEwen GD. Stabilization of pediatric diaphyseal femur fractures with flexible intramedullary nails (a technique paper). Journal of orthopaedic trauma. 1992; 6: 452-9.
10. Anglen JO, Choi L. Treatment options in pediatric femoral shaft fractures. Journal of orthopaedic trauma 2005; 19: 724-33.
11. Parsch KD. Modern trends in internal fixation of femoral shaft fractures in children. A critical review. Journal of Pediatric Orthopaedics Part B 1997; 6: 117-25.
12. Narayanan UG, Hyman JE, Wainwright AM, Rang M, Alman BA. Complications of elastic stable intramedullary nail fixation of pediatric femoral fractures, and how to avoid them. Journal of Pediatric Orthopaedics 2004; 24: 363-9.
13. Perez A, Mahar A, Negus C, Newton P, Impelluso T. A computational evaluation of the effect of intramedullary nail material properties on the stabilization of simulated femoral shaft fractures. Medical Engineering and Physics 2008; 30: 755-60.
14. Wall EJ, Jain V, Vora V, Mehlman CT, Crawford AH. Complications of titanium and stainless steel elastic nail fixation of pediatric femoral fractures. Journal of Bone and Joint Surgery - Series A 2008; 90: 1305-13.
15. Ligier JN, Metaizeau JP, Prevot J, Lascombes P. Elastic stable intramedullary nailing of femoral shaft fractures in children. The Journal of bone and joint surgery British volume 1988; 70: 74-7.
16. Olerud S, Stark A, Gillstrom P. Malrotation following Ender nailing. Clinical Orthopaedics and Related Research 1980; 147: 139-42.
17. Balakumar B, Natarajan MV. Is there a role for Ender's nailing of paediatric femoral fractures in a resource-restricted hospital set-up? Journal of pediatric orthopedics Part B 2013; 22: 101-5.
18. Chitgopkar SD. Flexible Nailing of fractures In children using stainless steel Kirschner wires.

Journal of Pediatric Orthopaedics Part B 2008; 17: 251-5.
19. Mahar A, Sink E, Faro F, Oka R, Newton PO. Differences in biomechanical stability of femur fracture fixation when using titanium nails of increasing diameter. Journal of Children's Orthopaedics 2007; 1: 211-5.
20. Green JK, Werner FW, Dhawan R, Evans PJ, Kelley S, Webster DA. A biomechanical study on flexible intramedullary nails used to treat pediatric femoral fractures. Journal of orthopaedic research : official publication of the Orthopaedic Research Society 2005; 23: 1315-20.
21. Luhmann SJ, Schootman M, Schoenecker PL, Dobbs MB, Gordon JE. Complications of titanium elastic nails for pediatric femoral shaft fractures. Journal of pediatric orthopedics 2003; 23: 443-7.
22. Gwyn DT, Olney BW, Dart BR, Czuwala PJ. Rotational control of various pediatric femur fractures stabilized with titanium elastic intramedullary nails. Journal of pediatric orthopedics 2004; 24: 172-7.
23. Kaiser MM, Wessel LM, Zachert G, Stratmann C, Eggert R, Gros N, et al. Biomechanical analysis of a synthetic femur spiral fracture model: Influence of different materials on the stiffness in flexible intramedullary nailing. Clinical Biomechanics 2011; 26: 592-7.
24. Li Y, Stabile KJ, Shilt JS. Biomechanical analysis of titanium elastic nail fixation in a pediatric femur fracture model. Journal of pediatric orthopedics 2008; 28: 874-8.
25. Kiely N. Mechanical properties of different combinations of flexible nails in a model of a pediatric femoral fracture. Journal of Pediatric Orthopaedics 2002; 22: 424-7.
26. Barry M, Paterson JM. A flexible intramedullary nails for fractures in children. The Journal of bone and joint surgery British volume 2004; 86: 947-53.
27. Nectoux E, Giacomelli MC, Karger C, Gicquel P, Clavert JM. Use of end caps in elastic stable intramedullary nailing of femoral and tibial unstable fractures in children: Preliminary results in 11 fractures. Journal of Children's Orthopaedics 2008; 2: 309-14.
28. Sink EL, Gralla J, Repine M. Complications of pediatric femur fractures treated with titanium elastic nails: A comparison of fracture types. Journal of Pediatric Orthopaedics 2005; 25: 577-80.
29. Moroz LA, Launay F, Kocher MS, Newton PO, Frick SL, Sponseller PD, et al. Titanium elastic nailing of fractures of the femur in children. Predictors of complications and poor outcome. The Journal of bone and joint surgery British volume 2006; 88: 1361-6.
30. Bandyopadhyay R, Mukherjee A. Short term complications of titanium elastic nail in the treatment of diaphyseal fracture of the femur in children. The open orthopaedics journal 2013; 7: 12-7.
31. Wall L, O'Donnell JC, Schoenecker PL, Keeler KA, Dobbs MB, Luhmann SJ, et al. Titanium elastic nailing radius and ulna fractures in adolescents. Journal of pediatric orthopedics Part B 2012; 21: 482-8.
32. Doser A, Helwig P, Konstantinidis L, Kuminack KF, Sudkamp NP, Strohm PC. Does the extent of prebending affect the stability of femoral shaft fractures stabilized by titanium elastic nails? A biomechanical investigation on an adolescent femur model. Journal of pediatric orthopedics 2011; 31: 834-8.
33. Salem KH, Keppler P. Limb geometry after elastic stable nailing for pediatric femoral fractures. Journal of Bone and Joint Surgery - Series A 2010; 92: 1409-17.

