

Original Research Article

A PROSPECTIVE STUDY OF TITANIUM ELASTIC NAILING FOR THE OSTEOSYNTHESIS OF MIDDLE THIRD CLAVICLE FRACTURE

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ABSTRACT

The majority of mid clavicular fractures are treated conservatively. Fractures that require internal fixation are treated by plate osteosynthesis as the standard procedure. Elastic stable intramedullary nailing is an increasingly popular alternative for the internal fixation of displaced midclavicular fractures mainly because of its anatomic reduction and early mobilization. In a three-year period, 20 adults with fractures of the mid clavicle were treated by elastic intramedullary nailing. Fracture healing, clinical outcome and complications were assessed. Mean follow-up time was one year. All fractures healed clinically and radiologically. Non-union or infections were not observed. Functional results according to the Constant Murley score were fair. Complications consisted of skin irritation in one case. Elastic stable intramedullary nailing of displaced mid-clavicular fractures is a minimally invasive technique with fair functional results and early pain relief.

Keywords: Clavicle fracture; anatomic reduction; elastic nailing; intramedullary fixation.

INTRODUCTION

Clavicular fracture is one of the most common bony injuries and account for 2.6% to 4% of adult fractures, 35% of injuries to the shoulder girdle. Clavicle is S-shaped bone that acts as strut between sternum and glenohumeral joint. It has suspensory function to the shoulder girdle. The shoulder hangs from the clavicle by the coracoclavicular ligament.^[1] A weak spot in the clavicle is present at midclavicular region, which accounts for most fractures occurring in this region. Numerous muscular and ligamentous forces act on the clavicle, and knowledge of these differing forces is necessary to understand the nature of displacement of clavicle fractures and why certain fracture patterns tend to cause problems if not reduced and surgically stabilized. The annual incidence of midclavicular fracture is 64 per 100 000 population. Mid clavicular fractures forms 70% to 80% of all clavicular fractures. Open clavicular fracture is an absolute rarity, found in only 0.1% to 1% of cases. The rate of midclavicular fractures is more than twice as high in men as in women. The peak incidence occurs in the third decade of life,^[2]

The incidence of non-union of midclavicular fractures is usually quoted as being from 0.1 to 0.8%, and the mainstay of treatment has long been nonoperative. These data are based on studies in which clavicle fractures were not adequately classified regarding patient age and fracture displacement. More recent data, based on detailed classification of fractures, suggest that the incidence of non-union in displaced comminuted midshaft clavicular fractures in adults is between 10 and 15%.^[3] Surgical treatment of acute midshaft fractures was not favoured due to complications. However, the prevalence of non-union or mal-union in dislocated midshaft clavicular fractures after conservative treatment is higher than previously presumed and fixation methods have evolved. Surgery is accepted more and more as primary treatment for dislocated midshaft clavicular fractures. And all fractures with initial shortening of more than 2cm resulted in non-union,^[2] Several studies have examined the safety and efficacy of primary open reduction and internal fixation for completely displaced midshaft clavicular fractures and noted high union rate with low complication rate. In a large number of complex

were followed up till fracture union. Results were analyzed both clinically and radiologically. Direct injury occurred in 16 patients (80%), among them 12 patient (60%) were due to fall on shoulder and 4 patients (20%) were due to road traffic accident. Indirect injury occurred in 4 patients (20%) due to fall with an outstretched hand. Majority of the patients were with mid clavicular fracture i.e 10 patients (50%) were in the age group of 30-39 years. The youngest patient was 25 years of age and the oldest was 42 years of age. The average age was 36 years. Out of 20 patients, 18 patients were male and 2 female. In this study 12 patients (60%) had left sided fracture and 8 patients (40%) had right sided fracture. Out of the 20 patients, 12 patients (60%) were type 2A2 (undisplaced and angulated) fracture and 8 patients (40%) were type 2B, (displaced with comminuted or displaced) fracture. All the patients were operated as early as possible once the general condition of the patients was stable. Out of 20 patients, 14 patients (70%) were operated within a week, 4 patients (20%) were operated in the 2nd week and 2 patients (10%) were operated in the 3 weeks. We advised the patient for removal of implant after 1 year. Implant removal was done for one patient at the fourth month, due to skin irritation. Other than that, no patient turned up for implant exit. Out of 20 patients, open reduction was done in 18 patients (90%) and closed reduction was done in 2 patients (10%). The fracture was considered to be united when clinically there is no tenderness, radiologically the fracture line was not visible and full unprotected function of the limb was possible. In 12 patients (60%) union is reported in 6 to 9 weeks & 8 patients (40%) union reported in 9-12 weeks. There was no major complication.

