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Comparative study between cc screw and TBW used in medial malleolus fractures

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Abstract

Aim: To compare outcome of CC screw and TBW in medial malleolar fractures.

Materials and Method: This is a prospective (From March 2018 to September 2018) study of 40 medial malleolar fractures treated at Krishna institute of medical sciences deemed university, Karad, Satara. It includes newly diagnosed patients with medial malleolar fractures admitted in hospital. Follow up period was till 24 months/ 6 months.

Results: In this study, it showed that excellent and good results were achieved in 65% in CCS category and 95% in TBW category, Baird and Jackson scoring system used.

Conclusion: We concluded that TBW is the better modality of fixation than CC screw for medial malleolar fractures resulting in excellent functional outcome of the ankle joint after open reduction and fixation.

Keywords: Medial malleolar ankle fracture, muller classification and Baird and Jackson scoring system

Introduction

Ankle joints are known to be highly prone to injuries which may be caused by twisting injuries or fall quite from height. This is because they are quite mobile and bear much of the load associated with weight bearing. The ankle joint supports more weight per unit area than any other joint in the body ^[1].

Ankle joint is the most congruous joint in the lower limbs bearing upto five times the body weight ^[2]. Sir Robert Jones said —Ankle is the most injured joint of the body but the least well treated ^[3]. Ankle injuries are important because body weight is transmitted through it and locomotion depends upon the stability of this joint. They are usually mixed injuries, ligamentous and bony and each injury is an end result of the sequence of ligamentous and bony failure due to deforming forces.

The French have written extensively on ankle injuries beginning with Baron, Dupuytren and then Maisonneuve, but it was not until 1922 that a proper understanding of the mechanism and classification of the ankle fractures was published in a paper by Ashurst and Bromer ^[4].

Fractures of the medial malleolus are some of the most commonly encountered fractures seen by an orthopaedic surgeon. Their incidence has increased over the last 30-35 years, affecting one in every 800 people each year, and accounting for 9% of all fractures. They continue to pose severe problems as these being intraarticular are being subjected to continuous deforming forces. It is also difficult to restore the desired anatomical continuity and congruity of their articular surfaces after reduction.

In the modern age, the treatment of osteoarticular fractures with plaster immobilisation for prolonged period is not at all justified when the fracture is sustained by relatively younger people. Thus, conservative treatment of these fractures is becoming a thing of past now. Furthermore in elderly patients, early mobilization and early ambulation is the ideal treatment of fractures ^[5].

The superiority of ORIF over closed treatment have been thoroughly demonstrated in literature ^[6]. With evolution and advances in orthopaedics, the mode of treatment of osteoarticular fracture has changed from closed reduction and plaster immobilisation to open reduction and internal fixation.

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In treating medial malleolar fractures, restoration of anatomical alignment is very important. This is because, only a slight variation from normal is incompatible with good joint function. Ramsey and Hamilton have reported that only 1mm lateral shift of talus decreases contact area by 40% and displacement of 3 mm decreases contact area by 60% [17].

Various implants made of stainless steel came into vogue. They included screws, k-wires, tension band wires etc. For restoration of normal anatomy of the joint, Open reduction and internal fixation is an excellent method for treatment.

The study of Association of Osteosynthesis (AO) has evolved the methods of utilising rigid fixation and compression for internal fixation of fractures [5]. It works on principle that the implant absorbs much of the tension and increases compression across the fracture site and aims at the full restoration of painless movement and strength.

However in today's age, when different implants and different techniques are available for the treatment of medial malleolar fractures, no method is perfect and each one has its pros and cons. It is important to individualize treatment modality for every patient and not to be restricted by rigid protocols.

Objective

The following objectives are used for this study:-

1. To analyse functional outcomes in cases of medial malleolar fractures operated with tension band wiring and 4 mm cannulated cancellous screws.
2. To analyse fracture union in cases of medial malleolar fractures operated with tension band wiring and 4 mm cannulated cancellous screws.
3. To compare complications involved in cases of medial malleolar fractures operated with tension band wiring and 4 mm cannulated cancellous screws.
4. To compare clinical and radiological outcome of TBW and CC screw by using Baird and Jackson scoring system.

Methodology

In this study, comparative study was done between TBE and CC screw fixation for medial malleolar fractures of the ankle joint in our hospital.

This is a prospective study (From March 2018 to September 2018) of 40 medial malleolar fractures treated at Krishna hospital and Medical research center, Karad. Follow up period was till 24 weeks / 6 months.

