Original Article

The Frequency of Unsatisfied Patients Treated Conservatively for Midshaft Clavicle Fractures

Faheem Sultan Ghori[1*], Khalid Ahmed[1], Kashif Mehmood Khan[1]

ABSTRACT

OBJECTIVE: To determine the number of unsatisfied patients treated with non-surgical correction of mid -shaft Clavicular fractures.

METHODOLOGY: This prospective cross-sectional study was conducted at the Department of Orthopaedic Surgery, Jinnah Postgraduate Medical Centre, Karachi, from April to October 2021. The study enrolled individuals between the ages of 15 and 65 years who had been diagnosed with mid-clavicular fractures and received conservative treatment for three months. Following fracture reduction, patients were fitted with a figure-of-eight bandage or clavicular brace, and their limb was supported using a triangular sling or arm pouch positioned under the elbow and forearm. This treatment regimen was maintained for six weeks. Local examinations of the affected clavicle, including tenderness, instability, deformity, and shoulder movement assessments, were conducted and recorded according to the Disabilities of the Arm, Shoulder, and Hand (DASH) score.

RESULTS: The study included 87 patients with a mean age of 38.20±7.82 years. Among them, 63(72.41%) male, and 24(27.59%) were female. Additionally, 24(27.59%) patients hypertension, and 35(40.23%) had diabetes mellitus. The study outcomes revealed that 15(17.24%) patients achieved excellent results, 55 (63.22%) good outcomes, 12(13.79%) had fair outcomes, and only 5(5.75%) experienced poor outcomes. Notably, 16(18.39%) patients expressed dissatisfaction with the conservative treatment, while 71(81.61%) patients reported being satisfied with the treatment's overall outcome.

CONCLUSION: Conservative management of mid-clavicular fractures is associated with a low rate of patient dissatisfaction. It yields favorable outcomes and a high level of patient satisfaction.

KEYWORDS: Mid-clavicular fractures, conservative management, DASH Score.

INTRODUCTION

The clavicle is a distinctive S-shaped bone that serves as a vital structural linkage between the sternum and the glenohumeral joint, playing a pivotal role in supporting the shoulder girdle. It is suspended by the coracoclavicular ligament, effectively carrying the weight of the shoulder. The annual incidence of mid-clavicular fractures is 64 per 100,000 people in the general population. These fractures primarily manifest as shaft fractures, accounting for 70% to 80% of all clavicular fractures, with lateral fractures contributing 15% to 30% and medial fractures relatively rare, constituting only 3%. Open clavicular fractures are rare, occurring in just 0.1% to 1% of cases.[1,14]

Displaced and shortened fractures in the middle third of the clavicle are frequently encountered in young, athletic individuals, often resulting from high-energy incidents such as road traffic accidents or sports-related injuries. Historically, displaced mid-shaft clavicle fractures have been managed non-operatively, with an expectation of some residual deformity and potential functional impairment[2], despite successful fracture reduction. However, previous studies often relied on surgeon or radiograph-based outcome assessments, which may not adequately capture subtle functional deficits.[3]

Emerging evidence suggests that patients may experience considerable dissatisfaction following clavicular malunion, with symptoms including weakness and easy fatigability, particularly during overhead activities[4.] These symptoms are associated with residual strength deficits that can be assessed using patient-oriented questionnaires, such as the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire and objective muscle-strength testing[5,6].