DISCUSSION

In TENS fixation the soft tissue damage is very less, the strength and rigidity of the nail is not sacrificed even when its contoured and implant exit is minimally invasive and cosmetically advantageous. First report of conservative management of clavicular fracture goes back to Egypt, 17th century B.C.^[8] Traditionally (since Hippocrates), midshaft clavicular fracture have been managed conservatively with this assumption that it does not hamper shoulder function" and even malunion has only radiographic means, but now it is apparent that, it has an impact on orthopaedic, neurologic, and cosmetic aspect too. Study of Nowak et al(9)208 patients showed 46% symptomatic at ten-year follow-up. Displacement and comminution are the strongest predictor,^[31] Another prospective cohort study carried out in Malaysia to know the clinical outcome on non-surgically treated clavicle after six month of follow-up concluded that displacement more than 21 mm, shortening of more than 15 mm, nonunion and malunited fracture are indication of surgical intervention,^[10] Ledger et al,^[11] also

emphasized that short malunion limits the shoulder function so recommended open reduction and/ internal fixation to prevent shortening. Shortening (≥ 15 mm) increases 10.7 degree at sternoclavicular joint angulations and 6.1 degree improvement in scapular version, so tethering effect occur over scapula leading to shoulder dysfunctions.^[13] By using Biodex isokinetic assessment with constant and Murley scoring system for Allman type 1 conservatively treated clavicle, Flavin et al., found that after three years follow-up there was 74% malunion, 3% non-union, average angulation 13.9 degree and shortening of 15 mm which hampered the shoulder's isokinetic function.^[12] Anatomically aligned united midshaft fracture clavicle has shown superiority over conservatively treated clavicle, but it needs mulling over repercussion of surgical intervention. Various surgical treatment options are mentioned in literature for displaced midshaft clavicle, but plate and Intra-medullary nail osteosynthesis are more discussed and preferred modality of treatment. Plate osteosynthesis is most discussed and its long-term experience in literature is mentioned. Biomechanical verdict is that, it is a rigid fixation so early rehabilitation, technically less demanding but practically even while it is most exercised, complications are still more than nail fixation. Infection, nonunion, plate breakage, plate loosening, refracture are the well-documented pitfalls in 23% of cases in the study done by Bostman et al.^[13] Incisional numbness, cosmetic unhappiness, scar related pain, metal causing discomfort were encountered drawbacks of plate osteosynthesis in retrospective comparative study of Thyagarajan et al.^[14] But in our study, none of the above mentioned complication were encountered. Original technique of intra-medullary fixation given by Boehme et al, was open reduction and internal fixation in nonunion of clavicle by Hagie pin and autogenous bone grafting and concluded several advantage over other treatments,^[15] Threaded Steinmann pin, Rush pin, Kirschner wire, cancellous screw etc. had also been reported over time as an intra-medullary fixation device with relative pros and cons.^[16-19] Every modality of surgical intervention has its own pros and cons. Irrespective of the surgical treatment (plate versus intra-medullary fixation) the studies of Ferran et al, and Liu et al, could not draw significant difference in functional outcome(20,21)But in the aspect of complications, titanium elastic nail showed superiority over plating. Wijdicks et al., in their study found that plating is associated with higher refracture, major revision surgery and implant failure in comparison to elastic stable nail,^[22] In our study also no complications were encountered with TENS nailing. Theoretically each method of fixation has its own advantages and disadvantages but practically fixation with TENS has lesser complication compared to other methods.^[27,28] Due to three point bony fixation, titanium elastic nail circumvents these problems and gives rotational stability, even then, it is advised to remove it timely. In contrast to it, plate

fixation needs less implant removal but patients discomfort have been reported. Neither is it an out patients department procedure, nor can it be done under local anaesthesia and it may also need abstinence from sport activities. In our series result of Shoulder function (as assessed by Constant-Murley-Score) was better in comparison to conservatively managed, displaced fracture of clavicle.^[15,29]

CONCLUSION

In this study, we prospectively reviewed a consecutive series of 20 patients with midclavicular fractures that were treated with TENS between March 2012 and January 2014.

The operative treatment was performed an average of 6 days after trauma (range: 2 to 29 days). None of the patients had any associated injury or co morbidities. The recovery of the shoulder function was assessed with the Constant-Murley-Score and the functional outcome was good. A complete consolidation of all fractures was observed radiologically after 12 weeks. Non-union was not observed. The period of disability in the whole patient population was 22 ± 9 days. Minor complications were observed in two patients. In one case the TENS was removed early due to skin irritation, 5 months after the operative treatment. Afterwards, all patients were without complaints. There were no infections observed in our series. Post operative period was uneventful in other cases. The data of this study demonstrate that operative treatment of displaced midclavicular fractures with TENS, results in good functional outcome and anatomical reduction.

