

The timing of closed unstable ankle fracture fixation and major wound complications — an observation from a UK major trauma centre

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Abstract

Objective: A retrospective cohort study was performed at a UK major trauma centre to identify whether timing of surgical fixation of closed unstable ankle fracture affected the rate of major wound complications.

Methods: Consecutive cases of unstable ankle fractures treated with open reduction internal fixation (ORIF) between March 2014 to December 2016 were included in this retrospective cohort study. Data were collected from 2018 onwards allowing a minimum follow-up of 2 years. Patients under the age of 18, polytrauma, open fractures and those requiring external fixation were excluded. Timing of ORIF were categorised into early (within 24 hours of injury) and delayed (after 24 hours of injury). Primary outcome was major soft tissue complications (defined as deep wound infections or wound breakdown that required further surgery). Secondary outcomes included fixation failure, and symptomatic metal work requiring removal.

Results: A total of 235 consecutive cases were included. There were 108(46%) patients in the early fixation group, and 127(54%) patients in the delayed fixation group. Seven major wound complications were identified. Five of which were in the early group, and 2 in the late group. There was no statistically significant difference in the major wound complication rates between the early and delayed surgery groups ($p = 1.000$).

Conclusion: No significant difference was observed in the rate of major soft tissue complications between early and delayed fixation for isolated unstable ankle fractures.

Keywords: Trauma, Ankle fracture, ORIF, Complications. (JPMA 71: S-26 [Suppl. 5]; 2021)

Introduction

Ankle fractures are amongst one of the most common fractures encountered in the adult population.^{1,2} In the UK, the rate of ankle fractures is 10.4 per 10,000 person-years for people aged 50 years or over, and 7.5 per 10,000 person-years for people aged between 19 and 49.³ The total incidence of ankle fractures is expected to rise with the aging population.^{4,5}

Surgery for unstable ankle fractures is associated with a number of serious complications such as implant failure, mal-union, non-union and wound complications. Wound complications from ankle fracture surgery include superficial infections, wound dehiscence, wound edge necrosis and deep wound infections, all of which can be challenging to rectify. In some patients, fracture and surgical factors can contribute to risk of wound complications. Surgical factors that are potentially controllable are of particular interest to reduce wound complications. Tissue handling, placement of incision, implant selection and the timing of surgery are all important modifiable factors that surgeons should pay attention to whilst planning for ankle fracture fixation.

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The optimal timing of surgery for closed ankle fractures has been debated in the literature.⁶⁻¹⁷ Early fracture fixation within 24 to 48 hours from injury has been advocated to reduce wound complications, reduce hospital length of stay as well as promote early return to function. However, the window of opportunity for early surgical stabilisation is short due to the onset of soft tissue swelling. Typically when swelling is deemed too great for safe incision and closure of surgical wound, then the surgery is postponed till the swelling subsides. Some units allow patients to go home for limb elevation and then return to hospital for surgery as outpatient, thus saving the costs of hospitalisation.¹⁸⁻²⁰ Some units admit the patient for strict limb elevation for checking the swelling daily. Surgery is performed once the swelling subsides. However, despite being treated as an in-patient, delays can occur due to operating theatre capacity and logistical factors, especially seen in major trauma centres where other cases may need to be prioritised. BOAST guidelines recommends early fixation on the day or day after injury for patients under 60 years.²¹ AO group have recommended surgery within 6 to 8 hours from injury, or postponed to 4 to 6 days if early surgery is not possible.²²

The consequences of delay in surgery have been conflicting in literature, some view that surgical delay leads to increased postoperative wound complications,

whilst others have reported that no difference is found. With this factor in mind, we reviewed the results of surgery for isolated closed ankle fracture and associated clinically significant wound complications at a major trauma centre in the UK.

Methods

In this cohort study, 369 consecutive patients were admitted to Royal Sussex County Hospital, Brighton, England (Major Trauma Centre) with unstable ankle fractures requiring operative fixation between March 2014 to December 2016. The patients were identified retrospectively in 2018 using Bluespier (Bluespier™, Bluespier International UK), which is used as our local hospital information system after approval from the clinical governance committee. Data on any readmissions to hospital related to the same ankle injury were collected retrospectively.

