

EARLY RESULTS OF OPEN REDUCTION AND INTERNAL FIXATION FOR CLAVICLE FRACTURES IN CAN THO UNIVERSITY OF MEDICINE AND PHARMACY HOSPITAL

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ABSTRACT

Background: Clavicle fracture is one of the most common injuries of the shoulder girdle. Malunion with angulation or shortening following fractures could cause significant functional deficits of the shoulder. Many kinds of treatment, such as conservative treatments (figure-of-eight bandage, arm sling) or surgeries (fixation with an intramedullary nail, a Kirschner wire, or plates and screws), are described to have their pros and cons for clavicle fractures. Recently, surgeons have preferred open reduction internal fixation because it helps restore the clavicle's anatomy and allows patients to rehabilitate sooner. **Objectives:** (1) To investigate the demographics, clinical characteristics, and radiographic images of patients having clavicle fractures; (2) To evaluate the early results of open reduction internal fixation in those patients. **Materials and method:** A cross-sectional study was conducted on patients having clavicle fractures and undergoing open reduction internal fixation in Can Tho University of Medicine and Pharmacy Hospital from December 2021 to November 2022. **Results:** A total of 70 patients were included in this study, with 53 (75.7%) male and 17 (24.3%) female. The average age was 37 ± 13.5 years old. Traffic accident (98.6%) was the most common reason, followed by falling on the ground. All patients had pain; 81.4% had bruises, 88.6% had clavicle discontinuation, and 71.4% had crepitus. Radiographic images showed transverse fractures, comminuted fractures, and oblique fractures accounting for 62.4%, 22.9%, and 14.3%, respectively, and only 1 case of segmental fracture. The average incision size was 7.00 ± 0.73 cm. There was no surgical wound infection afterward. VAS pain scores significantly improved by 5 points after surgery to 3.31 ± 1.0 ($p < 0.001$). The average in-hospital stay was 5.93 ± 1.88 days. Most patients (62, 88.5%) felt extremely satisfied after surgical treatment. **Conclusions:** Early outcomes of open reduction internal fixation for clavicle fractures show significant postoperative pain relief, anatomical reduction achievement, a short in-hospital stay, and patient satisfaction achievement. A long-term follow-up should be considered for further outcome evaluation.

Keywords: Open reduction internal fixation, ORIF, clavicle fracture.

I. INTRODUCTION

A clavicle fracture is one of the most common shoulder girdle injuries. Most fractures result from indirect trauma or falling onto an outstretched arm [1]. According to previous studies, 85% of the case causing clavicle fracture in Vietnam is from a traffic accident. This type of injury is more common in young people [2], especially in males, with a ratio of males/females of about 2.5/1.

The skin is located close to the clavicle, making it easy to diagnose a clavicle fracture. Currently, conservative treatment remains a popular option for treating clavicle

fractures. However, this approach only provides moderate stabilization and may result in malalignment and reduced function. On the other hand, certain types of clavicle fractures may benefit from surgical fixation, as it can effectively restore the anatomy and function of the shoulder girdle [2], [3], [4].

Many internal fixation methods include intramedullary nailing, plates, or stainless-steel wire fixation. However, intramedullary threaded Kirschner wire fixation has been shown to cause many complications affecting the outcome, particularly pin breakage, pin loosening, and pin migration to the mediastinum, which could dangerously puncture the esophagus and trachea. At the same time, plates and screws have been more frequently used due to their ability to realign the clavicle and steadily stabilize the fracture site, which helps better healing and early rehabilitation [2], [4], [5].

In Can Tho University of Medicine and Pharmacy Hospital, open reduction internal fixation using plates is the prevailing method in the surgical treatment for clavicle fractures. To have a perspective of the technique to improve our expertise in clavicle fracture fixation, we conducted this study with two aims: the first aim is to investigate the demographics, clinical characteristics, and radiographic images of clavicle fractures; the second aim is to evaluate the early outcome open reduction internal fixation using the plates those patients.

II. MATERIALS AND METHODS

2.1. Study subjects

Seventy patients had clavicle fractures and underwent open reduction internal fixation using plates and screws admitted to the Department of Orthopedics and Traumatology, Can Tho University of Medicine and Pharmacy Hospital from December 2021 to November 2022.

2.2. Methods

Study design: Cross-sectional study was conducted.

Study size

The study sample size was determined according to the following formula:

$$n = z_{1-\frac{\alpha}{2}}^2 \times \frac{p(1-p)}{d^2}$$

n: is the estimated sample size for the study.

$z_{1-\frac{\alpha}{2}}$: is the confidence coefficient.

α : is the design significance level (with $\alpha = 0.05$).

