

Is TENS a Good Treatment Option in Midshaft Clavicle Fractures? A Prospective Study of 30 Patients

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ABSTRACT

Fractures of the clavicle are fairly common injuries and can be managed by both conservative and surgical means. Various fixation options are available for surgical management. The aim of this study was to evaluate whether TENS (Titanium elastic nailing system) was a good treatment option in the management of these fractures. 30 patients with midshaft fractures of the clavicle who presented between January 2012 to January 2015 were treated with TENS and were followed up over a 3year period. Functional evaluation was performed using the Oxford shoulder and the quickDASH score(Disabilities of arm, shoulder and hand). There was a male preponderance seen in our study with the left side being more commonly affected. The time taken to union of the fracture was 12.16 weeks. The average Oxford shoulder score was 46.4 and the mean quickDASH score was 6.9. All fractures united at the end of 6 months with minimal complications. TENS is a good minimally invasive option in the management of midshaft clavicle fractures and gives good cosmetic and functional results.

Keywords: Clavicle; Midshaft fracture; Oxford score; TENS

INTRODUCTION

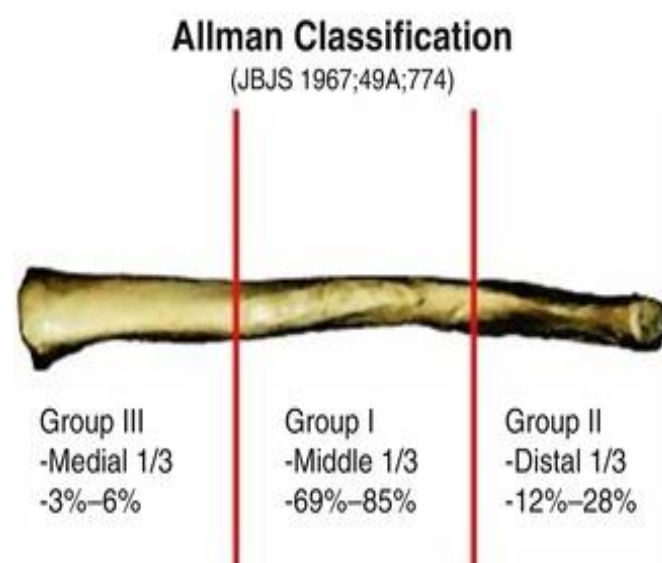
Fractures of the clavicle account for 2 to 5% of all fractures. The most common mode of injury for these fractures are road traffic accidents and sports injuries while it can fracture following a slip and fall in children and in the elderly age group (Postacchini *et al.*, 2002; Robinson, 1998; Rowe, 1968;). Midshaft fractures are the most common type seen in these injuries. Undisplaced and stable fractures can be managed conservatively by strapping with a cuff and collar or an arm sling for a period of 3 weeks but can lead to shoulder stiffness and poor patient compliance due to pain during the period of immobilization. Comminuted and displaced fractures are unstable and can be associated with complications such as non-union, malunion, cosmetic deformity, poor functional outcome and shortening of the clavicle which can result in decrease in function of the shoulder (Stanley. Norris, 1988; Hill *et al.*, 1997; Smekal *et al.*, 2009) The recent trend has been to opt for surgical fixation of these fractures which has shown to produce improved functional outcomes with decreased incidence of complications. The indications for surgery in clavicle fractures are excessive displacement of the fracture, tenting of the skin, compound fractures, neurovascular injury, floating shoulder and clavicle shortening more than 20 mm. Surgical management has shown to be associated

with a lesser risk of non-union as compared to conservative management by as much as 60-70% as noted by certain studies. The various fixation options available for surgical management are ORIF (Open reduction and internal fixation) with plate osteosynthesis, intramedullary implants, Kwire fixation, Rush pins, Knowles pins and TENS. ORIF with plating is the gold standard in the management of these fractures but is associated with issues such as necessity for a large skin incision, excessive soft tissue and periosteal stripping, longer operating times, more blood loss, injury to the neurovascular structures, increased risk of infection, cosmetic scar, soft tissue irritation by the hardware and stress shielding can occur after plate removal which can lead to a refracture. TENS was first introduced in 2002 and has shown to give good clinical and functional outcomes. The advantage with these intramedullary implants are a smaller skin incision, less soft tissue dissection, load sharing fixation and it gives relative stability so that micromotion occurs at the fracture site which promotes active callus formation. It provides a three point fixation within the S shaped clavicle. This method of fixation can be associated with complications such as medial and lateral cortex penetration, hardware irritation, implant breakage or migration (Frigg *et al.*,2009; Vinzenz *et al.*,2008; Mueller *et al.*,2008). The aim of this study was to analyse if TENS was a good treatment option in the management of midshaft clavicle fractures by evaluation of the functional outcomes achieved.