Exclusion criteria were open fracture, polytrauma, age under 18, external fixator or hindfoot nail used as initial treatment, transferred to other hospital for treatment and cases lost to follow up beyond 24 months after surgery. With these criteria, 134 patients were excluded (22 paediatric, 39 polytrauma, 7 hindfoot nail, 36 external fixation, 11 open fractures, 9 treated at other centre and 10 others). A total of 235 patients with closed unstable ankle fractures having open reduction internal fixation as the primary index procedure were included in the study for detailed analysis.

Patient medical records and radiographs were reviewed by two surgeons to verify recorded diagnosis and procedures. Data on patient demographics (age, gender), date of injury, fracture pattern, fixation method, implants used, number of days from presentation to surgery, length of hospital stay and details for any complications requiring further surgery on the same ankle were recorded.

Unstable ankle fractures were defined as lateral malleolar fracture with talar shift, medial malleolar fractures with syndesmotic injury or associated maisonneuve pattern, and bi/trimalleolar fractures.

Surgical fixation was performed for bimalleolar and trimalleolar fractures, unstable isolated lateral or medial malleolar fractures and isolated syndesmotic diastasis.

In our institution, lateral malleolus fractures that are amenable for anatomical reduction were stabilised with lag screw combined with one-third tubular neutralisation plate. Those with communicated fracture patterns or poor bone quality where anatomical reduction at fracture site

cannot be achieved were stabilised with a bridging plate (DCP, LC-DCP, recon plate) or distal fibular locking plate (DePuy Synthes Distal Fibula locking compression plate (LCP) or Smith and Nephew 3.5mm PERI-LOC VLP). Medial malleolus fractures were stabilised with two cancellous compression screws. Posterior malleolus fractures were stabilised with a posterior antiglide plate. Syndesmosis stability was examined intraoperatively with stress tests under intraoperative imaging, and if diastasis was noted, this would be stabilised with one or two trans-syndesmosis cortical screws.

Operations were performed by a consultant, trauma fellow or supervised registrar or house officer. All operations were done with thigh tourniquet applied with preoperative prophylactic antibiotics administered by anaesthetist. Post-operatively, patient were allowed to full weight bear in a walking boot on the discretion of the surgeon, based on intraoperative findings of fixation stability and bone quality. All patients were followed up at 2 weeks and at 6 weeks for reviews.

The timing from presentation to surgery was largely dependent on soft tissue swelling. Daily swell check using the skin wrinkle test was performed by the ward consultant on duty for amenability for surgery. Whilst waiting for surgery, all admitted patients were instructed to strictly elevate the injured limb with supervision by nursing staff. Other factors causing delay to surgery includes limited theatre capacity when other cases may need to be prioritised, and for patients with unstable injury found subsequently in the follow up clinic which is often between 1 to 2 weeks after injury. Timing of surgical fixation was categorised into early (ORIF within 24 hours of injury) and delayed (ORIF after 24 hours of injury).

In view of complications, we only report those with severe complications that have required further hospital admission for intravenous antibiotics or surgical management such as wound washout and debridement, metal work removal, and revision fixation. As such, superficial wound infections that did not lead to admission or surgical treatment were not classed as major complications in our study. Data was analysed with Statistical Package for the Social Sciences (SPSS) version 16.0 (SPSS, Chicago, IL) and p value of 0.05 was considered significant.

Results

Two hundred and thirty-five patients with isolated closed unstable ankle fractures were analysed in detail. The average age was 48 ± 19.6 years with a range of 18 to 93 years. One hundred and thirty-four (57%) were females.

Table-1: Demographics and procedural factors in early and delayed fixation groups.

	Early fixation (n=108)	Delayed fixation (n=127)	Total	P-value
Fracture pattern				0.007 ^b
Bimalleolar	38	44	82	
Trimalleolar	25	15	40	
Lateral malleolar	40	46	86	
Medial malleolar / maisonneuve fracture	5	21	26	
Others	0	1	1	
Demographics				
Mean age (years),(range)	48±18.25 (18-88)	49±19.97(18-93)	48±19.16 (18-93)	0.7535 ^a
Female	61	73	134	0.8955 ^b
Male	47	54	101	
Clinical pathway				
Admission status				<0.0001 ^b
Inpatient surgery	108	63	171	
Outpatient surgery	0	64	64	
Mean Postoperative length of stay (days) (range)	4.11±11.46 (0-77) 3.42±5.28*(0-48)	4.47±6.78 (0-38)	4.03±9.2 (0-77)	0.88045 ^{c*}
Complications				0.093 ^b
Major wound complications	5	2	7	1.000 ^b
Symptomatic metalwork	3	9	12	
Fixation failure	1	5	6	

^a T test, ^b Fisher's exact test, ^c Mann-Whitney U test, * outlier case excluded (prolonged postoperative hospital stay due to medial reasons).