REFERENCES

- Robert Buchholz, James.D.Heckman,Charles Court-Brown, ROCKWOOD GREEN'S FRACTURES IN ADULTS VOLUME-1(6th Edition 2006), pg 1213-1216.
- Schiffer G, Faymonville C,Skouras E,Andermahr J,Jubel A :Midclavicular fracture: Not just a trivial injury-current treatment options. Dtsch Arztebl Int 2010;107(41)711-7.
- Wun-Jer Shen M.D,Tsung-Jen Liu M.D,Young-Shung Shen M.D,Plate Fixation Of Fresh Displaced Midshaft Clavicle Fractures, J Bone Joint Surg[Br]2008;90-B:1495-B
- S.Terry Canale,James H. Beaty,CAMPBELL'S OPERATIVE ORTHOPEDICS VOLUME-3,11th Edition,pg 3371-3376.
- Stegeman Et Al.,Displaced Midshaft Fractures Of The Clavicle:Non-Operative Treatment Versus Plate Fixation (Sleutel-TRIAL). A Multicentre Randomised Controlled Trial.BMC Musculoskeletal Disorders 2011,12:196.
- N.Modi,A.D.Patel,P.Hallam Norfolk And Norwich University Hospital NHS Foundation Trust,NorwichUK.Outcome Of 62 Clavicle Fracture Fixations With Locked Compression Plate:Is This The Right Way To Go? doi: 10.1016/j.injury.2011.06.266.
- Wg Cdr V Kulshrestha,Primary Plating Of Displaced Mid-Shaft Clavicular Fractures.MJAFT 2008;64:208-211.
- Zenni EJ Jr,Krieg JK,Rosen MJ.Open reduction and internal fixation of clavicular fractures. J Bone Joint Surg Am.1981;63:147-51.
- Jupiter JB,Leffert RD.Non-union of the clavicle.Associated complications and surgical management.J Bone Joint Surg Am.1987;69:753-60.
- Iannotti MR,Crosby LA,Stafford P,Grayson G,Goulet R.Effects of plate location and selection on the stability of midshaft clavicle osteotomies:a biomechanical study.J Shoulder Elbow Surg.2002;11:457-62.
- McKee MD,Wild LM,Schemitsch EH.Midshaft malunion of the clavicle.J Bone Joint Surg Am.2003;85:790-7.
- McKee MD,Pedersen EM,Jones C,Stephen DJ,Kreder HJ,Schemitsch EH,Wild LM,Potter J.Deficits following nonoperative treatment of displaced midshaft clavicular fracture.J Bone Joint Surg Am.2006;88:35-40.
- Canadian Orthopedic Trauma Society.Nonoperative treatment compared with plate fixation of displaced midshaft clavicular fractures. A multicenter randomized clinical trial. J Bone Joint Surg Am.Jan 2007;89(1):1-10.
- Huang JI,Toogood P,Chen MR,Wilber JH,Cooperman DR.Clavicular anatomy and the applicability of precontoured plates.J Bone Joint Surg Am.2007;89:2260-5.
- Chul-Hyun Cho,MD, Kwang-Soon Song, MD,Byung-Woo Min,MD, Ki-Cheor Bae,MD, Kyung-Jae Lee,MD.Reconstruction Plate versus Reconstruction Locking Compression Plate for Clavicle Fractures.Clinics in Orthopedic Surgery 2010;2:154-159.
- Darren.S.Drosdowech, MD,Fresc, Biomechanical Analysis Of Fixation Of Middle Third Fractures Of Clavicle,Journal Of Orthopaedic Trauma 2011.
- Craig EV, Basamania CJ,Rockwood CA.Fractures of the clavicle.Chapter-11, In :Rockwood CA, Matsen FA,Wirth MA,Lippitt SB, editors,The shoulder. 3rd edition Philadelphia:Saunders, 2004;455-519.
- Lazarus MD.Fractures of the Clavicle.Chapter-26,In: Bucholz RW and Heckman JD, editors, Rockwood and Green's fractures in adults,6th edition,Philadelphia: Lippincott Williams and Wilkins,2001;1041-1078.
- Wilk KE. The shoulder.Chapter-15, In Malone TR,McPoil TG,Nitz AJ,editors, Orthopaedics and sports physical therapy,3rd edition, St.Louis: Mosby 1997;401-409.
- Ruedi T and Duwelins PJ.Fractures and dislocations of the shoulder girdle and humerus.Chapter-15,In: Chapman MW, editor,Chapaman's orthopaedic Surgery, Philadelphia, Lippincott Williams and Wilkins, 3rd edition 2001;444-450.
- Robinson's CM. Fractures of the clavicle in the adult.Epidemiology and classification. J Bone Joint Surgery (Br),1998;80:476-484.
- Creashaw AH.Fractures of shoulder arm and forearm.Chapter- 54, In:Canale ST, editor.Campbell's operative orthopaedics, 10th edition, St.Louis, Mosby,2003;2985-3071.
- Constant CR, Murley AHG. A clinical method of functional assessment of the shoulder. Clinical Orthopaedics and Related Research.1987;214:160-164.
- Labler L,Platz A,Weishaupt D,Trentz.O.Clinical and functional results after floating shoulder injuries J Trauma.2004;57:595-602.
- Hussein M, An ancient Egyptian treatise on traumatology J Bone joint Surg Am 1949;31(2):309-12.
- Nowak J,Holgerson M,Larsson S,Can we predict long-term sequelae after fractures of the clavicle based on initial findings? A prospective study with nine to ten years of follow-up J Shoulder Elbow Surg 2004;13(5):479-86.