A study conducted between 1989 and 1990 examined the age- and gender-specific incidence and characteristics of clavicular fractures among individuals aged 15 and above within a population of approximately 200,000. The study identified 187 clavicular fractures in 185 patients, resulting in an annual incidence of 50 per 100,000 (71 per 100,000 for males and 30 per 100,000 for females). Male patients were significantly younger and exhibited a higher prevalence of comminuted fractures, which typically had poorer outcomes. The incidence of fractures decreased with age, primarily in males. Bicycle accidents were the leading cause of clavicular fractures in both genders, although sports activities were more common among men. Both right and left clavicles were similarly affected, with direct falls on the

[1]*Jinnah Postgraduate Medical Centre, Karachi, Sindh-Pakistan.*

***Correspondence**: phaheemghori@gmail.com*

doi: 10.22442/jlumhs.2023.00000

shoulder being the most common injury mechanism. Anatomically, about three-quarters of fractures occurred in the middle part of the clavicle. At the same time, one-quarter involved the acromial part, and ninety-five percent of fractures healed without complications, resulting in excellent outcomes. At the same time, 5% developed non-union, evenly distributed between the middle and acromial parts of the clavicle. Undisplaced fractures of both the diaphysis and the lateral end of the clavicle have a high union rate and exhibit good functional outcomes after non-operative treatment.

In contrast, non-operative treatment of displaced shaft fractures may be associated with a higher risk of non-union and functional deficits than previously reported, with difficulty in predicting which patients are susceptible to these complications. Given that satisfactory functional outcomes can be achieved after operative treatment of clavicular non-union or malunion, there is ongoing debate regarding the merits of primary operative intervention for these injuries. Displaced lateral end fractures present a greater risk of non-union after non-operative treatment than shaft fractures. However, predicting non-union remains challenging and may be asymptomatic in elderly individuals. Operative treatment outcomes are more variable for lateral end fractures than shaft fractures. Various strategies have been proposed for reducing closed clavicular shaft fractures; however, none have consistently demonstrated effectiveness in achieving and maintaining reduction[7]. Consequently, displaced mid-shaft clavicle fractures often heal in a position similar to that seen in initial radiographs, typically characterized by inferior, medial translation, and anterior rotation deformities of the lateral fragment. While previous assessments suggested minor functional losses, more recent studies employing patient-oriented outcome measures, such as the patient-oriented, limb-specific Disabilities of the Arm, Shoulder, and Hand (DASH) score, have indicated the presence of residual impairment[8,9]. For example, one study reported an average DASH score of 32 points among 105 polytrauma patients with clavicular fractures, where a higher score signifies greater disability[10].

Furthermore, Hill JM 1997 [5] utilized a patient-oriented outcome questionnaire. They documented a 31% rate of unsatisfactory outcomes in a cohort of 52 adult patients who underwent non-operative treatment for displaced midshaft clavicular fractures. Several recent publications have highlighted the symptoms associated with clavicular malunion, including substantial skeletal deformities, particularly shortening of 2 cm or more[7-11]. Commonly reported symptoms include subjective weakness; however, these studies had limitations in objective muscle-strength testing. Oroko PK 1999[10] employed a spring balance with the arm at 90° of abduction, recording strength up to 25 lb (11.3 kg). Nordqvist A 1997[10] used the "Nicholas manual muscle tester" in a similar setting. Neither method appears to offer the requisite objective reproducibility or sensitivity required to detect subtle changes in strength, especially endurance strength.

This study aims to evaluate a series of patients using patient-oriented muscle-strength testing, range of motion assessments, and patient satisfaction following the healing of midshaft clavicle fractures treated non-operatively. This investigation is motivated by a lack of recent data on patient satisfaction and aims to provide insights into whether operative treatment should be considered from the outset.

METHODOLOGY

This prospective cross-sectional study was conducted at the Department of Orthopaedic Surgery at Jinnah Postgraduate Medical Centre, Karachi, and Jinnah Sindh Medical University from April to October 2021. Patient selection was performed using a Non-Probability Consecutive Sampling technique. A satisfactory outcome rate of 17.5% was considered to calculate the required sample size, with a confidence level of 92% and an absolute precision of 8%. This calculation resulted in a sample size of 87 patients with clavicle fractures, with a margin of error of 8%.

Patients of both genders aged 15-65 years who received conservative treatment for three months, Closed mid-shaft Clavicle fractures classified as Allman Classification Group I**,** Clavicle fractures classified as Neer Classification type 1 and type 2, Clavicle fractures classified as AO Classification 15.2, including types A1, A2, A3, B1, B2, and B3 were included.