แกนโลหะยึดในโพรงกระดูกชนิดยืดหยุ่นและมั่นคงสำหรับกระดูกหักในเด็ก

พัชราภา โอสธีรกุล, พบ, ณพชาติ ลิมปพยอม, พบ

การรักษาภาวะกระดูกหักบริเวณก้านกระดูกยาวในเด็ก วิธีรักษาตามมาตรฐานคือ การใส่เฝือก แต่พบว่าในบางกรณี การรักษาเช่นนี้อาจให้ผลไม่เป็นที่น่าพอใจ เช่น การเกิดภาวะกระดูกติดในลักษณะที่ผิดรูป หรือมีความแตกต่างของความยาว เมื่อเทียบกับแขนหรือขา ข้างปกติ นอกจากนี้ การดูแลภายหลังจากการใส่เฝือกค่อนข้างยุ่งยาก ส่วนใหญ่สร้างความลำบากต่อการใช้ชีวิตประจำวัน เช่น ต้องขาดเรียนเป็นเวลานาน การรักษาโดยการผ่าตัดใส่แกนโลหะยึดในโพรงกระดูก จึงมีที่ใช้ในผู้ป่วยบางราย การศึกษานี้ได้ทบทวนวรรณกรรมที่เกี่ยวข้องกับการรักษากระดูกหักในเด็กโดยใช้ elastic stable intramedullary nail ซึ่งนิยมใช้กันแพร่หลายมากขึ้นในปัจจุบัน การรักษาด้วยวิธีนี้ข้อดีคือ ช่วยหลีกเลี่ยงภาวะไม่พึงประสงค์เมื่อรักษาโดยการใส่เฝือก อย่างไรก็ตาม มีรายงานภาวะแทรกซ้อนที่เกิดตามหลังการผ่าตัดใส่แกนโลหะยึดในโพรงกระดูก ด้วยวิธีดังกล่าว เช่น การระคายเคืองต่อเนื้อเยื่ออ่อนรอบจุดเข้าของแกนโลหะยึดในโพรงกระดูก หรือกระดูกติดผิดรูป ถึงแม้ว่าผู้ป่วยได้รับการรักษาโดยการใส่แกนโลหะยึดในโพรงกระดูกไปแล้ว ซึ่งในกรณีหลังนี้ พบได้ไม่บ่อย แต่มักเป็นเหตุให้ผู้ป่วยต้องเข้ารับการผ่าตัดแก้ไขซ้ำอีกครั้ง

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

Conference proceeding

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

Abstract in scientific presentation

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

Book

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

Electronic article

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

คำแนะนำสำหรับผู้ส่งบทความเพื่อลงตีพิมพ์

จุดมุ่งหมายและขอบเขต

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

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

บทความประเภท Original articles เป็นรายงานผลการวิจัยทางด้านศัลยศาสตร์ออร์โธปิดิกส์ และสาขาอื่นที่เกี่ยวข้อง

บทความ Review articles เป็นบทความที่รวบรวมเอาผลงานในเรื่องใดเรื่องหนึ่งโดยเฉพาะ ซึ่งเคยลงตีพิมพ์มาแล้ว นำมาวิเคราะห์ วิจารณ์ เพื่อให้เกิดความกระจ่างในเรื่องนั้นยิ่งขึ้น