MATERIALS AND METHODS

This was a prospective study of 30 patients with midshaft clavicle fractures who presented between January 2012 to January 2015 treated with TENS and followed up for a period of 3 years. This study was approved by the ethical committee of our institution. All patients with Allman Type 1 clavicle fractures willing for the procedure and follow up were included in our study while Allman Type 2 and 3 fractures, compound fractures, floating shoulder and fractures with neurovascular injury were excluded. At the time of admission, the shoulder was supported with a broad arm sling and the patients were evaluated clinically and radiologically. Standard AP radiographs were taken and the fracture type was noted and documented. All fractures were classified according to the Allman classification. (Figure 1)

Figure 1: Allman classification



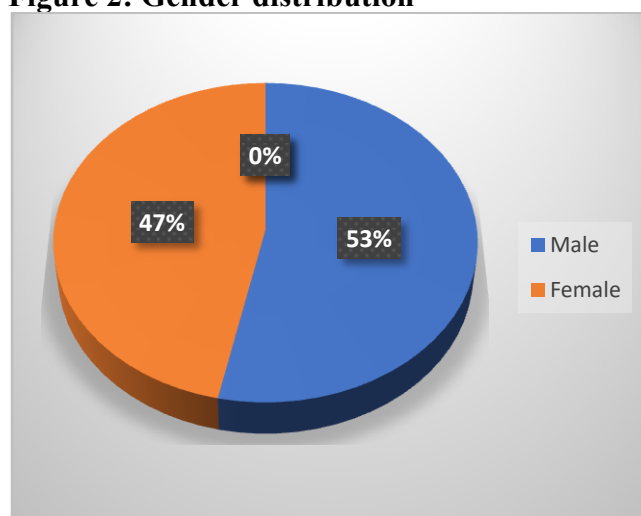
Routine blood investigations were done and the patients were worked up for the surgical procedure. Proper informed and written consent was obtained prior to the surgical procedure.

The surgeries were performed under general anaesthesia under antibiotic cover. Injection Cefazolin 1 gm was given at the time of induction of anaesthesia. The patient was placed in the supine position and prepping and draping was done. A 1.5 cm incision was made over the medial end of the clavicle and dissected down to the bone. A 3.2 mm drill bit was used to open the cortex followed by a bone awl. An appropriate size nail was then mounted on a T handle and introduced into the canal and advanced using rotational movements under fluoroscopic guidance. When the fracture site was reached, fracture reduction was done by either manipulating the affected shoulder and arm or by using a reduction forceps to manipulate the lateral fragment and the nail was passed across the fracture site and advanced laterally till the final seating position was reached. When it was not possible to reduce the fracture by closed means, a small incision was made over the fracture site and fracture reduction was done under direct visualization. Care was taken not to penetrate the dorsal cortex by manipulating the nail once it crosses the fracture site. The medial end of the nail was cut close to the bone leaving just enough to facilitate nail exit at a later stage. Wound wash was given and closure done in layers and sterile dressing was applied. Patient was given a cuff and collar postoperatively. The shoulder and elbow were mobilized on the same evening of surgery and the patient was advised to avoid overhead abduction for a period of 6 weeks. Injection Cefazolin was given for 3 days postoperatively and wound inspections were done on the 3rd and 5th postop days. Suture removal was done on the 12th postoperative day. Postoperative radiographs were taken and the quality of fracture reduction and fixation were noted. The patients were discharged and asked to review at regular time frames where serial radiographs were taken to assess fracture union and functional assessment was done using the Oxford shoulder score and the quickDASH score. All findings were noted and documented. The data collected was analyzed using IBM SPSS Version 22.0. Armonk, NY:IBM Corp. Chi square test was used in the comparison of categorical variables. A P value of less than 0.05 was considered to be statistically significant.