$p = 0.963$.

Based on a study conducted by Le Mong Tuyen (2019), p was the rate of successful treatment of clavicle fractures [6].

d: is the allowable error, with $d = 0.05$.

The estimated sample size was 55. In reality, 70 participants were included.

Research content

The study collected participants' demographics such as age, gender, trauma cause, and associated injuries. Clinical characteristics, including symptoms and signs of fractures, were collected, and radiographic images were assessed. Early postoperative results were evaluated by postoperative examination and recovery time (days), and the Visual Log Scale was used to compare pain relief before and after surgery.

Statistical analysis

The SPSS 26.0 program analyzed all data in line with accepted medical statistics methods.

Ethics approval

The Medical Ethics Committee of CTUMP on Medical Research permitted our research with No. 1524-QD/DHYDCT (Code: 21.T.KY.32).

III. RESULTS**3.1. Demographics of participants**

Seventy patients were included in this study. The average age was 37 ± 13.5 years old, in which the most common age group was between 30 to 50 years old (44.3%) and the least common was >50 (21.4%). The incidence of clavicle fractures is higher in men than in women, with the ratio of male/female being 3.11/1.

We found that the most frequent cause of fracture was traffic accidents (98.6%), only one patient got a clavicle fracture after falling on the ground, and no patient suffered from work or sports accidents. In addition, the right side (38 cases) was more injured than the left (32 cases).

Table 1. The demographics of the participants

Variables	N (%) or Mean \pm SD
<i>Age (years old)</i>	
Under 30	24 (34.3)
From 30 to 50	31 (44.3)
Over 50	15 (21.4)
Mean	37 ± 13.5
<i>Gender</i>	
Male	53 (75.7)
Female	17 (24.3)
<i>Etiology</i>	
Traffic accident	69 (98.6)
Work accident	-
Fall on the ground	1 (1.4)
Sports injuries	-
<i>Associated injuries</i>	
Head	5 (7.1)
Other bones	16 (22.9)
<i>Symptoms</i>	
Pain	70 (100)
Swelling	69 (98.6)
Inability to lift arm	57 (81.4)
Bruises	57 (81.4)
<i>Signs</i>	
Clavicle deformity	62 (88.6)
Abnormal movements	36 (51.4)
Crepitus	50 (71.4)

3.2. Preoperative characteristics

100% of patients had sharp pain, 98.6% had swellings, and 81.4% had bruises and inability to lift arm. 97.1% of patients had a sign of clavicle deformity. 21/70 of patients had associated injuries, with 23.8% having head injuries. Radiographic images showed that

transverse fracture morphology had the highest percentage (61.4%). VAS score for average pain intensity before surgery was 5.79 ± 0.832 . The majority of soft tissue conditions were average (75.7%). Cases with stabilization before surgery took up 94.3%.

Table 2. The preoperative clinical features of the participants

Variables	N (%) or Mean \pm SD
<i>Preoperative VAS</i>	
5	33 (47.1)
6	19 (27.1)
7	18 (25.7)
Mean VAS	5.79 ± 0.83
<i>Treatment before admission</i>	
Temporary immobilization	66 (84.3)
Non-temporary immobilization	4 (5.7)
<i>Soft tissue condition</i>	
Good	8 (11.4)
Moderate	53 (75.7)
Poor	9 (12.9)
<i>Fracture morphology (on X-rays)</i>	
Transverse	43 (61.4)
Oblique	10 (14.3)
Comminuted	16 (22.9)
Segmental	1 (1.4)

3.3. Postoperative results

The average surgical time was 82.09 ± 46.4 minutes, with 62.9% of cases lasting between 60 to 120 minutes. The patient's age and soft tissue condition before surgery did not affect the operation's time ($p=0.74$ and $p=0.62$, respectively). The average postoperative treatment time was 3.43 ± 1.43 days, and cases with treatments shorter than seven days accounted for 94.3%. The mean in-hospital stay was 5.93 ± 1.88 days, with most patients taking under seven days (72.9%).

Table 3. The postoperative outcomes of the participants

Variables	N (%) or Mean \pm SD
<i>The incision length (cm)</i>	
< 6	1 (1.4)
6-7	34 (48.6)
> 7	35 (50.0)
Mean	7.00 ± 0.73
<i>Reduction results</i>	
Physiological bone axis	60 (85.7)
Gap <1cm	9 (12.9)
Bending	1 (1.4)
<i>Post-operative treatment time (days)</i>	
< 7	66 (94.3)
7-14	4 (5.7)
Mean	3.43 ± 1.43
<i>In-hospital stay (days)</i>	

Variables	N (%) or Mean \pm SD
< 7	51 (72.9)
7-14	19 (27.1)
Mean	5.93 \pm 1.88
Patient satisfaction	
Satisfied	8 (11.4)
Very satisfied	50 (71.4)
Extremely satisfied	12 (17.1)

On average, the incision length was 7.00 ± 0.73 cm. As for the result of bone reduction, 85.7% had good bone realignment. Patients reported significant pain relief with a demonstration of VAS score decreasing to 3.31 ± 1.00 from 5.79 ± 0.83 before the operation ($p < 0.001$). There were no cases of infection recorded.