Table-2: Comparison between patients groups with or without wound complication.

	Major wound complications (n= 7)	No wound complication (n=228)	P-value
Clinical pathway			
Mean time to surgery and range (days)	1.9± 2.04 (0 to 6)	3.5±4.27 (0 to 23)	0.2757 ^c
Fracture pattern			0.008 ^b
Bimalleolar	3	72	0.6916 ^b
Trimalleolar	4	31	0.0132 ^b
Lateral malleolar	0	86	
Medial malleolar / maisonneuve fracture	0	25	
Demographics			
Mean age and range (years)	57±24.46 (19 to 88)	48±18.97 (18 to 93)	0.2697 ^c
Female	6	128	0.2437 ^b
Male	1	100	
Diabetes	0	15	1.0000 ^b
Surgeon grade			0.5567 ^b
Consultant	4	87	
Trauma fellow	0	24	
Registrar	3	115	
Senior House Officer	0	2	
Lateral Implant type			0.0323 ^b
One-third tubular plate	1	121	
Synthes fibular locking	3	31	0.0645 ^b
Smith and Nephew VLP	1	24	
Recon plate	1	4	
LC-DCP	0	16	
No lateral implant	1*	32	

*medial malleolus screw.

^a T test, ^b Fisher's exact test, ^c Mann-Whitney U test.

Table-3: Details of cases with major wound complications.

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Age (years)	66	88	61	37	82	49	19
Gender	M	F	F	F	F	F	F
Comorbidities	Fit and well	Fit and well	Hypertension	Asthma	CKD on dialysis	Hypertension	Fit and well
Fracture pattern	Bimalleolar	Bimalleolar	Trimalleolar	Bimalleolar	Trimalleolar	Trimalleolar	Trimalleolar
Timing of surgery (days)	1	1	3	6	1	1	0
Implant used	One-third tubular	Synthes fibula locking	Medial malleolus Compression screws only	Smith and Nephew VLP periloc	Synthes Recon plate	Synthes fibula locking	Synthes fibula locking
Surgeon grade	Consultant	Registrar	Registrar	Consultant	Consultant	Registrar	Consultant

The female group had a greater mean age of 51 compared to 41 in male.

The overall mean time from injury to fixation was 3.5 ± 4.23 days (range 0 to 23 days) with a mode of 1 day. To account for outpatient surgeries, the mean number of days from hospital admission to surgery was 1.2 ± 4.9 days (range 0 to 23). Early fixation (within 24 hours) was undertaken in 108 (46%) patients. Forty-seven (20%) patients had fixation on day 6 or more after injury. The overall average postoperative length of hospital stay was 3 ± 9.2 days (range 0-76). Patients were divided into early fixation (less than 24 hours) and delayed fixation groups, patient and injury characteristics are summarised in Table-1.

Complications were noted in 25 patients. Seven patients had fixation failure and revision ORIF. Twelve patients had symptomatic metalwork causing irritation with subsequent metal work removal. Specifically, major wound complications (deep wound infections, wound dehiscence) occurred in 7(2.98%) patients. Six of these patients had deep surgical site infection and required wound debridement, washout and removal of metal. One patient was re-admitted and treated with intravenous antibiotics only. Of the 7 patients with major wound complications, 5 were in the early fixation group. Soft tissue complication rates of 10%, 3.8% and 0% were observed in trimalleolar fractures, bimalleolar fractures and unimalleolar fractures respectively. A comparison of the demographics and surgical factors between cases with or without major wound complications is shown in Table-2. Details of each case with major wound complications is shown in Table-3.