Patients with open fractures of the clavicle**,** Polytraumatic with multiple fractures or injuries to vital organs, old clavicular fractures, younger than 15 years or older than 65 years of age were excluded.

Patients were provided with comprehensive explanations and counseling regarding the purpose, risks, benefits, and potential complications associated with non-surgical treatment of clavicle fractures. They were assured that all information collected would remain confidential. Following fracture reduction, a figure-of-eight bandage or clavicular brace was applied, and the limb was supported by a triangular sling or arm pouch placed under the elbow and forearm. This treatment regimen was maintained for six weeks. Patients were informed that some deformity of the shoulder girdle might occur, but overall shoulder function would typically remain normal. Shoulder joint movements, such as pendulum range of motion exercises, would commence afterwards. Heavy tasks and contact sports were prohibited for three months following the injury. Heavy laborers were allowed to return to light-duty lifting six weeks after the injury, with a total return to regular duty in 12 weeks. All patients underwent follow-up examinations at 6 and 12 weeks. Local examinations of the affected clavicle were conducted to assess tenderness, instability, deformity, and shoulder

movements.

1. X-rays were taken at each follow-up visit to monitor progressive fracture union.
2. Rehabilitation of the affected extremity was tailored based on the stage of fracture union and the time elapsed since the injury.
3. Patients were followed up for a total of 3 months.
4. The functional outcome was assessed using the Disabilities of the Arm, Shoulder, and Hand (DASH) score.
5. Demographic data and acceptable outcomes were recorded in the provided Performa.

SPSS version 23.0 was utilized for data analysis. Mean and standard deviation (SD) were calculated for age and DASH scores. Gender, diabetes mellitus, hypertension, and satisfactory outcomes were expressed as frequencies and percentages. Effect modifiers such as age, gender, diabetes mellitus, and hypertension were addressed through stratification. Post-stratification chi-square tests were applied, with a significance level of $p \leq 0.05$.

RESULTS

The mean age of the patients included in this study was 38.20±7.82 years, with a minimum age of 20 and a maximum age of 65 **(Table I)**. The study comprised a higher proportion of male patients, with 63 (72.41%) males and 24 (27.59%) females. Among the patients, 35 (40.23%) were diagnosed with diabetes mellitus, while 52 (59.77%) did not have diabetes mellitus. Additionally, 24 (27.59%) of the 87 patients had hypertension.

Regarding the frequency of outcomes, 15 (17.24%) patients achieved an excellent outcome, 55 (63.22%) had a good outcome, 12 (13.79%) had a fair outcome, and only 5 (5.75%) had a poor outcome. Among the patients, 16 (18.39%) were unsatisfied with the treatment outcome, while 71 (81.61%) expressed satisfaction.

Stratification by age was conducted, revealing that among patients aged 20-35 years, 5 (16.10%) were dissatisfied, while among patients aged 36-50 years, 11 (19.60%) were dissatisfied. However, this difference was not statistically significant, with a p-value of 0.685 (**Table II**). Stratification by gender showed that 12 male patients were dissatisfied, while four female patients expressed dissatisfaction, but this difference was not statistically significant, with a p-value of 0.798 (**Table III**). Stratification by diabetes mellitus status indicated that five patients with diabetes mellitus were dissatisfied, compared to 11 patients without diabetes mellitus who were dissatisfied. However, this difference was not statistically significant, with a p-value of 0.417 (**Table IV**). Stratification by hypertension status showed that two patients diagnosed with hypertension were dissatisfied, while 14 patients without hypertension were not satisfied. Once again, this difference was not statistically significant, with a p-value of 0.135 (**Table V**).

