Surgically Treated Ankle Fracture, Danis – Weber Type C: A Short Term Functional Outcome

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ABSTRACT:

BACKGROUND:

Fractures of the ankle are fairly common injuries. Large comparative studies that have evaluated long-term functional outcome of operatively treated ankle fractures are lacking.

OBJECTIVE:

This study is performed to analyse the functional outcome of gender, weight and age of patient with Weber C in the early follow up time.

PATIENTS AND METHODS:

This retrospective review of 18 patients (13 males and 5 females), age ranges between 19-78 years (average 38.9 years) with Weber type C ankle injury that were treated by open reduction and internal fixation in Medical city Complex from October 2013 to February 2014. All patients were followed up for a mean time of 15.5 months (12- 30 months) after index surgery. The body mass index (BMI) of all patients ranges from 19.9-36.7 (mean 27.4), of these patients, 6 (4 females and 2 males) had BMI more than 30 (mean 33.5), the other 12 patients had BMI of less than 30 (mean23.4). Outcome measurements were determined using the Olerud and Molander scoring system and Linear Analogue Scale for all patients.

RESULTS:

According to the (OMAS) scoring system, there were 12 patients had excellent outcome, 3 had good, 2 had fair and one patient had poor results.14 patients of less than 50 years their average OMAS score was 82.8, while those of more than 50 years 57.5 (P value =0.001); LAS score for patients less than 50 years average score was 8.07 while those more than 50 years was 5.5 (P value =0.0007).Male gender in this study was 13 patients, average OMAS score was 91.5, and average LAS was 9, female patients were average scored 40 and 3.6 by OMAS and LAS respectively. (P value=0.0022).Regarding the BMI, patients of less than 30 had average OMAS score 85 and LAS score 8.25. On the other hand, patients who had more than 30 BMI had average OMAS 61.6, and average LAS 6. (P value =0.0001).

CONCLUSION:

The early follow up time shows better results in male gender, younger age group, and non-obese patients. A long follow up time is required for this type of injury in order to base the evidence of these parameters and to evaluate the functional outcome.

KEY WORDS: ankle fractures, weber c, surgical treatment, functional outcome.

INTRODUCTION:

Ankle-related complaints are among the most commonly encountered problems for musculoskeletal clinicians. Ankle injuries encompass a broad array of pathology including trauma, deformity, reconstruction, and sports medicine. For nontraumatic injuries, physicians typically provide non-operative treatment modalities to start including activity modification, rest, immobilization, bracing, orthotics, nonsteroidal anti-inflammatory medications, intra-articular injections, and physical therapy. When patient symptoms worsen and begin to negatively affect quality of living, surgical intervention often becomes necessary for definitive management. Patients with traumatic injuries, including fractures and/or dislocations, often require immediate surgical intervention. Regardless of the specific surgical technique performed, these procedures all require adequate visualization of the ankle pathology to be performed correctly[(1)].

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The ankle joint is comprised of three bones including the tibia, fibula, and talus. The distal tibia forms an inferior quadrilateral surface that articulates with the talus and fibula to form a constrained joint. The fibula is externally rotated 25–30° relative to the distal tibia in the incisura fibularis, and the talus is wider anteriorly than posteriorly [(2)].

Parameters (figure 1) that suggest unstable fracture patterns include lateral malleolar displacement greater than 2 mm with resultant talar shift on the AP or lateral, significant medial malleolar displacement, deltoid ligament disruption defined by greater than 5 mm medial clear space, syndesmosis injury identified by tibial-fibular clear space greater than 5 mm or tibial-fibular overlap of less than 10 mm (both on the AP), or a tibial-fibular overlap of less than 1 mm on the mortise view[(3)].

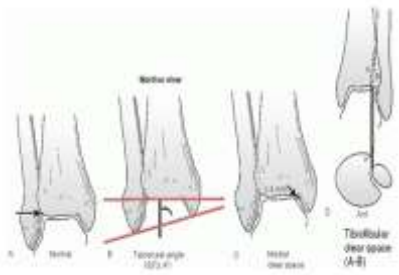


Figure 1: Radiographic appearance of the normal ankle on mortise view[3].
A. The condensed subchondral bone should form a continuous line around the talus.
B. Talocrural angle should be approximately 83 degrees. When the opposite side can be used as a control, the talocrural angle of the injured side should be within a few degrees of the noninjured side.
C. The medial clear space should be equal to the superior clear space between the talus and the distal tibia and less than or equal to 4 mm on standard radiographs.
D. The distance between the medial wall of the fibula and the incisural surface of the tibia, the tibiofibular clear space, should be less than 6 mm.

Ankle fractures can be classified purely along anatomical lines as monomalleolar, bimalleolar, or trimalleolar. The Lauge-Hansen classification attempted to associate specific fracture patterns with the mechanism of injury and proposed a detailed classification, with each broad classification subdivided into four groups [(4,5)]

The Danis-Weber classification [(6)] is based on the location and appearance of the fibular fracture.

