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Does the Closure Technique Affect the Wound Healing in Ankle Fractures in Diabetic Patients -A Prospective Study

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Abstract

Aim: A prospective study was carried out to see the effect of closure techniques on wound healing in ankle fractures in diabetic patients

Material & Methods: This study was conducted in the Post graduate department of orthopedics, Govt. Medical College, Jammu from January 2015 to November 2016. A total of 40 patients were included in this study and were assigned to group 1 [Allgower Donati closure] or group 2 [2 layer closure] at random. In both groups, fractures were fixed with ORIF (Open reduction and internal fixation). In group 1 the closure was done using the Modified Allgower donati suture technique while in group 2 the closure was done in two layers with a subcutaneous closure. The wounds were examined on the 2nd post operative day and subsequently on every alternate day. The sutures were removed on the 12th post operative day.

Results: The evidence of wound complication that was taken into consideration were wound dehiscence, wound blistering, active discharge, swelling warranting a single or multiple suture removals to reduce tension and wound nonhealing or delayed healing. A 10.52 percent rate of wound complication was observed in group 1 [Allgower Donati closure] as compared to about 44.44 percent in group 2 [2 layer closure]. A P value of 0.0293 was found to be statistically significant. Taking all other variables into consideration we

Conclusion: It is concluded that in the diabetic patients, operative wounds of the ankle fractures treated with open reduction and internal fixation closed with the Allgower Donati suture technique yield significantly and statistically better results than the two-layered closure with subcutaneous and skin closure.

Keywords: Allgower Donati closure, ORIF (Open reduction and internal fixation), Diabetes mellitus, Ankle fracture

Introduction

Ankle fractures are among the most common injuries treated by orthopedic surgeons. Ankle fractures represent 10% of all fractures and are second to only hip fractures as the most common lower extremity fracture.^{1,2} With an ever-aging population, the number of ankle fractures continues to rise. The skin overlying the ankle has a rather tenuous blood supply and is relatively thin with limited deep soft tissue coverage due to tendons rather than muscle bellies crossing the joint.^{3,4} On the other hand of the 500 million diabetics in this world, about 70 million are in India. While protocols for management of ankle fractures are generally well established, treatment of these injuries in patients with diabetes mellitus poses a challenge for orthopedists. These patients have unique characteristics, including delayed fracture-healing, impaired wound-healing, vasculopathy, and neuropathy and all must be taken into account when formulating a treatment plan. As the prevalence of diabetes mellitus has continued to increase, so too has the number of ankle fractures seen in this patient population. The rates of surgical site infection of ankle fractures range from 1.25% to 1.44% in the general population, but rates of infection have been reported to be up to 32% in diabetic patients.⁵⁻⁷ While much has been published on the impact of diabetes on the treatment of ankle fractures, only a few studies refer to the wound problems faced in the postoperative period. One of the most significant modifiable factors in wound healing to prevent complications is maintenance of perfusion to the incision site.⁸⁻¹² In this study, we have tried to examine the effect of wound closure techniques on final wound outcome in a diabetic patient.

Technique

Patient data

The study was conducted in the Postgraduate Department of orthopedics, GMC Jammu from January 2015 to November 2016. A total of 40 patients were included in this prospective study and were assigned to group 1 [Allgower Donati closure] or group 2 [2 layer

closure] at random. The age of the patients ranged from 20 to 85 years [mean 59.7]. Mean age for group 1 was 63.2 years and for group 2 was 56.2 years. All patients were above 18 years of age. There were 29 males and 11 females included in the study with group 1 [14M/6F] and group 2 [15M/5F].

In our study, we had an inclusion criteria as following

- Diabetic patients
- Ankle fracture [uni, bi or trimalleolar] that needed ORIF
- Controlled blood sugar

And an Exclusion Criteria

- Noncompliant patients
- Vascular or neural injury
- Evidence of PVD
- Diabetic foot ulcer/ acute or established Charcot's arthropathy
- Any wound needing a primary flap or plastics consultation.
- Fracture requiring external fixation.

The complete history and examination regarding the mechanism of injury, the pattern of injury, open or closed, history of diabetes, medication being taken, previous history of any foot complication and blood sugar control were taken. On admission, the patients were managed following the ATLS protocol and then the injured limb was examined for associated injuries and the status of distal neurovascular structures was documented. The limb was placed in a Cramer wire splint and after taking X-rays was put in a below knee plaster slab till the time of surgery. The open wounds were washed with a prescribed volume of normal saline and tetanus and antibiotic prophylaxis was administered. Admission blood sugar levels were taken and if found to be out of range endocrinology consultation was sought. Patients were operated once the anesthetic fitness tests were complete with times ranging from 6 hours to 42 hours [mean

13.35 hours] with the mean for group 1 is 12.85 hours and for group 2 is 14.85 hours. In case of an open fracture, debridement followed by open reduction and internal fixation was done on an emergent basis.

In both groups, the fractures were fixed with ORIF {open reduction and internal fixation} using stainless steel implants. In case of a lateral malleolus fracture, one-third tubular plate with 3.5 mm screws, TBW[tension band wiring] or Rush nailing was done. In case of medial malleolus fractures, 4.5 mm CCS or TBW were

used. For posterior malleolus fractures, the 4.5 mm CCS was used.

