นิพนธ์ต้นฉบับ | Original Article

เปรียบเทียบระยะเวลาการติดของกระดูกขาที่รักษาด้วยวิธีการผ่าตัดยึดตรึงกระดูกแบบ 4 สกรูและ 8 สกรูบน Narrow DCP

Comparison of The Union Time of Tibial Shaft Fracture Treated with Open Reduction and Internal Fixation Between 4 Screws and 8 Screws on Narrow DCP

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บทคัดย่อ

วัตถุประสงค์ : เปรียบเทียบระยะเวลาการการติดของกระดูกขาที่รักษาด้วยวิธีการผ่าตัดยึดตรึงกระดูกแบบ 4 สกรู และ 8 สกรูบน Narrow DCP

รูปแบบงานวิจัย : retrospective cohort study

วิธีการศึกษา : ทบทวนเวชระเบียนผู้ป่วยกระดูกขาหักที่นอนโรงพยาบาลและได้รับการผ่าตัดยึดตรึงกระดูกตั้งแต่วันที่ 1 มกราคม พ.ศ.2558 ถึง 31 ธันวาคม พ.ศ.2562 ที่โรงพยาบาลบุรีรัมย์ ผู้ป่วยถูกนัดติดตามอาการจนกระดูกติด

ผลการศึกษา : มีผู้ป่วย 23 คนได้รับการยึดตรึงกระดูกโดยใช้สกรู 4 ตัว มีผู้ป่วย 27 คนได้รับการยึดตรึงกระดูกโดยใช้สกรู 8 ตัว จากการศึกษาพบว่าค่ามัธยฐานของระยะเวลาการติดของกระดูกคือ 92 วัน และ 93 วัน ในการยึดตรึงกระดูกโดยใช้สกรู 4 ตัวและ 8 ตัวตามลำดับ แต่อย่างไรก็ตามยังพบผู้ป่วยมีภาวะแทรกซ้อนหลังจากการผ่าตัดเป็นจำนวนทั้งหมด 3 คน โดยหนึ่งในนั้น (ร้อยละ 2) พบว่ากระดูกติดช้า และได้รับการผ่าตัดซ้ำ ส่วนอีก 2 คน พบปัญหาการติดเชื้อของแผล คนแรกหลังจากได้รับยาปฏิชีวนะทางเส้นเลือดดำ มีอาการดีขึ้น คนที่สองจำเป็นต้องได้รับการผ่าตัดเพื่อจัดการกับการติดเชื้อ

สรุปผล : การผ่าตัดยึดตรึงกระดูกขาหักโดยใช้สกรู 4 ตัวไม่มีความแตกต่างในการติดของกระดูกเมื่อเทียบกับการผ่าตัดยึดตรึงกระดูกโดยใช้สกรู 8 ตัว ยิ่งไปกว่านั้นปริมาณเลือดออกระหว่างผ่าตัดและเวลาที่ใช้ในการผ่าตัดของการผ่าตัดยึดตรึงกระดูกโดยใช้สกรู 4 ตัวยังน้อยกว่าการผ่าตัดยึดตรึงกระดูกโดยใช้สกรู 8 ตัวอีกด้วย

คำสำคัญ : กระดูกขาหัก ระยะเวลาการติดของกระดูก จำนวนสกรู narrow DCP

ABSTRACT

Objective : To compare the union time of tibial shaft fracture after fixation with narrow DCP between 4 screws and 8 screws

Design : Retrospective cohort study

Methods : Reviewed of medical records of patients with tibial shaft fractures who had been treated with open reduction and internal fixation from 1st January 2015-31st December 2019 at Buriram hospital. The Patients were followed up until presentation of union of fractures.

Results : 4 screws were applied in 23 cases and 8 screws were applied in 27 cases. The median of union time was 92 and 93 days consecutively. There were 3 complications after operation; one delayed union of fracture (2%) at 200 days resolved with revision, two infected wounds; one resolved after intravenous antibiotic treatment and local wound care. The other required surgical intervention.

Conclusion : 4 screws fixations of tibial shaft fracture had no difference of union time compared with 8 screws fixations. Moreover, Blood loss and operating time in 4 screws were less than 8 screws

Keywords : tibial shaft fracture, union time, narrow DCP, number of screws

Introduction

Tibial shaft fracture was the most common fracture of long bone. The incidence was more than 17 per 100000 people each year.[1] They were often the result of violent trauma and were associated with soft tissue damage and osseous comminution.[2] In general, gold standard of treatment of tibial shaft fracture[3] was intramedullary nail; however, plate and screws fixation was quite widely used especially in tertiary care center. They were well-known practice with long history of use which had been shown good outcomes.[4, 6] The AOOTA[7] recommended at least 8 cortices or 4 screws of each fragment of fracture for sufficient strength of plate and screws fixation.