RESULTS

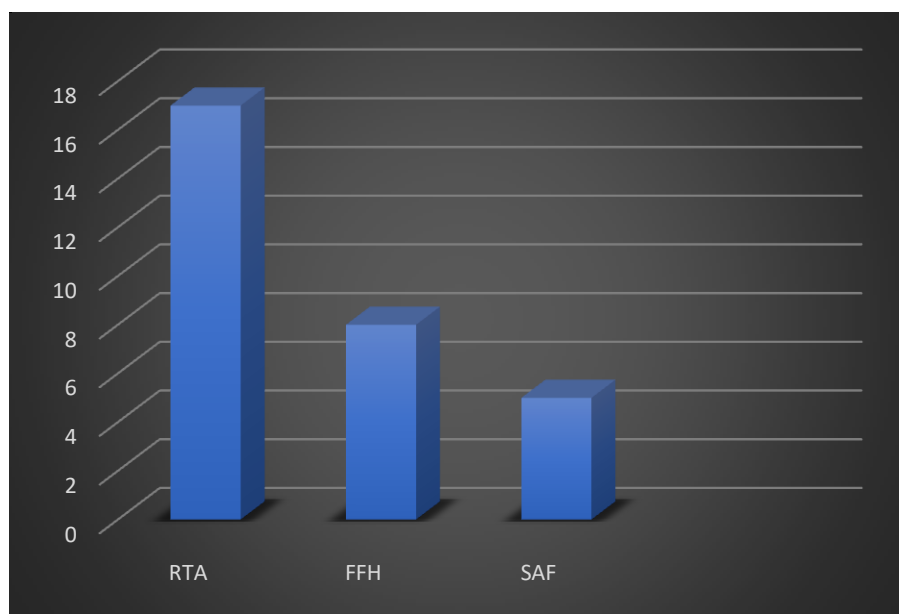
The mean age of the patients was 41.3 years ranging from 21 to 56 years. There was a male preponderance seen in our study with the left side being more commonly affected. (Figure 2)

Figure 2: Gender distribution



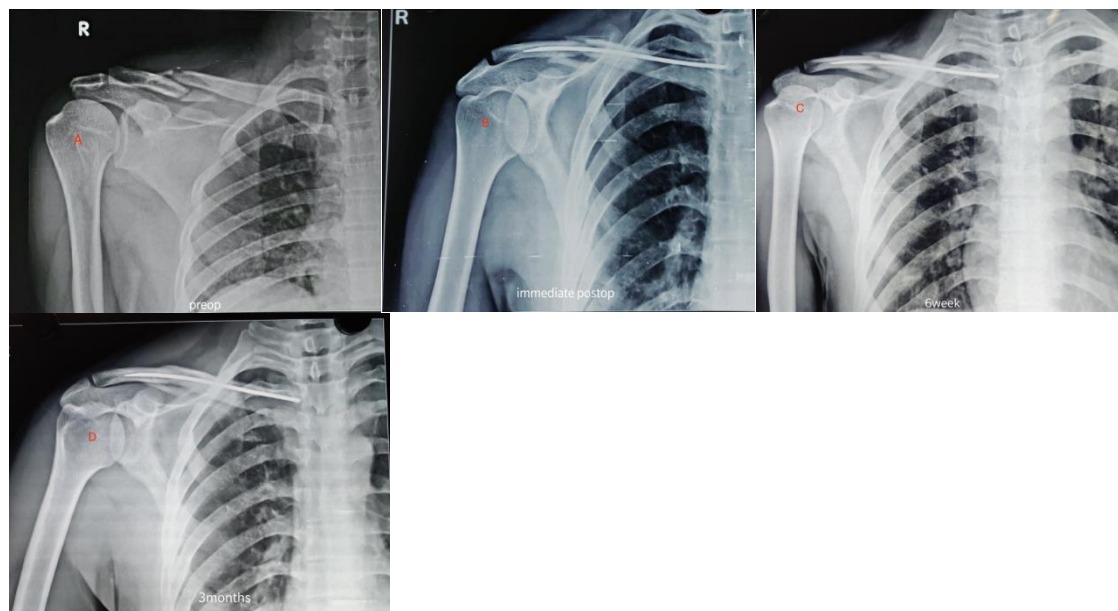
The most common mode of injury were road traffic accidents followed by fall from height and slip and fall. (Figure 3)

Figure 3: Mode of injury



The mean time from injury to presentation was 5 days ranging from 2 to 10 days while the mean time from presentation to the surgical procedure was 3 days ranging from 2 to 6 days. The average surgical time was 57 minutes ranging from 45 to 65 minutes and the mean time to fracture union was 12.16 weeks ranging from 9 to 14 weeks. We were able to achieve a 100% union rate in our series. (Figure 4)

Figure 4: Illustrative case



A: Preoperative radiograph. B. Immediate postop radiograph. C. 6 weeks follow up. D. Radiograph at 3 months showing complete union of the fracture.