Table I: Descriptive Statistics of Age

Table II: Stratification of Age to Determine the Association of Age with Satisfaction

Age (Years)	
Mean	38.20
SD	7.82
Minimum	20
Maximum	50

Satisfaction	Age Group (Years)		P-value
	20-35	36-50	
Yes	26 (83.90%)	45 (80.40%)	0.685
No	5 (16.10%)	11 (19.60%)	

Table III: Stratification of Gender to Determine the Association of Gender with Satisfaction

Satisfaction	Gender		P-value
	Males	Females	
Yes	51	20	0.798
No	12	4	

Table IV: Stratification of Diabetes Mellitus to Determine the Association of Diabetes Mellitus with Satisfaction

Satisfaction	Diabetes Mellitus		P-value
	Yes	No	
Yes	30	41	0.417
No	5	11	

Table V: Stratification of Hypertension to Determine the Association of Hypertension with Satisfaction

Satisfaction	Hypertension		P-value
	Yes	No	
Yes	22	49	0.135
No	2	14	

DISCUSSION

Historically, non-operative management has been the standard approach for clavicle fractures. However, recent studies have challenged this strategy, particularly in cases of middle third clavicle fractures (Group I Allman Classification) and those resulting in clavicular shortening of 2 cm or more, suggesting that non-operative management may lead to unsatisfactory outcomes as measured by the DASH score[14,19,21].

Clavicular shortening has also been linked to higher rates of malunion or non-union, which further contribute to the earlier symptoms and functional deficits[19]. Therefore, consideration of operative intervention in such cases becomes necessary.

Several studies have demonstrated fewer malunion and non-union following operative repair of mid-shaft clavicular fractures, accompanied by improved DASH scores compared to non-operative management[21,22]. These findings support the idea that non-operative treatment of shortened midclavicle fractures may result in suboptimal functional outcomes when compared to other fracture locations or fractures with less shortening. Interestingly, clavicular lengthening did not appear to have a detrimental effect on patient functional outcome as measured by the DASH score, suggesting that the changes in anatomic relationships associated with shortening may contribute to limited shoulder function[23].

The DASH questionnaire, a validated tool for assessing functional outcomes following upper extremity injuries, was employed in our study. However, it is essential to acknowledge that some patients in our study may have suffered multiple traumatic injuries beyond clavicle fractures, and the impact of these additional injuries on survey responses is unknown. Dowrick AS 2006[26] have reported that lower extremity injuries can also influence the DASH score, indicating that specific questions in the survey may not exclusively pertain to upper extremity disabilities. To address this issue, Khan WS et al. [27] developed a modified DASH questionnaire specifically tailored to assess upper extremity disability in multi-trauma patients, but further validation studies are needed.

There remains no consensus in the literature regarding the optimal treatment approach for clavicle fractures, and the decision to employ conservative or surgical treatment remains a subject of debate[28]. Factors such as the severity of the dislocation, comminuted fractures, high-energy trauma, involvement of the dominant limb, age, athletic demands, and patient preference all play a role in determining the appropriate treatment approach, as described by Hillen RJ 2010[29].

In our study, the satisfaction rate after conservative management of mid-clavicular fractures was 18.39%. This finding aligns with previous research, where patient dissatisfaction rates have varied after conservative treatment. De Giorgi S et al.[30] reported a dissatisfaction rate of 28.2%, while Postacchini R 2015[31] found a dissatisfaction rate of 20% after conservative management. Subramanyam KN et al.[32] suggested that non-operative management should be the first-line approach for displaced midshaft clavicular fractures in skeletally mature patients, provided that the intent is to achieve a "good" outcome or better as per the Constant Score.

Other studies have investigated operative intervention for clavicle fractures. Moverley R 2020[33] found that open reduction and internal fixation with a plate reduced the incidence of malunion and non-union. However, surgical treatment did not significantly differ from conservative treatment regarding functional outcomes. Rofiq HDK 2022[34] suggested that operative treatment may be superior to non-operative treatment. Hegazy A 2019[35] recommended non-operative treatment with a broad arm sling for solitary closed uncomplicated mid-shaft clavicular fractures but advocated for operative treatment in cases of associated scapular neck fractures.