Discussion

Wound complication is a devastating consequence of ankle fracture surgery in which many scholars are looking for ways to optimise the modifiable risks factors such as timing to surgery. In our study, we found no significant statistical difference in the rate of severe wound complications with the timing of surgery for isolated closed ankle fractures treated with internal fixation.

As expected, more severe fracture pattern such as trimalleolar ankle fractures were associated with the highest risk of wound complications. In our study, 63% of trimalleolar fractures were surgically stabilised within 24 hours of injury, whilst more than half of bimalleolar, unimalleolar fractures and equivalents were treated beyond 24 hours. Contrary to some reports in literature, we found that severe wound complications trended towards injuries with early fixation within 24 hours, whilst no patient treated beyond 1 week developed any wound complications. The figures in our study however were too low in numbers to show a statistical difference.

Although difficult with our retrospective study to determine the cause of wound complications in this early operative group, a potential reason could be attempting to operate on ankles too early when they had massive swelling. Excessive skin tension on closure of swollen tissue as well as excessive retraction may cause more tissue damage intraoperatively. As also highlighted by Tantigate et al, surgery performed too soon could lead to wound complications due to severe swelling.¹⁵ The degree of soft tissue swelling varies from case to case owing to the mechanism of injury, patient comorbidities and ability to provide ice, rest and elevation to the injured limb early after injury. With this in mind, suitability for early surgery should be determined on a case to case basis, rather than subjecting patients to surgery even if the tissues are grossly swollen. Tissue swelling and fracture blisters are notably major factors for delaying surgery, and therefore patients should be instructed for strict elevation of the injured limb, with clinical assessment of skin swelling performed daily if the patient is admitted in hospital.

If timing of surgery is not a key factor to wound complications, perhaps we should be focusing more on other factors. Miller et al have found patient factors such as open fractures, diabetes, peripheral neuropathy, wound compromising medications and postoperative noncompliance to be more predictive for postoperative wound complication than the timing of surgery.²³

Significant predictors for surgical site infections as reported by Sun et al included high-energy injury, open injury, older age, greater BMI, incision cleanliness grade 2 to 4, surgeon level, chronic heart disease, history of allergy, and preoperative neutrophil count of >75%.²⁴ Although these risk factors are important to note, in the acute setting of ankle fracture, many patient factors such as obesity and diabetes are not simply modifiable prior to surgery.

Our study did not find a link between surgical timing with wound complications, and therefore we believe further studies are required to investigate into other modifiable risk factors for wound complications. A recent study by Gowl et al found increased intraoperative time to be an independent risk factor for surgical site infections.²⁵ Implant selection is also another modifiable factor that has been investigated with association of postoperative wound infections. Schepers et al reported a wound complication rate of 17.5% in the use of locking plates versus 5.5% in the conventional fixation with one-third tubular plate ($p = 0.019$) over a 6 year period.²⁶ In our study, we found that 4 out of 7 patients with wound complications had been stabilised with distal fibula locking plates. Our complication rate with the use of fibular locking plate was 6.8% versus 0.8% with one-third tubular plates. Our findings resonate with the results from Schepers' study and suggests caution when using locking plates,²⁶ however a larger study would be useful to determine the significance of this factor.

Lastly, our study also found no significant difference in the postoperative length of stay. The findings are mixed in the literature on early versus delayed surgery on the postoperative length of stay. Whilst a large proportion of studies have shown a reduced length of stay with early surgery,¹³ few studies, including our study have not demonstrated this.¹⁵ Our findings could be resulting from out-patient surgery for ankle fractures, where a number of patients with reliable compliance were allowed home, for strict elevation and scheduled back to hospital for planned procedure. The so called "home therapy" has been adopted by many orthopaedic units, with ankle fractures fixation performed as outpatient settings found to be safe and cost effective in selected patients.^{19,20} Although the costs of an acute trauma bed is approximately £225 per day and early surgery may seem to be logical solution to be cost-effective, it may not be in the best interest of the patient if their soft tissue is not suitable for early intervention.

Conclusion

No significant difference in the rate of major soft tissue

complication was found between early versus delayed surgical fixation for isolated closed unstable ankle fractures. Whilst early surgical fixation has been advocated to reduce healthcare related costs and promote early return to function, suitability for early intervention should be assessed on a case to case basis. Further studies should focus on other modifiable factors related to postoperative wound complications.

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Conflicts of Interest: None.

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