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## Fractures of the ankle are amongst the most common injuries treated by ORIF

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### Abstract

Fractures of the ankle are amongst the most common injuries treated by an orthopaedic surgeon [1, 2]. With literature indicating that open reduction and internal fixation (ORIF) yields better results than conservative management, there has been an increasing trend towards operative intervention. The aim of internal fixation is to stabilise bony fragments and permit early movement, but the onset of a surgical site infection (SSI) may lead to a poor outcome. Notwithstanding this, they have been proven to prolong the length of hospital stay by two weeks per patient and double re-hospitalization rates. It is therefore imperative that such occurrences are minimised.

Whilst some authors have investigated the long-term results following fracture few have focussed on SSIs. The purpose of this study was to therefore retrospectively review the rate of infection following ankle ORIF and determine factors in their causation. We hypothesised that the infection rate would be relatively low other than in certain patient subgroups such as diabetics and the elderly. The identification of patients susceptible to such problems is useful for evaluating operative indications and the need for further preventative measures.

**Keywords:** ankle, common injuries, ORIF

### Introduction

#### Material and Methodology

We undertook retrospective analysis of all patients who received ORIF for an ankle fracture study was conducted in Department of Orthopaedics of Maharajah's Institute of Medical Sciences between March 2017 to March 2018. The inclusion criteria were therefore all ankle fractures that underwent surgical fixation during the study period and for which complete medical charts, operative records and radiographs were available for. All cases were treated in a trauma unit within a large university teaching hospital.

A consecutive series of 60 skeletally mature patients were identified using the computerised theatre register at our institution. The cohort consisted of 28 females and 32 males with an average age of 40 (Range 16-82) years. Medical charts were then reviewed to identify preoperative details including patient age, gender, mechanism of injury, type of injury (open or closed), anatomical classification of the fracture, comorbidities, medication, smoking history, grade of operating surgeon and the delay to surgery. Initial recording of the data onto medical charts was performed by several members of different orthopaedic surgical teams, whereas the retrospective analysis was performed solely by the authors.

A similar intraoperative protocol was used throughout the study group, with orthopaedic residents or attendees performing all procedures during a dedicated trauma list within the confines of a designated clean air trauma theatre. Surgical fixation was carried out when the overlying skin exhibited wrinkling. This was based on clinical assessment during a ward round on the morning of the proposed surgery, or a preoperative ward round the evening before surgery was carried out. Prophylactic intravenous cefuroxime, as specified in the hospital formulary, was used in all cases. All operations were performed under tourniquet control. Operations were carried out under the supervision of several orthopaedic attendees. As such, while the method of wound closure was uniform (layered closure, with vicryl and nylon/ clips) the specific choice of material was at the discretion of the supervising surgeon. To evaluate the stability of the fixation, intraoperative image intensification was used in all cases.

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During the postoperative period the following parameters were assessed: onset of SSIs, need for readmission, need for further surgery and the final outcome.

For those cases where the clinical suspicion of a wound infection was high, the classification of superficial and deep SSIs was used. Confined to only the skin and subcutaneous tissue layers, the former was identified by an acutely inflamed superficial incision. Alternatively, a deep infection was characterised by involvement of the underlying muscle and fascia with the production of a purulent discharge and/or abscess. It was recognised clinically by a deep incision that spontaneously dehisced or necessitated exploration due to either pyrexia or localised pain [9]. In cases where wound discharge cultured micro-organisms the advice of the microbiology department was sought in order to institute appropriate antimicrobial therapy.

The Fisher's exact test was used for statistical evaluation of categorical data with the aim of finding factors associated with infection.

## Results

The majority of patients presented to hospital within one (Range 0-19) days of injury and on average, were operated on within five (Range 0-19) days. The mean length of hospital stay was 10 (Range 2-60) days. A unimalleolar injury was found in 28 patients, bimalleolar in 18 and trimalleolar in 14. There were 56 closed and 4 open fractures. These were predominantly due to low energy falls, as was noted in 48 patients. The remaining cases were due to a sporting event in 8 patients and road traffic accident in four. 48 of 60 patients were followed up to 34 months following hospital discharge with the remaining 12 not seen again for problems pertaining to their operation.

Medical problems were frequently reported with 18 having one system disease, 13 having two-system disease and 7 reporting three-system disease. The most common conditions were hypertension, asthma, diabetes and epilepsy. The remaining 22 patients were free from chronic disease. 10 of the 14 patients with trimalleolar fractures had comorbidities in contrast to 9 of the 28 with unimalleolar injuries (Table 1). Furthermore, the age of the trimalleolar group was higher than the unimalleolar subset. Residents performed many of the fixations under supervision as necessary, with the attending surgeon being the primary surgeon in six cases.

We noted 15 complications within the study group. These comprised of 8 superficial infections, 4 deep infections, two fixation failures and one case of chronic regional pain syndrome. Patients who were diagnosed to have superficial infections were all treated as an outpatient with oral antibiotics but without microbiological confirmation of an organism. Those with a diagnosis of a deep infection though were all readmitted to hospital and had micro organisms isolated. Within this group, four patients underwent further surgery including a washout and debridement in two cases and removal of metal work in a further two. The final patient received intravenous antibiotics. All patients that required further surgery healed satisfactorily.

## Discussion

Internal fixation is the foremost treatment employed for ankle fractures [6]. Results are generally favourable with the majority of patients having a good functional outcome [3, 10]. There are instances though when complications occur, some of which necessitate in further surgery [11]. There is a paucity of literature investigating this however, and the studies that

have been conducted vary considerably.