The average nail size used was 2 mm. The mean range of movements achieved were: Flexion- $160^{\circ}\pm 7.21$, Abduction- $158^{\circ}\pm 10.20$, External rotation- $71.5^{\circ}\pm 6.2$ and Internal rotation- $72.25^{\circ}\pm 5.2$. The average Oxford shoulder score was 46.4 ranging from 36 to 49 while the average quickDASH score was 6.9 ranging from 2 to 14.2. Nail removal was performed for 28 patients 6 months after clinical and radiological union of the fracture while 2 patients refused metal exit. One patient developed a superficial infection which resolved with antibiotics and one patient developed a hypertrophic scar. We had no complications such as non-union, malunion, deep infection, nail migration or breakage seen in our study. We did not lose any of our patients to follow up.

DISCUSSION

Fractures of the clavicle can be managed both conservatively as well as by surgical means. Conservative management in case of undisplaced stable fracture patterns is done by strapping and application of a cuff and collar or a broad arm sling for a period of 3 weeks. This can be often associated with discomfort and poor patient tolerance for the period of immobilization. Displaced and unstable fracture patterns are associated with high rates of non-union, malunion and shortening leading to a poor functional outcome. Studies have shown decreased incidence of these complications in surgical management as opposed to conservative management. ORIF with plate osteosynthesis is associated with factors such as necessity for a large skin incision, excessive soft tissue and periosteal stripping, longer operating times, more blood loss, injury to the neurovascular structures, increased risk of infection, cosmetic scar, soft tissue irritation by the hardware and stress shielding can occur after plate removal which can lead to a refracture. In this scenario, intramedullary implants have various advantages such as a smaller skin incision, less soft tissue dissection, load sharing fixation and it gives relative stability so that micromotion occurs at the fracture site which promotes active callus formation and leads to good functional outcomes (Leppilahti, Jalovaara, 1999; Hartmann *et al.*, 2008). It provides a three point fixation within the S shaped clavicle. It provides faster recovery times and gives a better cosmetic appearance with better pain relief. It can be associated with complications such as nail migration or breakage, soft tissue irritation caused by the prominent medial part of the nail and in cases of fractures with comminution, it can cause shortening of the clavicle by telescoping of the nail (Chen *et al.*, 2010; Jubel *et al.*, 2003). Kadakia AP *et al.* studied 38 patients treated with TENS with a 12 month follow up and reported a 100% union rate at an average time of 11.3 weeks. The average Oxford score was 45.6 and the DASH score was 6.7. Nail removal was done in 47% of patients (Kadakia *et al.*, 2012). In Beigang Fu study of 36 patients, they also reported a 100% union rate at a mean time of 11.58 ± 2.79 weeks. The Constant and Murley score was 93.3 ± 2.7 and the DASH score was 2.52 ± 1.5 . There were no nonunions or refractures observed (Beigang fu, 2006). In Christopher Meier *et al.* study of 14 patients, a 100% union rate was reported with the Constant score being 98 at 6 months. Hardware removal was done in 11 patients and there was a secondary fracture displacement seen in 1 patient (Meier *et al.*, 2006). In our study, we were also able to achieve a 100% union rate with the mean time to fracture union being 12.16 weeks. The average Oxford shoulder score was 46.4 ranging from 36 to 49 while the average quickDASH score was 6.9 ranging from 2 to 14.2. Nail removal was performed for 28 patients 6 months after clinical and radiological union of the fracture while 2 patients refused metal exit. One patient developed a superficial infection which resolved with antibiotics and one patient developed a hypertrophic scar. We had no complications such as non-union, malunion, deep infection, nail migration or breakage seen in our study. None of our patients were lost to follow up. All patients were satisfied with the functional outcome achieved.

CONCLUSION

We conclude by stating that TENS is a good minimally invasive treatment option in the management of midshaft clavicle fractures and has the advantages of fewer complications and faster recovery times leading to a good cosmetic and functional outcome to the patient.

DECLARATION

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Conflict of interest: None declared

Ethical approval: Approval taken from the ethical committee

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