According to Hu et al in 2014[8], the Biomechanics were introduced to tibial shaft fixation with plate and minimum screws to stabilize fracture. They represented superior mechanical fixation in position and number of screw fixation on narrow DCP on tibial shaft fracture. In Laurence et al[9] was also represented number of screws and screw placement in view of Physics.

Besides fracture fixation, soft tissue injury was major influences of bone healing.[5,6,10] To prevent consequences of the tibial shaft fracture such as infection, delayed union and nonunion[5,11], technique of soft tissue management[5] was the key of success. The better result relied on these steps[6]; repositioning of bone fragment, proper debridement in open fracture[5], short operating time, less blood loss and minimum soft tissue damage.

Tibial shaft fracture was a major fracture in Orthopedics not only number but also their sequelaes.[11] Prior study of less screws fixation in laboratory showed good result and there was still no clinical study. We applied ours study to confirm that 4 screws fixation was not inferior to 8 screws fixation in strength. Furthermore, it might be superior to 8 screws in operating time, blood loss, and cost-effectiveness. Therefore, the aim of this study was to compare outcome of biomechanical fixation of tibial shaft fracture with 4 screws and 8 screws on Narrow DCP plate.

Methods

Study design

We conducted a retrospective cohort study by manually reviewing and extracting from electronic medical records (EMR) data. 75 patients with tibial shaft fracture were enrolled in the study. Every patient was diagnosed with ICD10 code S8220 and S8221[12] and admitted for open reduction internal fixation with DCP from January, 1st 2015 to December, 31st 2019 in Buriram hospital.

Data source

All EMRs were accessed through Doctor App, a web-based clinical patient record system. We reviewed and extracted data from the ER notes, orthopedics clinical notes, operating notes, nurse clinical notes, and imaging documents. Extracted data were collected and chronologically categorized as demographic data, preoperative data, perioperative data, and post-operative data.

Inclusion and exclusion criteria

Inclusion criteria was composed of : 1. Medical records of patients were coded with S8220 and S8221[12] 2. Patients were admitted for open reduction internal fixation with 4 and 8 screws on DCP 3. Patients were operated by an experienced orthopedist 4. Patients were followed up until presentation of union (radiographic and clinical union)[13,14] 5. Patients were between 18 and 60 years of age. Exclusion criteria was composed of 1. Loss follow-up until union 2. Incomplete medical record. 3. Multiple trauma