In a retrospective study by Beauchamp *et al.* [6] 71 patients who underwent ORIF of an ankle fracture were reviewed. Wound infections were noted in 11% but no causative factors could be identified. In a recent study by SooHoo *et al.* [12] the complication rate following ORIF for 57,183 ankle fractures was reviewed. Open injury, diabetes and peripheral vascular disease were recognised as being strong risk factors. Accordingly, the incidence of wound infections was 1.44% in the overall study population, yet in those with complicated diabetes was 7.71%. Admittedly though, the authors did not investigate the effect of smoking on such occurrences. Furthermore, unlike in the present study, the fracture pattern was not significant.

The elderly population have long been considered to have a greater risk of postoperative morbidity. To further investigate this, Srinivasan *et al.* [13] reviewed 74 elderly patients who had received ORIF for an ankle fracture in order to establish the rate of complications. Deep infection was noted in 1% and delayed wound healing in 9%. Conventionally regarded as a vulnerable subgroup of patients, elderly individuals were in actual fact noted to have a good outcome. Conversely, Anderson *et al.* [2] conducted a retrospective case control study of ankle fractures in the elderly and concluded that patients over the age of 65 years were at a significant risk ( $p < 0.007$ ) of postoperative complications when compared to younger patients.

In the current study, SSIs formulated the majority of postoperative problems. Superficial lesions were found in seven patients whereas deep infections were diagnosed in five. The latter were also associated with further surgery in four cases, including removal of the fixation device in two patients and washout and debridement in the remaining two. Wound healing problems in this area are traditionally thought to be due to factors such as delay to surgery, degree of soft tissue damage, Comorbidities such as diabetes tourniquet use and advanced age of the patient [8, 9, 14-17]. Our results however, only implicate smoking and a bimalleolar fracture. We acknowledge that the rate of SSIs reported here are considerably higher than those quoted in the literature which range from 3-8% for superficial infections and 1-6% for deep ones [3, 13, 18, 19]. Since there is evidence to suggest that current and previous exposure to cigarette smoke is a potent risk factor for infection, it is plausible that the high proportion of current and former smokers within the study group may be responsible for this [20]. This is also a direct reflection of the high prevalence of smokers within the geographical location from which the sample was taken. Owing to the small sample size in the current study, little insight into the effect comorbidities such as diabetes have on infection rate could be evaluated. Whilst it is evident that the majority of cases were performed by residents, this was not a significant variable.

Cigarette smoking is a well recognised risk factor for infection but there is little evidence to suggest it has a similar role in the incidence of SSIs following ankle ORIF [10, 20]. Egol *et al.* [10] prospectively followed 232 patients treated surgically for an ankle fracture in order to evaluate predictors of short-term functional outcome. A history of smoking was not deemed to be a significant variable. Conversely, Mangram *et al.* [21] conducted a randomised control trial comparing two groups of smokers undergoing elective hip and knee replacements. The intervention group received intense smoking cessation whereas the control group did not. There was an 83% reduction in wound complication risk in the intervention group when compared to the control (5 vs 31%).

Furthermore, in a study by Bhandari *et al.* [22] poor functional outcomes were noted in those who smoke.

Considerable work has been carried out on the outcome following different patterns of ankle fracture. The majority of research concludes that bimalleolar fractures are associated with poor results, yet there has been no association to date with the development of SSIs. In a long-term study by Day *et al.* [23], 25 patients with bimalleolar fractures were followed up for 10-14 years after their initial injury. Poor outcomes were recorded in 24% of the group. Similarly, in a prospective study of 456 patients who had sustained an ankle fracture, Tejwani *et al.* [24] noted both a worse functional outcome and higher rate of elective hardware removal in patients with bimalleolar injuries. A comparable result was also found by Kennedy *et al.* [25]; however other predictors of poor outcome were also noted. These included the severity of the initial injury and advanced age of the patient.

The results presented in the current study are not applicable to all ORIF procedures and as such, the conclusions cannot be applied ubiquitously to orthopaedic practice. To overcome this, future studies should assess the incidence of SSIs related to ORIF of many different types of fractures and in doing so, ways in which they can be minimised on a larger scale may be determined. Other limitations of our study are predominantly due to the method of data collection and study design. Sole reliance upon medical records may jeopardise the reliability of the results due to inaccurate recording of data. Details of pre and postoperative parameters such as soft tissue and bony abnormalities may not have been classified as attentively as they would have been done in a prospective study. We do not also have data on how many of the ankles were dislocated on presentation, and needed manipulation prior to surgery. Fractures associated with dislocations are likely to be associated with more soft tissue trauma. Moreover, outcomes measured retrospectively are subject to the bias of their surrogates. It is feasible that due to several observers recording details of the wounds, inconsistencies with the diagnosis of an infection may have occurred. It is therefore difficult for one to be certain that all positive cases were correctly identified.

### Conclusions

Our small study showed a correlation between the development of SSIs and either smoking and/or bimalleolar fractures. SSIs have a profound effect on the outcome following surgery and as seen here, can lead to further procedures. Accordingly, we recommend that patients with ankle fractures who either have a history of smoking and/or bimalleolar injury be counselled about the potential risk of infection and its implications on their functional recovery. The ability to identify patients at risk of such problems highlights the need for caution during the perioperative period so that care strategies may be altered to facilitate recovery.

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