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RESEARCH ARTICLE

WOUND COMPLICATIONS FOLLOWING SURGICAL TREATMET OF CLOSED INTRA-ARTICULAR CALCANEAL FRACTURES

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Abstract

Objectives: To find and analyse the incidence of wound complications following surgical treatment of closed inta-articular calcaneal fractures, identify and investigate the following as possible risk factors to be a causation of post-operative wound complications: (a) age of the patient; (b) sex of the patient; (c) smoking habit; (d) timing of surgery; (e) operating and tourniquet time; (f) metal used either low profile calcaneal plate, or other thicker plates; (g) closure method of the surgical wound.

Design: retrospective study.

Setting: Orthopaedic department-Sohag university hospital, Egypt; in association with orthopaedic department- Al-Jahra hospital, ministry of health, Kuwait state; from February 2008 to December 2014.

Subjects: 64 patients with 72 intra-articular calcaneal fractures, treated via open reduction using extensile lateral approach and internal fixation using different plates.

Results: An overall wound complications rate were 26.4% (19 fractures), which included; Wound edges necrosis and wound dehiscence {Occurred in 13 (18.1%) fractures; all treated by local care of the wound and regular dressing; except 2 fractures needed debridement and secondary closure.}, and wound superficial infection {occurred in 6 (8.3%) fractures; 3 are treated by local care, and 3 required antibiotics, one of them needed debridement and secondary closure.}.

Conclusion: We recommend careful attention to these possible risk factors in surgical treatment of closed intra-articular calcaneal fractures.

Introduction:-

The management of calcaneus fractures and their associated soft tissue injuries is a challenging task[1]. Being a cancellous bone, it may be deformed under compressive force during traumatic impact. Surgical restoration of the anatomy is difficult as reduction and stabilization are technically demanding. With the improvements in diagnosis and internal fixation techniques, surgical treatment has become a reality. Many authors claim better results with surgical treatment[2,3].however as the calcaneus being a subcutaneous bone, most part of calcaneum is covered with a thin layer of skin and subcutaneous tissue. Injury to this area including surgical trauma may be associated with damage to this soft tissue envelope and devascularization of it[4].So the post-operative wound complications remain a problem[5]. The incidence of post-operative wound complications varies from0% to32.8%[3,5]. So the purpose of this study was firstly, to find the incidence of post-operative wound complications after surgical treatment of closed intra-articular calcaneal fractures in our series; and secondary, to investigate and identify a possible risk factors contributing to them, and clarify how these complications were treated.

Patients and methods:-

All data were collected retrospectively; from our study which conducted From February 2008 to December 2014 at orthopaedic department –Sohag university hospital, Egypt; in association with orthopaedic department- Al-Jahra hospital, ministry of health, Kuwait state; we studied 64 patients (with 72 intra-articular calcaneal fractures), all patients were adults, 54 males and 10 females with a ratio of 5.4:1. The mean age of the patients was 35.66 years with a range 16-60 years (figure 1). 32 patients had right sided fracture, 24 had left sided fracture, and 8 had bilateral fractures. Mechanism of injury mostly was falling from a height in 50 (78.1%) cases. Looking at the occupation of the patients, most 53 (82.8%) were blue collar workers, there were 5 (7.8%) white collar, and 6 (9.4%) were unemployed. The fracture classified according to Essex-Lopresti and Sander and all fractures were of closed type. All patients were primary; clinically and radiologically assessed. The duration of delaying from injury till surgery ranged from 1: 19 days with a mean of 7.4 days, and can be distributed as shown in (table 1) and (figure 2).

