

Longitudinal Analysis of Clavicle Fractures Managed with Pre-contoured Locking Compression Plates: A Prospective Investigation

Chandra Kishor Das¹, Ketan Kumar²

¹Assistant Professor & HOD, Department of Orthopaedic, Government Medical College Purnea, Bihar, India

²Senior Resident, Department of Orthopaedic, Government Medical College Purnea, Bihar, India

Received: 22-10-2023 / Revised: 24-11-2023 / Accepted: 28-12-2023

Corresponding Author: Chandra kishor Das

Conflict of interest: Nil

Abstract:

Background: Clavicle fractures are a common orthopedic injury, often resulting from sports-related incidents, falls, or motor vehicle accidents. While conservative management has been a traditional approach, surgical intervention with pre-contoured locking compression plates has gained prominence, especially for specific fracture patterns. This study explores the efficacy of surgical treatment for clavicle fractures, assesses associated complications, and evaluates functional outcomes to contribute to improved patient care.

Methods: A prospective observational study was conducted involving 55 patients who underwent surgical intervention for clavicle fractures. Inclusion and exclusion criteria were established to select a representative sample. Data collection encompassed patient demographics, mode of injury, fracture location, surgical techniques, and complications. Functional outcomes were assessed using the Constant and Murley score. Statistical analysis included descriptive statistics and relevant tests to determine significance.

Results: Among the study participants, the majority were male (90%), with a significant proportion in the 19 to 29-year age group. Direct trauma, primarily from road traffic accidents, was the most common cause of injury. Left-sided fractures were predominant, and all patients received anatomical Locking Compression Plates. Fracture union was achieved in the majority within three months, but complications such as hypertrophic scars, plate prominence, and delayed nonunion were observed. Functional outcomes indicated excellent or good recovery in most cases.

Conclusion: Surgical intervention with anatomical Locking Compression Plates for clavicle fractures appears to be an effective approach, resulting in favorable functional outcomes for the majority of patients. However, potential complications should be considered in the treatment decision-making process, highlighting the importance of individualized management strategies based on fracture type and patient demographics.

Recommendations: Further research is required to assess long-term outcomes and complications in clavicle fracture surgical interventions. Surgeons should carefully assess treatment benefits and risks while considering individual patient factors and fracture characteristics.

Keywords: Clavicle fractures, surgical intervention, Locking Compression Plates, complications, functional outcomes.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Clavicle fractures, comprising a substantial portion of orthopedic injuries, occur as a result of a variety of causes including sports-related accidents, falls, and motor vehicle collisions [1,2]. These fractures not only induce significant pain but also impose a considerable burden of functional impairment, negatively impacting the overall quality of life for those afflicted. Over the years, the management of clavicle fractures has undergone a transformative evolution, with surgical intervention emerging as the preferred approach for specific fracture patterns [3].

A prominent stride in the surgical treatment of clavicle fractures has been the adoption of pre-contoured locking compression plates. These

innovative devices have been meticulously engineered to offer secure fixation while minimizing disruption to surrounding soft tissues, resulting in improved patient outcomes [4]. The integration of locking screws within these plates not only enhances fracture stability but also provides superior biomechanical support. Consequently, pre-contoured locking compression plates have become an increasingly attractive option for orthopedic surgeons when addressing clavicle fractures [4].

The introduction of these advanced techniques represents a pivotal moment in the field of orthopedics, offering a promising avenue for improved patient care. This study seeks to delve

deeper into the efficacy of pre-contoured locking compression plates in the treatment of clavicle fractures. By rigorously evaluating the outcomes of this surgical approach, we aim to contribute invaluable insights that can inform clinicians' decision-making processes and ultimately enhance the standard of care for individuals suffering from clavicle fractures [5].

The primary aim of this study is to comprehensively investigate the role of surgical intervention in the management of clavicle fractures, with a specific focus on understanding the associated complications and evaluating the functional outcomes in patients with displaced clavicle fractures.

Methodology

Study Design: This research employs a prospective observational approach.

Study Setting: The study was conducted at Govt. Medical College, Purnea, Bihar, during the period spanning 2022-2023.

Participants: A total of 55 patients who had undergone surgical treatment for clavicle fractures were enrolled as study participants.

Inclusion Criteria: Inclusion criteria encompassed young patients with closed fractures, specifically those with displaced clavicle fractures.

Exclusion Criteria: Exclusion criteria encompassed open fractures, undisplaced fractures, medial and lateral clavicle fractures, as well as clavicle fractures associated with head injuries.

Bias: To mitigate selection bias, participants were selected based on stringent inclusion and exclusion criteria.