A meta-analysis by Qin M et al.[36] suggested that open reduction and plate fixation had slightly better efficacy than non-surgical treatment, particularly in reducing non-union, malunion, and cosmetic issues. However, non-surgical treatment showed a lower complication rate, with no significant difference in DASH scores between the two treatment groups. Dahal S et al.[37] found that operative treatment led to earlier fracture union, restoration of shoulder function, and quicker return to work but had the disadvantages of higher cost and infection risk compared to conservative treatment. Dalal J 2021[38] concluded that non-operative treatment resulted in a higher rate of malunion and non-union but yielded similar functional outcomes and union times compared to operative management. Thus, treatment decisions should be individualized based on patient needs and functional demands.

In summary, the choice between conservative and surgical management of clavicle fractures should be guided by multiple factors, including fracture type, patient age, activity level, and individual patient preferences. Our study adds to the existing body of evidence by highlighting the impact of clavicular shortening on functional outcomes, emphasizing the need for personalized treatment approaches to achieve the best possible results for each patient.

CONCLUSION

Conservative management of mid-clavicular fractures has good outcomes and is associated with a higher patient satisfaction rate. In the present study, only 13.79% of patients were not satisfied by the results of conservative management of mid-clavicular fractures.

Ethical permission: Jinnah Post Graduate Medical Centre, Karachi, ERC letter No. F.2-81/2020-GENL/43017/JPMC.

Conflict of interest: There is no conflict of interest

Funding: No funding disclosure

Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publically.

AUTHOR CONTRIBUTION

Ghori FS: Data collection, interpretation, analysis, article writing
Ahmed K: Data collection
Khan KM: Supervision in data analysis, interpretation, and article writing