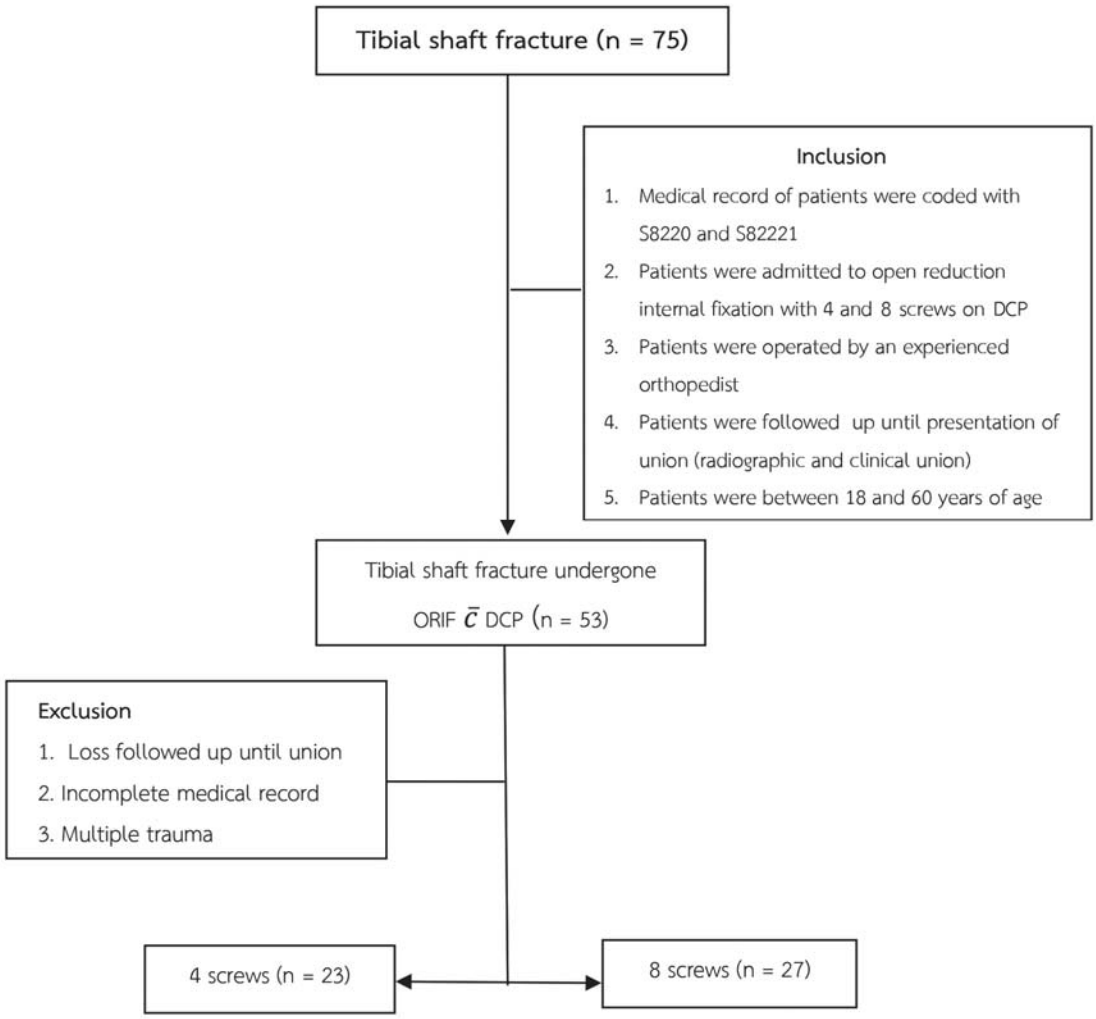
Tibial shaft fracture (n = 75)
Inclusion
1. Medical record of patients were coded with S8220 and S82221
2. Patients were admitted to open reduction internal fixation with 4 and 8 screws on DCP
3. Patients were operated by an experienced orthopedist
4. Patients were followed up until presentation of union (radiographic and clinical union)
5. Patients were between 18 and 60 years of age
Tibial shaft fracture undergone ORIF $\bar{c}$ DCP (n = 53)
Exclusion
1. Loss followed up until union
2. Incomplete medical record
3. Multiple trauma
4 screws (n = 23)
8 screws (n = 27)

Diagram 1

Definition of Fracture Related Condition

The diagnosis of union fracture[13-14] was routinely based upon serial clinical and radiographic assessments. Clinically healing fracture was evaluated by absence of pain on weight bearing or palpation at fracture site. Radiographic union could show absence of fracture gap.

The diagnosis of delayed union & nonunion[13-14] was opposed to union fracture and also based on clinical and radiological findings over a minimum follow-up period over 6 months (twice of normal union time). A fracture was not considered to be a nonunion until 12 months after injury, to account for potential cases of delayed union. The clinical criteria used to define nonunion included the presence of pain and/or motion in response to physiological strain of the affected limb (e.g.) the instability to fully weight bearing without pain). The radiographic confirmation of union relied on the presence of fracture gap assessed on anteroposterior and lateral radiographs.

The diagnosis of local infection[15] was made according to clinical presentation, not reliant on positive cultures. Infection occurred at any points in the study period and related to initial injury or operation. Any surgical intervention, revision, or antibiotic use were indicative of infection.

Population

The initial cohort of 75 patients was collected. The extreme age was sorted out; 22 people. From 53 patients, 3 patients were excluded. One patient lost follow-up until union and 2 patients had multiple traumas. The remaining 50 patients had undergone open reduction internal fixation and were completely followed up until union. All 50 patients had definitive fixation with 8 holes narrow DCP. 4 screws were placed in 23 patients and 27 patients were placed with 8 screws.

Statistical Analysis

For categorical data, descriptive statistics was used and chi-square of comparison with 95% confidence intervals. For continuous data, data distribution was assessed with a Shapiro-Wilk normality test. Where data were normally distributed, data were described by mean and standard deviation (SD). They were compared with unpaired 2-tailed t-tests. Non normal distribution of data were described by the median and interquartile range (IQR). The data were calculated by using SPSS version 21.
Results

Demographics data

Of the 50 patients included, 41 were male and 7 were female. The mean age was 38.9 years old (SD 13.58). 22 patients were smoker. There was an essential hypertension patient. The 4 screws and 8 screws groups had comparable demographics as demonstrated in Table 1.