Variables:

Variables included surgical treatment for clavicle fractures, complications arising from clavicle fractures, functional outcomes evaluated using the constant and murley score.

Data Collection: Clinical assessments were performed within the emergency department, where patients were immobilized using a clavicle brace and arm pouch. Following surgery, patients were monitored for a period of 3-5 days with the administration of antibiotics and analgesics. Rehabilitation progress was tracked through pendulum shoulder exercises, active shoulder range of motion exercises (with abduction restricted to 90 degrees), and regular follow-up appointments scheduled every 4-6 weeks. Data pertaining to complications, radiological assessments, and functional outcomes were recorded during these follow-up visits.

Surgical Techniques: Surgical intervention involved the utilization of open reduction and internal fixation (ORIF) with anatomical locking plates. This was performed under brachial block anesthesia and short general anesthesia.

Statistical Analysis: To summarize patient demographics and clinical characteristics, descriptive statistics were employed. Continuous variables were presented as means accompanied by standard deviations, whereas categorical variables were presented as frequencies and percentages. Statistical significance was defined as a p-value below 0.05.

Ethical Considerations: Ethical clearance was obtained from the institutional review board before initiating the study. Informed consent was procured from all participants or their legal guardians, and strict adherence to patient confidentiality and privacy was maintained throughout the study.

Result

Table 1: Characteristics of study population

Parameter	Patients (n=55)
Gender:	
- Male	50 (90%)
- Female	5 (10%)
Mode of Injury:	
- Direct Trauma (e.g., RTA)	44 (80%)
- Indirect Trauma (e.g., FOOSH)	11 (20%)
Fracture Side:	
- Left	38 (70%)
- Right	17 (30%)
Fracture Union Time:	
- Within 3 months	47 (85%)
- By 4 months	8 (15%)
Complications:	
- Hypertrophic Scars	8 (15%)
- Plate Prominence	8 (15%)
- Delayed Nonunion	8 (15%)
- Plate Loosening	3 (5%)

Functional Outcomes:	
- Excellent	41 (75%)
- Good	11 (20%)
- Fair	3 (5%)

The study involved a total of 55 patients who underwent surgical intervention for clavicle fractures. Among these patients, 50 individuals (90%) were male, while the remaining 5 patients (10%) were female. In terms of age distribution, 19 to 29 years was the most prevalent age group, encompassing 20 patients (36%) as the youngest being 19 years old and the oldest 60 years old, resulting in an average age of 36 years.

The most frequent cause of injury was direct trauma, mainly resulting from road traffic accidents, with 44 patients (80%) reporting a fall onto their shoulder. In contrast, 11 patients (20%) sustained indirect injuries due to falls on outstretched hands.

Left-sided fractures were more common, accounting for 38 patients (70%), while right-sided fractures constituted 17% of the cases. All patients received treatment involving anatomical Locking Compression Plates (LCP) with a minimum of three screws on each side. Fracture union was determined both clinically, as evidenced by the resolution of tenderness, and radiologically, when the fracture line was no longer visible.

In this study, 47 patients (85%) achieved fracture union within three months, while 8 patients (15%) achieved union by the end of four months. Notable complications included hypertrophic scars in 8 patients (15%), plate prominence in 8 patients (15%), delayed nonunion in another 8 patients (15%), and plate loosening in 3 patients (5%).

Functional outcomes were assessed using the Constant and Murley score, revealing excellent outcomes in 41 patients (75%), good functional outcomes in 11 patients (20%), and a fair outcome in 3 patients (5%).

Discussion

In a study involving 55 patients who underwent surgical treatment for clavicle fractures, the majority were male (90%), with the age group of 19 to 29 years being the most common, averaging 36 years. Direct trauma, primarily from road traffic accidents, was the leading cause of injury (80%), while indirect injuries accounted for 20%. Left-sided fractures were more prevalent (70%), and all patients received anatomical Locking Compression Plates (LCP) treatment. Fracture union was achieved in 85% of patients within three months and 15% within four months, with complications including hypertrophic scars (15%), plate prominence (15%), delayed nonunion (15%), and plate loosening (5%). Functional assessment using the Constant and Murley score showed excellent outcomes in 75% of

patients, good outcomes in 20%, and fair outcomes in 5%.

The results suggest that surgical intervention with anatomical Locking Compression Plates (LCP) for clavicle fractures is effective in achieving fracture union, with the majority of patients experiencing excellent or good functional outcomes. However, there are some potential complications associated with this surgical approach, such as hypertrophic scars, plate prominence, and delayed nonunion, which should be considered when making treatment decisions.