Patient were examined and admitted. Diagnosis was confirmed by a radiograph and fracture stabilization done with below knee splint. Routine investigations and pre-operative anaesthetic check up was done for further management.

Inclusion criteria

1. Patients having medial malleolus fracture.
2. Patients of any sex.
3. Age group: 20 years and above.
4. Patients who are fit for surgery.
5. Patient willing to participate in the study.

Exclusion criteria

1. Unwillingness to participate in the study.
2. Patients unfit for surgery and or anaesthesia.
3. Patients with history of previous medial malleolus fracture of either ankle.

4. Patients with open ankle fractures and pathological fractures.
5. Patients with co-morbidities like diabetes mellitus.
6. Patients with vertical shear (adduction) fracture of medial malleolus.
7. Immature skeleton.

According to muller classification fractures, type B, type C and type D were included in this study.

Fixation techniques of the medial malleolus

Fracture of the medial malleolus in Danis-Weber type-A, supination adduction, is a shear fracture, more vertical than horizontal, and the fracture classically begins at the level of the plafond. The fracture is fixed with two 4mm cancellous screws placed perpendicular to the fracture.

Fracture of the medial malleolus in types B and C is an avulsion fracture, often distal to the plafond and in type C often horizontal. It is fixed as in type A with two 4mm cancellous screws placed perpendicular to the fracture.

With a smaller fragment, it may not be possible to insert two screws; a Kirschner wire should then be added to the one screw to prevent rotational stress at the fracture site. Another effective method of fixation under such circumstances is tension band fixation which is bio mechanically a strong construct and may be improved by placing a 20-gauge circlage wire in a figure of 8 pattern with two twists, each of which can be tightened independently around two 2mm Kirschner wires.

The smaller the medial malleolar fragment, the more difficult reduction can be. This is particularly true when the fracture involves the anterior colliculus rather than the medial malleolus. The anterior colliculus is difficult to reduce and fix, especially if the fracture is transverse rather than the usual oblique type.

Tension band principle [25]

Early concepts of load transfer within bone were developed and described by Frederic Pauwels. He observed that a curved tubular surface under axial load always has a compression side as well as a tension side.

A tension band converts tensile force into compression force at the opposite cortex. This is achieved by applying a device eccentrically, on the convex side of a curved bone.

A tension band that produces compression at the time of application is called a static tension band, as the forces at the fracture site remain fairly constant during movement. Tension band application to the medial malleolus is an example of a static tension band.

If the compression force increases with motion, the tension band is a dynamic one. A good example is the application of the tension band principle to a fracture of the patella. Upon knee flexion, the increased tensile force (Between quadriceps muscle and the tibial tuberosity) is converted to compression force at the articular surface.

Muller classification for isolated fracture of medial malleolus

Type A: Fracture avulsions of the tip of the malleolus.

Type B: Fracture occurring between the tip and the level of the plafond

Type C: Fracture at the level of the plafond

Type D: Fracture extending vertically above this

Fig 1: Muller Classification for isolated fracture of medial malleolus

Out of 40 fractures, 20 were operated with open reduction and internal fixation with tension band wiring and 20 were operated with open reduction and internal fixation with 4mm cannulated cancellous screws.

The basic idea was to achieve near anatomical reduction. Open reduction and internal fixation was used in all 40 patients. It was done as a planned and elective procedure. Before patients were taken up for surgery, they were put on foot elevation and anti-inflammatory drugs for few days to reduce foot swelling. For all 40 cases, anteromedial approach was used.

Post operatively limbs were immobilized in plaster splint, patients were put on antibiotics and analgesics and limbs were elevated. Dressings were done regularly and sutures were removed on average on 14th day (decided according to the wound inspection). The below knee splint was continued till 6 weeks post operatively in both groups and was then removed. Patients were assessed for fracture union radiologically. Once the fracture showed signs of union, partial weight bearing was advised, which was approximately at 6-8 weeks and it was

then gradually increased to full weight bearing. Physiotherapy exercises for range of movements were started on removal of slab.

Follow up

Weight bearing is restricted for 6 weeks. At 6 weeks the plaster was removed. Clinical examination was done regarding movement of ankle. At 6 weeks x-ray of the ankle was taken in AP, lateral and mortise views and looked for signs of fracture union and then were advised partial weight bearing once the fracture showed signs of union. Patients were advised to keep the limb at elevation at night times and perform active movements of ankle joints. It was then gradually increased to full weight bearing. Regular follow up was done at 6 weeks, 3 months and thereafter at monthly intervals till 6 months after operation till the fracture united. Follow up X-rays were taken to assess fracture union, the condition of implant.