รายงานผู้ป่วย (Case report) เป็นรายงานผู้ป่วย วิจารณ์อาการทางคลินิกและผลตรวจทางห้องปฏิบัติการที่น่าสนใจ

เรื่องที่ส่งมาต้องไม่เคยพิมพ์เผยแพร่มาก่อน กองบรรณาธิการขอสงวนสิทธิ์ในการตรวจทาน แก้ไขต้นฉบับ และพิจารณาตีพิมพ์ข้อคิดเห็นในบทความเป็นความเห็นและเป็นความรับผิดชอบของเจ้าของบทความโดยตรง

การส่งบทความ

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

ประเภทของบทความ

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

การเตรียมต้นฉบับ

- **เกณฑ์การเขียนบทความ**
  1. อธิบายเนื้อหาของบทความหรือวิเคราะห์ข้อมูลที่ได้มาให้ชัดเจน

2. หากต้นฉบับมีข้อผิดพลาดของรูปแบบหรือมีความไม่สมบูรณ์ขององค์ประกอบในบทความ บทความนั้นจะถูกส่งกลับไปยังผู้เขียนเพื่อทำการแก้ไขต่อไป
3. แก้ไขปรับปรุงเนื้อหาของต้นฉบับตามคำแนะนำของผู้ประเมินบทความ

หากมีการเขียนบทความโดยกลุ่ม กรุณาระบุชื่อผู้เขียนทุกคน และระบุชื่อผู้วิจัยหลักให้ชัดเจน

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

- **บทความที่ส่งมาจะต้องเป็นเรื่องที่ไม่เคยตีพิมพ์ที่ใดมาก่อน และผู้เขียนจะต้องไม่ส่งบทความเพื่อไปตีพิมพ์ในวารสารฉบับอื่นในเวลาเดียวกัน**

หลักเกณฑ์สำหรับผู้เขียนบทความ

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

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

(1) ใช้ตัวพิมพ์มาตรฐาน เช่นภาษาอังกฤษ ใช้ตัวอักษร “Times Roman” ขนาด 10 point ภาษาไทยใช้ ตัวอักษร “Angsana New” ขนาด 12 point

(2) พิมพ์ข้อความสำคัญด้วยตัวเอน

(3) ตั้งค่าเลขหน้าโดยอัตโนมัติ

(4) ไม่ใช้ “field functions”

(5) ใช้ปุ่ม “Tab” เมื่อขึ้นย่อหน้าต่อไป

(6) เลือกคำสั่งตาราง (Table) เมื่อต้องการพิมพ์ตาราง

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

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

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

(1) ให้เขียนหมายเลขตารางเป็นเลขอารบิก

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

(3) การอธิบายผลในตารางต้องไม่ซ้ำซ้อนกันและมีใจความกระชับรัดกุม และมีคำอธิบายกำกับไว้เหนือตาราง

(4) เขียนคำอธิบายเพิ่มเติมเกี่ยวกับแหล่งที่มาของเอกสารอ้างอิงไว้ที่ใต้ตาราง

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

- **รูปภาพ (figures)**

(2) ให้ใช้โปรแกรมกราฟฟิกคอมพิวเตอร์ในการวาดรูป

(3) รูปภาพที่เป็นลายเส้นควรใช้รูปแบบ EPS ในการวาดเส้นรูปภาพและรูปภาพที่เป็นโทนสีควรใช้รูปแบบ TIFF ในการไล่เฉดสี

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

- **เอกสารอ้างอิง (references)** เรียงลำดับเลขการอ้างอิงตามเอกสารอ้างอิงท้ายบทความ และใช้ตาม Vancouver style การอ้างอิงถึงชื่อบุคคล ถ้ามีผู้เขียนมากกว่า 6 คน ให้ใส่ชื่อ 6 คนแรก แล้วตามด้วย et al. ส่วนการเขียนเอกสารอ้างอิง

ท้ายบทความ การย่อชื่อวารสารให้ใช้ตาม Index Medicus โดยศึกษาได้ในเว็บไซต์ http://www.medscape.com/home/search/indexMedicus/IndexMedicus-A.html

กรุณาลงนามในแบบฟอร์มการส่งบทความเพื่อขอตีพิมพ์ เพื่อแสดงว่าผู้เขียนได้อ่านเกณฑ์การเขียนบทความทั้งหมด

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