In group 2 the closure was done in two layers with a subcutaneous closure with a Vicryl2.0 [Ethicon, NJ, USA] interrupted sutures and skin closure with a skin stapler [Centennial, Mumbai], Nylon 2.0 [Ethicon, NJ, USA] or Prolene2.0 [Ethicon2.0, NJ,USA]. In group 1 the closure was done using the Modified Allgower Donati suture technique with a Nylon 2.0 [Ethicon, NJ, USA] or Prolene 2.0 [Ethicon, NJ, USA]. (Fig1-7)



Fig.1 Start on one side like a simple skin suture



Fig .2



Fig 3: Continue as a horizontal mattress suture in the subcutaneous layer on the opposite side.



Fig 4: End on the starting side like a vertical mattress suture



Fig 5: Secure the suture with multiple instrumental knots



Fig 6: Immediate post – operative picture showing the lateral incision closed with an Allgower Donati suture technique



Fig 7: Similar closure on the medial side

Approach

In both these groups standard approaches to visualize the fractures were used. In case of the lateral malleolus, the direct lateral or the posterolateral approach was used. In case of the medial and posterior malleoli, the medial or the posteromedial approach was used. In case of an open fracture the debridement was done and then instruments were discarded and the limb was redraped for fixation.

No drains were used and postoperative protocol of nonweight bearing for 8 to 12 weeks was followed.

Statistics.

2 tailed P values were calculated using the Fisher's exact test with a Graph Pad Prism software.

Follow up

The wounds were examined on the 2nd post operative day and subsequently on every alternate day. The sutures were removed on the 12th post operative day. The evidence of wound complication that was taken into consideration was wound dehiscence, wound blistering, active discharge, swelling warranting a single or multiple suture removals to reduce tension and wound nonhealing or delayed healing requiring a plastic surgery consult.

A total of 3 patients were lost during this period with case no. 2 [group 2] opting to take an early discharge from the hospital and 2 other patients case no. 12 [group 2] and case no. 8 [group 1]

died of complications unrelated to their injury. So a total of 19 patients were in group 1 and 18 in group 2. (Fig 8, Fig 9)



Fig 8: Two weeks post-operative picture of the medical incision closed with Allgöwer Donati suture showing adequate healing.



Fig 8: Picture showing a 4th post-operative day condition of the medical incision closed with a 2 layer closure.

Discussion

Allgöwer donati suture technique

The Allgöwer Donati suture has documented role in the closure of a traumatic wound with a hypo vascular flap in danger of being totally

devascularised with a normal skin closure under tension.

The Allgöwer-Donati suture is similar to a corner suture in that it enters the skin on one side of the wound, depicts a horizontal mattress on the far side of the incision, and then advances from deep to superficial at the finishing. It offers the

advantage of grasping a relatively broad amount of tissue (thus spreading the tension force over a large area) while not disrupting as much of the vertical blood flow as a truly horizontal mattress. It is useful wherever there are flaps or parts of an incision that appear less vascularized than others. Furthermore, the Allgöwer suture technique if properly applied, results in cosmetically acceptable scars.²⁰

Shannon et al in their study comparing the ankle wound closures comparing the Allgower Donati and vertical mattress suture found using the intraoperative angiography that the Allgower Donati suture cause a lesser amount of perfusion disturbance a.c.t vertical mattress suture.²¹

Sagi et al in their study using color Doppler found that Allgower Donati suture causes the least distortion of the cutaneous blood flow as compared to vertical mattress or a simple suture as the tension was increased in a pig model.²²The porcine model is well documented in the scientific literature as a good representation of human skin in terms of blood supply and flow, as well as wound-healing characteristics.¹³⁻¹⁹

Clinical significance: A 10.52 percent rate of wound complication was observed in group 1 [Allgower Donati closure] as compared to about 44.44 percent in group 2[2 layer closure]. A P value of 0.0293 was found to be statistically significant. To rule out any confounding factors various variables were checked against the results. The distribution of Type 1 diabetes and Type 2 diabetes mellitus in both groups' patients with wound complications yield a P value of 0.7164 [not significant].The number of patients in both groups with wound complications with either DM1 or DM2 yields a P value of 0.3778 [not significant].The complications in either an open or closed fracture in either group yield a P value of 1.000 [not significant]. The time to surgery post-trauma in wound complication cases i.e <10 hours vs>10 hrs in either group had a P value of 0.3778 [not significant]. In considering the complicated wounds with the fracture pattern [bi or tri malleolar] a P value of 1.000 was calculated [not significant]. Taking considerations of the sex of the patient with wound complications male vs female yields a P value of 1.000[not significant].

Conclusion

Of the 20 patients in each group, the group 1 had 2 patients with wound complication and group 2 had 8. Taking all other variables into consideration we can conclude that, in the diabetic patients, operative wounds of the ankle fractures treated with open reduction and internal fixation closed with the Allgower Donati suture technique yield significantly and statistically better results than the two-layered closure with subcutaneous and skin closure.

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