Assessment of results

Baird and Jackson scoring system was used to evaluate the patients at the end of 6th month. Score and fracture union in both the groups were compared using unpaired —t test. Finally correlation between results of the score and clinical data were evaluated using chi square test.

A scores according to the baird and jackson scoring system

Excellent: 96 - 100
Good: 91- 95
Fair: 81- 90
Poor: 0 – 80

Maximum possible score- 100

Method of statistical analysis

The Excel and Graphpad Instat (Graphpad softwares inc, USA) software packages were used for data entry and analysis.

Fig 2: Post operative Xray at 6 months follow up

Fig 3: Post operative Xray at 6 months follow up

Observation and results

A total of 40 cases were enrolled in the study, 20 cases were operated with open reduction and internal fixation with 4mm cannulated cancellous screws and 20 cases were operated with open reduction and internal fixation with tension band wiring. The mean age in CCS group was 39.95 years whereas in TBW group was 38.15 years. According to unpaired t test, the difference was statistically insignificant.

Majority of the patients (57.5%) included in the study were in the age group 20-39 years. When Chi square test was applied for the distribution of patients in three age groups for both the

operative procedures modalities it was found to be statistically non-significant.

Out of total 40 patients considered in study 35 (87.5%) were male and 5 (12.5%) were female. Almost similar ratio was seen in either of the group.

Out of total 40 patients treated 20 (50%) had medial malleolus fracture on right side and 20(50%) had medial malleolus fracture on left side. The comparison of side affected in individual group was statistically non-significant. There was no statistically significant difference in range of dorsiflexion in both groups at the end of 6 weeks (Graph 1).

Graph 1: Range of dorsiflexion in both groups at the end of 6 weeks

The mean range of plantarflexion in CCS group at the end of 6 weeks was 24.25 degrees as compared to 24.5 degrees in TBW group, which was not statistically significant. (Graph 2)

Graph 2: Range of plantarflexion at the end of 6 weeks

The mean range of dorsiflexion in CCS group at the end of 12 weeks was 19.5 degrees as compared to 19.75 degrees in TBW group, with mean difference of 0.25 degrees which was not statistically significant (Graph 3).

Graph 3: Range of dorsiflexion at the end of 3 months

The mean range of plantarflexion in CCS group at the end of 3 months was 30.5 degrees with mean difference of 3.0 degrees as compared to 33.5 degrees range of plantarflexion in TBW group. The improvement in the range was statistically significant (p value- 0.0274) in TBW group (Graph 4).

Graph 4: Range of plantarflexion at the end of 3 months

The mean range of dorsiflexion in CCS group at the end of 6 months was 21.5 degrees as compared to 21.75 degrees in TBW group, and showed no statistically significant difference. (Graph 5).

Graph 5: Range of dorsiflexion at the end of 6 months

The mean range of plantarflexion in CCS group at the end of 6 months was 37 degrees with mean difference of 2 degrees as compared to 39 degrees range of plantarflexion in TBW group. The improvement in the range was statistically significant in TBW group with a p value of 0.0439. (Graph 6)

Graph 6: Range of plantarflexion at the end of 6 months

Out of total 40 patients treated in this study, 3 cases in CCS group and 2 cases in TBW group developed post operative infection which was similar in both groups and was statistically insignificant.

Average time taken for radiological union in CCS group was 18.4 weeks and in TBW group was 16.8 weeks. So union

occurred earlier in TBW group. Union was considered when fracture line could not be seen on radiographs and normal bony trabeculae were seen crossing across the fracture site. When patient could walk full weight bearing and did not have any tenderness. When unpaired t test was applied to these values, it was found to be statistically significant with a p value of 0.0303. (Graph 7).

Graph 7: Time taken for radiological union

The mean Baird and Jackson score at the end of 6 months for CCS group was 91.7 and for TBW group was 95.05. The

mean score in TBW group was found to be better as compared to CCS group. On applying unpaired t test, statistical significant difference was found (p value- 0.018). (Graph 8).

Graph 8: Baird and Jackson score at the end of 6 months

Out of the 40 patients treated 50% had good results and 30% had excellent results. On comparing the results in both groups by applying chi square test statistically significant difference was found with p value of 0.0490, showing better results in TBW group as compared to CCS group. (Graph 9)

Graph 9: Results according to Baird and Jackson scoring system

Discussion

Malleolar injuries are the most common significant lower extremity fracture. They primarily involve medial malleolus. They are produced indirectly by shearing and tensile forces applied through the talus [8, 9]. The treatment of medial malleolar fractures with accurate open reduction and stable internal fixation using AO method and principles was found to give a high percentage of excellent and good results. In this study the outcomes of medial malleolar fractures treated with open reduction and internal fixation with tension band wiring and 4 mm cannulated cancellous screws were evaluated and compared. The results of present study are compared to with those of previous similar studies.