Table 4. Comparison between preoperative and postoperative VAS score

	Mean \pm SD	p-value (Wilcoxon Signed Rank test)
Preoperative VAS score	5.79 ± 0.83	$P < 0.001$
Postoperative VAS score	3.31 ± 1.00	

IV. DISCUSSION

4.1. Patients' general characteristics

The characteristics of patients (age, gender) in our study resembled previous studies, with an average age of 37 ± 13.5 years, compared to the study of Tiefenboeck T.M. [7], which is 37 ± 8.0 years. Additionally, clavicle fractures were more commonly suffered in men than women with an approximate ratio of 3:1. This similarity frequently came from traffic accidents. It was common in young, working-age patients who needed early rehabilitation to return to work. The study recognized similarities between the study of Prabhu Ethiaj. However, there were some differences with the study of Saragaglia D. and Caroline Kihlström regarding causes of trauma [4], [8], [9]. Specifically, we recorded traffic accidents accounted for 98.6%, almost similar to 98.4% of Prabhu Ethiaj recorded in India but different from Saragaglia D in France and Caroline Kihlström in Sweden with the rate of 85.5% due to sports accidents and 41.5% due to traffic accidents, respectively [4], [8], [9]. Those results could be explained due to the differences in population. Our study and Prabhu Ethiaj's were recorded in 2 developing countries with high traffic accident rates [9]. Meanwhile, the remaining two studies were recorded in developed countries with a high rate of sports accidents. Simultaneously, we also did not record the connection between the injured clavicle side with previous studies.

4.2. Clinical Characteristics and Radiograph images evaluation

Our study results recorded that the rate of lancinating pain was 100%, and the rate of swelling was 98.6%. This result is very similar to the study of Nguyen Hoang Thao Nguyen [10], with 100% of pain and swelling signs suffered by the patients, and this is also the main reason for hospital admission. Regarding definite symptoms, because the clavicle is located superficially to the skin, it can be easily observed and palpated to detect. However, the malformation will be difficult to observe if the shoulder area is swollen or the subcutaneous layer is thick. Therefore, palpation of bone discontinuity is most likely to be seen clinically. In our study, most patients had clavicle fractures after traffic accidents.

Simultaneously, we found that the combined injury rate was not high between studies, with 3.5% of patients having a follow-up rib fracture, according to Saragaglia D. [4]. Furthermore, our study found that the characteristics of fractures on X-rays differ from other studies by domestic authors [11].

4.3. Postoperative results

The results of bone realignment after surgery were good, accounting for 85.7%. There were 9 cases with small displacement patterns and only 1 with large displacement. This result was quite similar to that of the author Raju Vaishya with 32 cases of clavicle fractures with acceptable correction results on X-rays image [12]. This could be explained by the fact that the clavicle was located in a position that was easy to approach, expose and reduce. In addition, we also noted the similarity of the study on the VAS pain scale before and after surgery with the study of Anil K. Sahu and postoperative infection with the study of Saragaglia D. and Govindasamy [4], [13], [14]. Specifically, we recorded the highest VAS 3 score of 44% compared to 42.9% for Anil K.Sahu [14]. Regarding postoperative infection, our results were quite similar to Saragaglia D. and Govindasamy, with only one infectious case recorded in each of the mentioned studies [4], [13]. In our study, the mean in-hospital stay was 5.93 ± 1.88 days, which was similar to study of Le Mong Tuyen and Vo Van Danh with 6.4 ± 2.7 days and 5.09 ± 2.72 days, respectively. Thereby, it could be seen that simple clavicle fractures usually had a few days of hospital stay. Most of the reasons patients stayed longer in the hospital were primarily due to combined trauma [5], [6].

We also recorded 71.4% very satisfied patients and 11.4% satisfied patients, and this result was very similar to the study by Naveen, with 83.3% completely satisfied patients and 16.7% patients with satisfaction [15].

V. CONCLUSION

Open reduction internal fixation for clavicle fractures is a safe procedure and shows significant postoperative pain relief, good anatomical reduction achievement, short in-hospital stay, and patient satisfaction. A long-term follow-up should be considered for further outcome evaluation.

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