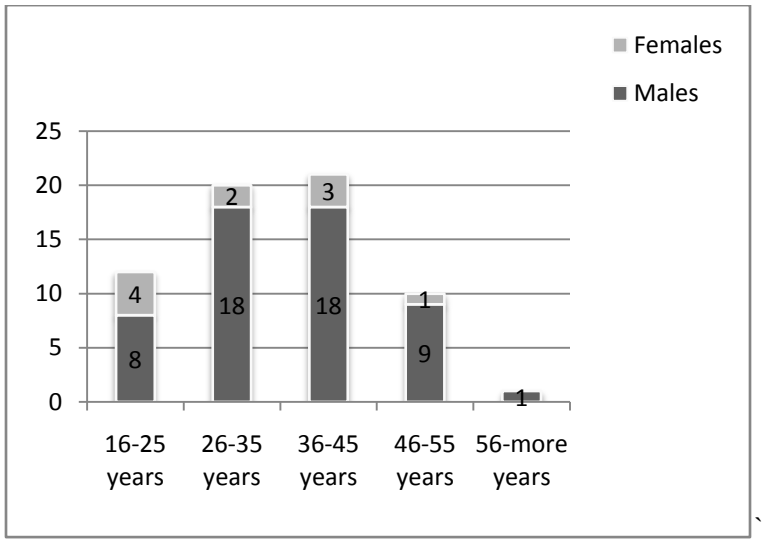

Figure (1) Distribution of patients into age groups in correlation with the sex in our series.

Time of surgery. (Days).	*No. (Patients).*	*%.*
1st._7th.	*37*	*57.8*
8th._14th.	*22*	*34.4*
15th._21st.	*5*	*7.8*
Total.	*64*	*100*

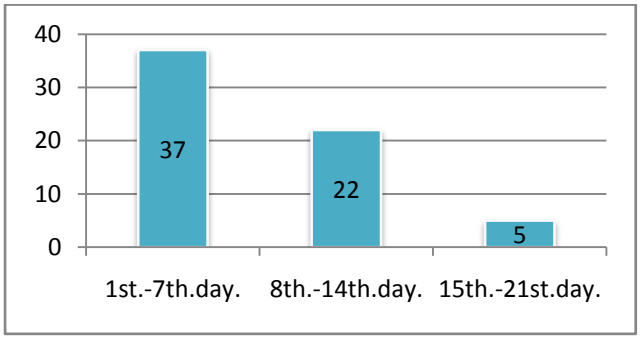

Table (1) & Figure (2): The duration of delaying from injury till surgery in our series.

All were treated via open anatomical reduction using extended lateral approach. A tourniquet was used in all cases. The fracture were rigidly internally fixed; we used 3.5mm, or 4mm cancellous screws as lag inter-fragmentary screws in 60(83.3%) fractures out of 72 fractures. We used numerous types of plates as; 3.5 reconstruction plates in 33(45.8%) fractures (25 plates was of 6 holes, 7 plates was of 5 holes, and 1 plate of 7 holes). 3.5 1/3 tubular plates in 6(8.3%) fractures (4 plates was of 5 holes, 1 plate of 6 holes, and 1 plate of 7 holes). 3.5 L.C.-D.C.P. in 1(1.4%) fracture (of 5 holes). Y-shaped plates in 7(9.7%) fractures. Calcaneal plates in 25(34.8%) fractures (10 conventional branched calcaneal plates, 11 locking branched calcaneal plates, and 4 locking mesh calcaneal plates), (table 2) and (figure 3).

We can classified the used plates into; low profile calcaneal plates (thickness 1.2 mm.) in 25(34.8%) fractures, and other thicker A.O. plates (thickness 2.8 mm.) in 47(65.2%) fractures.

Plate type.	*No. (Plates).*	*%*
3.5 reconstruction plate.	*33*	*45.8*
3.5 1l3 tubular plate.	*6*	*8.3*
3.5 L.C.-D.C.P.plate.	*1*	*1.4*
Y shaped plate.	*7*	*9.7*
Calcaneal plate.	*25*	*34.8*
Total.	*72*	*100*

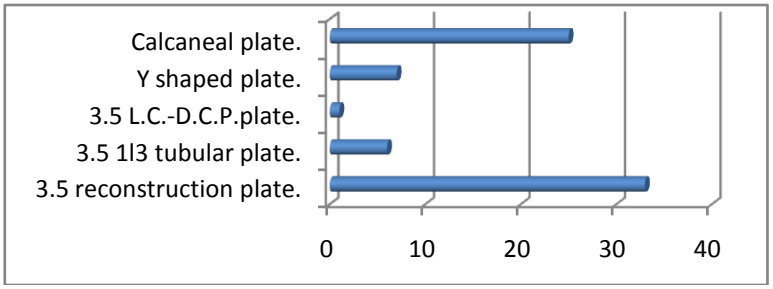

Table (2) & Figure (3): types of plates used in our series.