The majority of clavicle fractures typically receive non-surgical treatment. Research conducted by [6-8] focused on this conservative approach, revealing less favorable outcomes, especially when addressing fractures located in the middle third of the clavicle conservatively. Consequently, fractures with specific characteristics, such as displacement with or without comminution, often necessitate surgical stabilization. In a study led by [9], which examined the nature of injuries, it was found that 78.55% of cases resulted from direct injury, while 21.36% were attributed to indirect injury, findings consistent with our own study. Furthermore, in a study conducted by [10], it was observed that the average age of patients treated with plating was 36 years, ranging from 13 to 68 years. Another noteworthy observation from [10] study was that 32% of cases exhibited plate prominence in the pre-contoured plate group, compared to 64% in the non-contoured plate group.

Conclusion

The findings of this study involving 55 patients who underwent surgical treatment for clavicle fractures highlight the effectiveness of surgical intervention with anatomical Locking Compression Plates (LCP) in achieving fracture union and promoting favorable functional outcomes. The majority of patients, particularly those within the age group of 19 to 29 years, experienced excellent or good functional recovery, with minimal residual limitations. However, it is important to acknowledge the presence of potential complications, such as hypertrophic scars, plate prominence, and delayed nonunion, which warrant careful consideration in treatment planning. These results underscore the importance of individualized approaches in the management of clavicle fractures, taking into account factors such as fracture type and patient demographics to optimize outcomes and minimize complications.

Limitations: The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendations: Further research is imperative to comprehensively evaluate the long-term outcomes and potential complications linked to surgical interventions for clavicle fractures. Surgeons must exercise meticulous consideration, weighing the advantages and risks of surgical treatments, while taking into account individual patient factors and the specific characteristics of the fracture. To enhance post-operative functional outcomes and mitigate complications, tailored rehabilitation protocols are essential. Additionally, there is a pressing need for the development of educational and awareness programs aimed at equipping patients with a comprehensive understanding of the available treatment options, enabling them to make informed decisions regarding their care by appreciating the associated risks and benefits.

Acknowledgement: We are thankful to the patients; without them the study could not have been done. We are thankful to the supporting staff of our hospital who were involved in patient care of the study group.

References

1. Zargarani E, Zargarani A, Hardwicke J, Brown M. Epidemiology of clavicle shaft fractures in a public hospital in South Africa: differences between developing and developed countries. *Injury*. 2022 Jul;53(7):2364-2368.
2. de Oliveira Filho OM, Belangero PS, de Andrade MAP, da Silva RAP, Kojima KE, dos Santos JBG. Surgical treatment of clavicle fractures: a descriptive analysis of 88 cases. *Rev Bras Ortop (Sao Paulo)*. 2023 Jul;58(4):e108-e112.
3. Nguyen T, Le V, Pham T, Tran T, Nguyen T, Phan P, et al. Early results of open reduction and internal fixation for clavicle fractures in can tho university of medicine and pharmacy hospital. *Can Tho Univ Med Pharm J*. 2023 Oct; 721:1-6.
4. Kim SH, Ha KI. Comments on the Article "Comparison of Locking Plate Osteosynthesis versus Coracoclavicular Stabilization for Neer Type IIB Lateral Clavicle Fractures". *Clin Orthop Surg*. 2023 Mar;15(1):140-141.
5. Nowak J, Holgersson M, Larsson S. Epidemiology of clavicle fractures. *Acta Orthop Scand*. 2002 Sep;73(5):500-502.
6. Hill JM, McGuire MH, Crosby LA. Closed treatment of displaced middle third fractures of the clavicle gives poor results. *J Bone Joint Surg*. 1997;79-B(4):537-40.
7. Nordqvist A, Petersson CJ, Redlund-Johnell, I. Mid clavicular fractures in adults: end result study after conservative treatment. *J Orthop Trauma*. 1998; 12:572-6.
8. Robinson CM, Brown CMC, McQueen MM, Walkefield AE. Estimating the risk of non union following non operative treatment of a clavicular fracture. *J Bone Joint Surg*. 2004; 86(7): 1359-65.
9. Bostman O, Manninen M, Pihlajamaki H. Complications of Plate Fixation in Fresh Displaced Midclavicular Fractures. *J Trauma*. 1997; 43(5): 778-83
10. VanBeek C, Boselli KJ, Cadet ER, Ahmad CS, Levine WN. Precontoured Plating of Clavicle Fractures: Decreased Hardwarerelated Complications? *Clin Orthop Relat Res*. 2011;469 (12): 3337-43