REFERENCES

1. Neer CS. Fractures of the clavicle. In: Rockwood CA Jr, Green DP, editors. Fractures in adults. 2nd ed. Philadelphia: JB Lippincott; 1984. p. 707-713.
2. Crenshaw AH. Fractures of the shoulder girdle, arm, and forearm. In: Crenshaw AH, editor. Campbell's operative orthopaedics. 8th ed. St. Louis: Mosby Year Book; 1992. p. 989-1053.
3. Eskola A, Vainionpaa S, Myllynen P, Patiala H, Rokkanen P. Outcome of clavicular fracture in 89 patients. Arch Orthop Trauma Surg(1978). 1986; 105(6): 337-8. doi: 10.1007/BF00449938.
4. Nordqvist A, Petersson CJ, Redlund-Johnell I. Mid -clavicle fractures in adults: end result study after conservative treatment. J Orthop Trauma. 1998; 12(8): 572-6. doi: 10.1097/00005131-199811000-00008.
5. Hill JM, McGuire MH, Crosby LA. Closed treatment of displaced middle-third fractures of the clavicle gives poor results. J Bone Joint Surg Br. 1997; 79(4): 537-9. doi: 10.1302/0301-620x.79b4.7529.
6. SooHoo NF, McDonald AP, Seiler JG, McGillivary GR. Evaluation of the construct validity of the DASH questionnaire by correlation to the SF-36. J Hand Surg Am. 2002; 27(3): 537-41. doi: 10.1053/jhsu.2002.32964.
7. Chan KY, Jupiter JB, Leffert RD, Marti R. Clavicle malunion. J Shoulder Elbow Surg. 1999; 8: 287-90. doi: 10.1016/s1058-2746(99)90146-5.
8. Chen DJ, Chuang DC, Wei FU. Unusual thoracic outlet syndrome secondary to fractured clavicle. J Trauma. 2002; 52(2): 393-9. doi: 10.1097/00005373-200202000-00033.
9. Oroko PK, Buchan M, Winkler A, Kelly IG. Does shortening matter after clavicular fractures? Bull Hosp Jt Dis. 1999; 58(1): 6-8.
10. Nordqvist A, Redlund-Johnell I, von Scheele A, Petersson CJ. Shortening of the clavicle after fracture. Incidence and clinical significance, a 5-year follow-up of 85 patients. Acta Orthop Scand. 1997; 68(4): 349-51. doi: 10.3109/17453679708996175.
11. Solway S, Beaton DE, McConnell S, Bombardier C. The DASH Outcome Measure User's Manual. 2nd Toronto, Ontario: Institute for Work & Health. 2002; p. 5.
12. Gummesson C, Ward MM, Atroshi I. The shortened disabilities of the arm, shoulder and hand questionnaire (Quick DASH): validity and reliability based on responses within the full-length DASH. BMC Musculoskelt Dis. 2006; 7(1): 44. doi: 10.1186/1471-2474-7-44.
13. Bucholz R, Heckman JD, Court Brown C. Rockwood green's fractures in adults, 8th ed. Rockwood and Green. 2014; 1: 1427-1474.
14. McKee MD, Pedersen EM, Jones C, Stephen DJ, Kreder HJ, Schemitsch EH et al. Deficits following non-operative treatment of displaced midshaft clavicular fractures. J Bone Joint Surg Am. 2006; 88(1): 35-40. doi: 10.2106/JBJS.D.02795.
15. Kaplan NM. Kaplan's Clinical Hypertension, 9th ed. Lippincott Williams & Wilkins. 2006.
16. Nordqvist A, Petersson C. The incidence of fractures of the clavicle. Clin Orthop Relat Res. 1994; (300): 127-32.
17. Toogood P, Horst P, Samagh S, Feeley BT. Clavicle fractures: A review of the literature and update on treatment. Phys Sportsmed 2011; 39 (3): 142-50. doi: 10.3810/psm.2011.09.1930.
18. Neer CS II. Nonunion of the clavicle. JAMA. 1960; 172(9): 1006-11. doi: 10.1001/jama.1960.03020100014003.
19. Burnham JM, Kim DC, Kamineni S. Midshaft clavicle fractures: a critical review. Orthopedics. 2016; 39(5): e814-21. doi: 10.3928/01477447-20160517-06. Epub 2016 May 25.
20. Robinson CM, court-Brown CM, McQueen MM, Wakefield AE. Estimating the risk of non-union following non-operative treatment of a clavicular fracture. J Bone Joint Surg Am. 2004; 86(7): 1359-65. doi: 10.2106/00004623-200407000-00002.
21. Altamimi SA, McKee MD, Canadian Orthopaedic Trauma Society. Non-operative treatment compared with plate fixation of displaced midshaft clavicular fractures: Surgical Techique. J Bone Joint Surg. 2008; 90(Suppl 2(1)): 1-8. doi: 10.2106/JBJS.G.01336.
22. Smekal V, Irenberger A, Struve P, Wambacher M, Krappinger D, Kralinger FS. Elastic stable intramedullary nailing versus non-operative treatment of displaced midshaft clavicular fractures - a randomized, controlled, clinical trial. J Orthop Trauma. 2009; 23(2): 106-12. doi: 10.1097/BOT.0b013e318190cf88.
23. Ledger M, Leeks N, Ackland T, Wang A. Short malunions of the clavicle: an anatomic and functional study. J Bone Joint Surg. 2005; 14(4): 349-54. doi: 10.1016/j.jse.2004.09.011.
24. Beaton DE, Katz JN, Fossel AH, Wright JG, Tarasuk V, Bombardier C. Measuring the whole or the parts?: Validity, reliability, and responsiveness of the disabilities of the arm, shoulder and hand outcome measure in different regions of the upper extremity. J Hand Ther. 2012; 14(2): 128-42.
25. Dixon D, Johnston M, McQueen M, Court-Brown C. The Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH) can measure the impairment, activity limitations and participation restriction constructs from the International Classification of Functioning, Disability and Health (ICF). BMC Musculoskelet Disord. 2008; 9: 114. doi: 10.1186/1471-2474-9-114.
26. Dowrick AS, Gabbe BJ, Williamson OD, Cameron PA. Does the disabilities of the arm, shoulder and hand (DASH) scoring system only measure disability due to injuries to the upper limb?. J Bone Joint Surg Br. 2006; 88(4): 524-7.