As regarded to wound closure; a deep haemovac drain is placed exiting proximally in line with the vertical limb of the incision. In the first 18 cases we closed the wound using skin stapler, we notice high rate of wound dehiscence. After that we started to use the modified Allgöwer-Donati technique to decrease tension on skin edges and then decrease wound edges complication. This was by using deep #0 absorbable sutures placed in interrupted, figure-of-eight fashion, beginning with the apex of the incision, and progressing to the proximal and distal ends. The sutures are temporarily clamped until all sutures have been passed. The sutures are then hand-tied sequentially, starting at the proximal and distal ends, and working toward the apex of the incision, so as to eliminate tension at the apex of the wound. The skin layer is closed with 3-0 monofilament suture using the modified Allgöwer-Donati technique, again starting at the ends and working toward the apex (figure 4).The tourniquet is deflated and sterile dressings are placed, followed by a bulky Jones dressing.

Figure (4): Wound closure using modified Allgöwer-Donati technique.

Operating and tourniquet times were obtained from operating room registers. The injured limb kept elevated, an elastic compression stocking applied, analgesia given according to the patient tolerance to pain, and intra-venous antibiotics were administrated for 72 hours postoperatively followed by prophylactic oral antibiotics for one week more. The haemovac drain removed after 48 hours post operatively. All patients were encouraged for early mobilization started on 2nd day post-operatively .The anticoagulant stopped once the patient started mobilization out of the bed. The patient usually discharged from the hospital after being steady mobilized out of bed, usually on 3rd. day post-operatively. The sutures are removed once the incision is fully sealed and dry, typically at 2-3 weeks; the

sutures should not be removed, however, until the wound is fully healed. All cases were strictly followed up both clinically and radiologically range of 4-45 months, with mean follow up period of 11.9 months.

Statistical analysis:-

For the purpose of statistical analysis the fractures are divided into complicated and uncomplicated groups. Age, sex, smoking, timing of surgery, operating and tourniquet time, metal used for fixation, and closure method of the surgical wound; were studied as possible risk factors to wound complications following surgical treatment of closed intra-articular calcaneal fractures.

Statistical analysis was performed using Statistical Package for Social Services software SPSS™ program.

Results:-

The criteria used to describe wound complications were as follow; acute infection was defined by using clinical criteria such as inflammatory signs or persistent drainage with or without positive culture results that resolved with local care. Beyond 2 weeks, infection was defined as a clinical situation requiring antibiotics; wound edges necrosis and wound dehiscence.

In our series wound complications following surgical treatment of 72 closed intra-articular calcaeal fractures, occurred in 19 (26.4%) fractures (table 3).

Type of early complication	*No. of fractures*	*%*
Wound edges necrosis and wound dehiscence.	*13*	*18.1*
Superficial infection.	*6*	*8.3*
Total.	*19*	*26.4*

Table (3): wound complications following surgical treatment of 72 closed intra-articular calcaeal fractures.

- *Wound edges necrosis and wound dehiscence:*

Occurred in 13 (18.1%) fractures; all treated by local care of the wound and regular dressing; except 2 fractures needed debridement and secondary closure.

- *Superficial infection:*

In our series this occurred in 6 (8.3%) fractures; 3 are treated by local care, and 3 required antibiotics, one of them need debridement and secondary closure.

The statistical analysis of the studied possible risk factors are summarized in (table 4).