The mean age of this study was 39.05 years. This finding was similar to observation of Roberts RS [10] in whose study the mean age was 40 years, Beris *et al.* [11] in whose study the mean age was 43.8 years.

There was male predominance in this series which is also observed in other studies. In our study out of 40 patients, 35(87.5%) were male and 5(12.5%) were females. Nabeel Shams *et al.* [12] in his study of 30 patients had 22 male and 8

female patients. Dr. Maruthi CV [13] *et al* in their study of 40 cases had 28 males and 12 females.

The current study showed that excellent and good results were achieved in 65% in CCS group (Treated with 4mm cannulated cancellous screws) and 95% in TBW group (Treated with tension-band wiring) according to Baird and Jackson scoring system, the difference was statistically significant (p=0.0490). This agrees with the results of Sang-Hank and Young- Junpark [14] who achieved excellent and good results in about 78% of cases treated with screws and 89% of cases treated with tension-band wiring. Al-Lamy *et al.* [15] also achieved excellent and good results in 80% in group treated with screws and 90% in group treated with tension-band wiring, according to the modified ankle scoring system of Olerud and Molander [16].

In this study the mean time for radiological bone union in CCS group was 18.4 weeks and in TBW group was 16.8 weeks with a statistical significant difference (p=0.0303). So union occurred earlier in tension band wiring group in this study. This is similar to SK. Nurul *et al.* [17] study that reported a mean time of 11.8 weeks for screws and 9.4

weeks for tension-band wiring; and Al-Obaidy and Al-Lamy^[18] who in their study had union time of 12 weeks in screw group and 9 weeks in tension band wiring group, both of whom reported earlier fracture union in tension band wiring group.

Ostrum and Litski^[19] recently demonstrated the biomechanic advantages of the tension-band over other fixation techniques for medial malleolus. When resisting pronation forces and applying compression force tension-band were four times stronger than screws. This might explain the faster union rate we were achieved in TBW group (Mean of 16.8 weeks) as compared with CCS group (Mean of 18.4 weeks).

We did not have any cases of non union which were similar to the study results of S K. Nurul^[17] who achieved 100% union rate in both groups. Al Lamy *et al.*^[18] had experienced two cases of delayed union (5%) out of 40 cases of the study but did not report any cases of non-union.

Authors reported loss of reduction with the use of tension band technique as a result of K wires become loosened and migrate proximally^[20]. Some reported back out of cannulated cancellous screws leading to implant loosening. On the other hand many authors did not agree with the frequency of this complication and reported that with the proper surgical techniques, wire migration was not a problem^[21, 22]. In this study we did not see any wire migration, pull out of screw or loss of reduction and implant failure. Al Lamy and Al-Obaidy^[18] in their study of 40 cases did not report any case of fixation failure or kirschner wires migration or loss of reduction.

Better range of motion was noticed in TBW group as compared with CCS group, with significant statistical difference ($p=0.0439$). This could be attributed to more rigid fixation with the use of tension-band.

The use of tension band wire for fixation on the tension surface of a fractured bone converts the distracting tensile force in to a compressive force^[23].

In our study out of 40 cases, the only post operative complication we encountered was infection. We came across this complication in 5 cases which was managed by regular dressings and administration of antibiotics. Nabeel Shams *et al.*^[12] in his study of 30 patients, reported superficial infection in 2 patients. Pradeep Choudhari & Ranjeet Agrawal^[24] in their study on 68 cases, superficial infection was found in only one patient.

Conclusion

From this study we conclude that in the management of medial malleolus fracture open reduction and internal fixation with tension band wiring gives better results as compared to open reduction and internal fixation with 4mm cannulated cancellous screws.

Tension band wiring ensured better improvement in the range of motion at ankle joint. Also, fracture union was seen earlier in patients operated with open reduction and internal fixation with tension band wiring compared to cannulated cancellous screws group.

We conclude that open reduction and internal fixation with tension band wiring remains the mainstay of treatment showing better functional and radiological outcomes as compared to open reduction and internal fixation with cannulated cancellous screws.

Small sample size and no long term follow up remain the limitations of this study.

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