doi: 10.1302/0301-620X.88B4.17223.
27. Khan WS, Jain R, Dillon B, Clarke L, Fehily M, Ravenscroft M. The 'M2 DASH' - Manchester-modified disabilities of arm shoulder and hand score. Hand. 2008; 3(3): 240-4. doi: 10.1007/s11552-008-9090-6.
28. Faldini C, Nanni M, Leonetti D, Acri F, Galante C, Luciani D et al. Non-operative treatment of closed displaced midshaft clavicle fractures. J Orthopaed Traumatol. 2010; 11(4): 229-23. doi: 10.1007/s10195-010-0113-z.
29. Hillen RJ, Burger BJ, Pöll RG, de Gast A, Robinson CM. Malunion after midshaft clavicle fractures in adults. Acta Orthop. 2010; 81(3): 273-9. doi: 10.3109/17453674.2010.480939.
30. De Giorgi S, Notarnicola A, Tafuri S, Solarino G, Moretti L, Moretti B. Conservative treatment of fractures of the clavicle. BMC Res Notes. 2011; 4: 333. doi: 10.1186/1756-0500-4-333.
31. Postacchini R, Gumina S, Farsetti P, Postacchini F. Long-term results of conservative management of midshaft clavicle fracture. Int Orthop. 2015; 34 (5): 731-6. doi: 10.1007/s00264-009-0850-x. Epub 2009 Aug 10.
32. Subramanyam KN, Mundargi AV, Gopakumar KU, Bharath T, Prabhu MV, Khanchandani P. Displaced midshaft clavicle fractures in adults – is non-operative management enough? Injury. 2021 Mar; 52(3): 493-500. doi: 10.1016/j.injury.2020.10.019. Epub 2020 Oct 5.
33. Moverley R, Little N, Gulihar A, Singh B. Current concepts in the management of clavicle fractures. J Clin Orthop Trauma. 2020; 11(Suppl): S25-S30. doi: 10.1016/j.jcot.2019.07.016.
34. Rofiq HDK, Ramawan E. Comparison of subjective and functional results on the operative and non-operative application of clavicle fractures. Qanun Medika-Medical J Faculty Med Muhammadiyah Surabaya. 2022; 6(1): 24-31.
35. Hegazy A, Al-Olemy A, Romeih M, Quolqela M. Non-operative Treatment Compared with Plate Fixation of Displaced Midshaft Clavicular Fractures in Adults. Med J Cairo Univ. 2019; 87 (3): 1741-1751.
36. Qin M, Zhao S, Guo W, Tang L, Li H, Wang X et al. Open reduction and plate fixation compared with non-surgical treatment for displaced midshaft clavicle fracture: A meta-analysis of randomized clinical trials. Medicine(Baltimore). 2019; 98(20): e15638. doi: 10.1097/MD.000000 0000015638.
37. Dahal S, Shreshtha S, Bandari P, Bajracharya S, Bajracharya A, Maharjan B. Conservative Versus Operative Management of Mid-Clavicular Fractures: A prospective, observational study. J Chitwan Med Coll. 2021; 11(4): 83-87. doi: 10.54530/jcmc.555
38. Dalal J, Dudani B, Jadhav S, Shah N, Pujara R. A prospective comparative study of functional outcome in patients treated non-operatively and surgically (by plate osteosynthesis) for mid-shaft clavicle fractures in adults. Int J Orthop. 2021; 7 (2): 616-625. doi: 10.22271/ortho.2021.v7.i2h.2685.