Risk factor	*statistic*	*Complicated group*	*Uncomplicated group*
Age	Total fractures No. Range (years) Mean (years)	19 25-54 40.37	53 16-60 33.81
Sex	Total fractures No. Males No. & (%) Females No. & (%) Males: Females ratio	19 16 (84.2%) 3 (15.8%) 5.3: 1	53 43 (81%) 10 (19%) 4.3: 1
Smoking	Total fractures No. Smokers No. & (%) Non Smokers No. & (%)	19 13 (68.4%) 6 (31.6%)	53 19 (35.85%) 34 (64.15%)
Time to surgery	Total fractures No. Range (days) Mean (days)	19 1-12 4.84	53 1-19 8.38
Operating and tourniquet time	Total fractures No. Range (minutes) Mean (minutes)	19 75-150 106.31	53 60-125 84.25
Metal used	**Total No. of Low profile plates =25plates:* No. of low profile plates & (%) **Total No. of Non-Low profile plates =47plates:* No. of non-low profile plates & (%)	4 (16%) 15 (31.9%)	21 (84%) 32 (68.1%)
Wound closure type	**Total No. of wounds closed by staples =18* No. of wounds closed by staples & (%) **Total No. of wounds closed by modified Allgöwer-Donati technique =54* No. of wounds closed by modified Allgöwer-Donati technique & (%)	7 (38.89%) 12 (22.22%)	11 (61.11%) 42 (77.78%)

Table (4): results of possible risk factors analysis for wound complications following surgical treatment of closed intra-articular calcaneal fractures.

Discussion:-

Although the surgical treatment of the calcaneal fractures seems to improve the outcome, the wound complications rate after surgery and internal fixation remains high. In our study; out of 72 displaced intra-articular calcaneal fractures, it was 26.4% (19 fractures); including wound edges necrosis and wound dehiscence in 18.1% (13 fractures), and wound superficial infection in 8.3% (6 fractures).

In comparable to other reported studies, Palarick[6] reported seven infections in 28 fractures treated surgically (25%). Chan et al.[7] reported three infections in 31 patients (9.6%). Zwipp et al.[8] reported a wound edge necrosis rate of 8.3% and haematoma rate of 2.5% in 157 patients. Be'zes et al.[2] reported an infection rate of 5% and skin necrosis rate of 8% in 120 fractures. Stromsoe et al.[9] recorded superficial infection and skin necrosis in 12 of 46 fractures (28.2%).

From The statistical analysis of the studied possible risk factors for wound complications following surgical treatment of closed intra-articular calcaneal fractures (table 4); we can find: (a) complications were more in older age group. (b) Complications were more in males, with males: females ratio 5.3: 1 in complicated group. (c) Complications were more with smoking, in 68.4% in complicated fractures, which confirm the earlier finding of Sorensen et al. that smoking increases the risk of post-operative wound infections and skin flap necrosis.[10] (d) Complications were decreasing with appropriate delay surgical intervention[11,12] until wrinkling of the skin reappears prior to afflicting a second assault on the soft tissue envelope for all calcaneal fractures requiring surgical intervention. The leg must be elevated and cold compresses started on admission. This delay may allow the soft tissue envelope to recover and swelling to subside to a large extent thereby promoting better integument closure and wound healing following surgery. In our study the appropriate delaying in surgery mean was 8.38 days post fracture. (e) Complications were more with lengthy operating and tourniquet time; as this increasing ischemia, and trauma by soft tissues retraction. (f) Complications were less with using a low profile plates, due to decreasing tension on soft tissue and easy wound closure without tension. (g) Complications were decreasing by using the modified Allgöwer-Donati technique which decreasing tension on skin edges and then decreasing wound edges complication.

Conclusion:-

Despite developments in the surgical treatment of a fractured calcaneum, wound complications following operative fixation still remain a problem. In order to reduce these complications we recommend the following: (1) more careful patient selection; younger aged patients and female sex; have a better prognosis, smokers have a bad prognosis; (2) delaying surgery until wrinkling of the skin reappears prior to surgery; (3) the surgeon should be experienced to reducing the operating and tourniquet time; (4) using of low profile hardware; (5) wound closure using modified Allgöwer-Donati technique.

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