Table 1. The patients' characteristic data including demographics, preoperative data, perioperative data, and postoperative data

	4 screws (n = 23)	8 screws (n = 27)	p-value
Demographic characteristics			
Mean Age (year) (SD)	37(13.7)	42(13.6)	0.487
Male : Female+	22:1	21:6	0.107
Underlying disease*	1(4.3%)	0(%)	1.000
Smoking Habit*	11(47.8%)	11(40.7%)	0.615
Median time to operation(hr) (IQR)	9.30(6.5-14.3)	9(7-12)	0.329
Preoperative Data			
Opened Fracture*	12(52.2%)	11(40.7%)	0.419
Fracture configuration			0.777
AO42A*	1(4.3%)	5(18.5%)	
AO42B*	11(47.8%)	8(29.6%)	
AO42C*	11(47.8%)	14(51.9%)	
Perioperative Data			
Mean operating time (min), (IQR)	45(35-60)	60(40-75)	0.928
Blood loss (ml), (IQR)	20(20-50)	30(20-50)	0.0655
Postoperative Data			
Mean hospital stay(day), (IQR)	4(3-6)	4(3-6)	0.928
Mean hospital cost(baht), (IQR)	23,688 (19,780-30,217)	23,378 (20,201-30,278)	0.846
Postoperative complications*	1(4.5%)	2(7.4%)	0.645
Mean union time(day), (IQR)	92(89-99)	93(85-97)	0.464

* The values were presented as number of patients having that condition (percentage of this group).
+ The values were presented as ratio of sex of patients in this group.

Preoperative Data

In 50 patients, there were 23 open fracture. AO classification for fracture configuration in 4 screws group showed ratio of AO42A: AO42B: AO42C[16] equal to 1-11 -11 compared with 8 screws that represented 5 - 8 -14.

Perioperative Data

During operation, Median of blood loss which was recorded in 4 screws contrasted to with 8 screws was 20 (20-50) ml and 30 (20-50) ml consecutively. In addition, median operating time showed 45 (35-60) minutes to 60 (40-75) minutes in group of 4 screws and 8 screws in turn.

Postoperative Data

The hospital stay period in 4 screws and 8 screws fixation showed the same mean 4(3-6) days. There was a little difference of hospital cost 23,688 (19,780-30,217) and 23,378 (20,201-30,278) baht in 4 and 8 screws respectively. There were 3 complications after operation. Only one patient (2%) appeared delayed union of fracture at 200 days resolved with revision. 2 patients encountered with infected wound. One spontaneously resolved after intravenous antibiotic injection and local wound care. The other required subsequent surgical procedure for elimination of infection. Union time showed in consequential difference in 4 screws and 8 screws as 92(89-99) days and 93(85-97) days.

Discussion

The study supported the result of number of screw and position of screw on DCP fixation in tibial shaft fracture as in Hu study.[8] We demonstated the union time of both conventional group and study group related to stoutness of fixation.

According to Hu et al[8], this study provided biological fixation in human with biomechanic fixation theory. There was not only bone fixation as in Hu study but also soft tissue (eg.muscle, tendon, fat, skin) involved to effectiveness of fixation. The bone healing still depended on biological status of individual.[10] The result showed sufficient strength of fixation with narrow DCP at 4 screws in selected position. Compared with 8 screws, there was minor difference in union time. In addition, 4 screws represented advantage over 8 screws in blood loss (20 vs 30 ml) and operating time (45 vs 60 min).

There were several limitations to this study. The design of the study was retrospective and allocation was not randomized, leading to the potential for selection bias. In addition, there was no blinding in the follow-up process, leading to the potential for observer bias. Furthermor, size of the sample was quite small in each group. However, the data in this study had enabled to perform a power calculation. In the study, there were no osteoperotic status or nutritional status eg. DXA scan, Vitamin D level, calcium level, and serum albumin.

Fig.1 Anteroposterior (Left) and Lateral (Right) of radiographs undergone fixation with 4 screws on narrow DCP

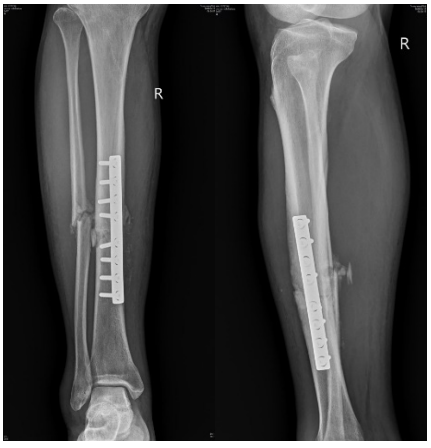

Fig.2 Anteroposterior (Left) and Lateral (Right) of radiographs undergone fixation with 8 screws on narrow DCP

Conclusion

Our study demonstrated that tibial shaft fracture undergone open reduction and internal fixation with 4 screws represented strong advantage over 8 screws which were less blood loss and operating time. Nonetheless, they showed the same union time.

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