- Type A fracture is caused by internal rotation and adduction that produce a transverse fracture of the lateral malleolus at or below the plafond, with or without an oblique fracture of the medial malleolus.
- Type B fractures: Approximately 80% to 90% of lateral malleolar fractures fall into the Danis-Weber type B category, an oblique fracture of the lateral malleolus, beginning on the anteromedial surface and extending proximally to the posterolateral aspect. The injury may include rupture or avulsion of the anterior anteroinferior tibiofibular ligament, fracture of the medial malleolus, or rupture of the deltoid ligament.
- Type C fractures are divided into abduction injuries with oblique fracture of the fibula proximal to the disrupted tibiofibular ligaments (C-1) and abduction–external rotation injuries with a more proximal fracture of the fibula and more extensive disruption of the interosseous membrane (C-2).
  - Type C injuries may involve a medial malleolar fracture or a deltoid ligament rupture. Fracture of the posterior malleolus may accompany any of the three types.

PATIENT AND METHODS:

This retrospective review of 18 patients (13 males and 5 females), age ranges between 19-78 years (average 38.9 years) with Weber type C ankle injury that were treated by open reduction and internal fixation in Medical city Complex from October 2013 to February 2014. All patients were followed up for a mean time of 15.5 months (12- 30 months) after index surgery.

All patients were unilaterally injured. The average time from initial injury was 13.9 days (range 1 to 45 days).

Inclusion criteria:

- Type C closed ankle fractures

Exclusion criteria:

- Multi-injured patients
- Pilon fractures

- Physeal injuries

Statistical analysis were performed with an unpaired Student t-test with statistical significance defined as $p<0.05$. Two-tailed p values are presented.

The body mass index (BMI) of all patients ranges from 19.9-36.7 (mean 27.4), of these patients, 6 (4 females and 2 males) had BMI more than 30 (mean 33.5), the other 12 patients had BMI of less than 30 (mean23.4).

Outcome measurements were determined using the Olerud and Molander scoring system (OMAS) and Linear Analogue Scale 30 for all patients. (Figure 2,3)

PARAMETER	DEGREE	SCORE
1. Pain	None	25
	While walking on uneven surface	20
	While walking on even surface outdoors	10
	While walking indoors Constant and severe	5
		0
2. Stiffness	None	10
	Stiffness	0
3. Swelling	None	10
	Only in evenings	5
	Constant	0
4. Stair-climbing	No problems	10
	Impaired	5
	Impossible	0
5. Running	Possible	5
	Impossible	0
6. Jumping	Possible	5
	Impossible	0
7. Squatting	No problems	5
	Impossible	0
8. Supports	None	10
	Taping, Wrapping	5
	Stick or crutch	0
9. Work, activities of daily life	Same as before injury	20
	Loss of tempo	15
	Change to simpler job	15
	Severely impaired work capacity	0

Figure 2: The Olerud-Molander Ankle Score (OMAS)[7]

The outcome depends on the sum of all variables in the score system being:

- 85- 100 excellent
- 65-85 good
- 45-65 fair
- Less than 45 poor

The score is validated against (a) linear analogue scale (LAS) measuring subjective recovery, (b) range of motion in loaded dorsiflexion, (c) presence of osteoarthritis and (d) presence of subluxations of talus on radiographs, and it has been found to correlate well with these four parameters[7].

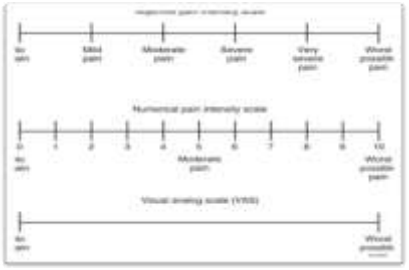
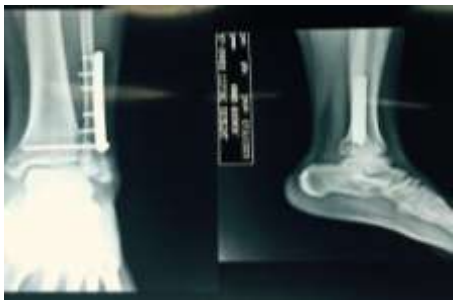


Figure 3: Linear Analogue Scale[7].

All patients who met the inclusion criteria were invited to participate in the study. If patients still could not be reached by phone, the patients were considered lost to follow-up. Fortunately, none of these patients were dropped out. Patients willing to participate provided written informed consent after being informed about the study.

A **B** **C**

Figure (4-A): Anteroposterior view film of 24 years male with Weber C fracture ankle with talar tilt (4-B). The immediate postoperative Anteroposterior and (4-C). lateral views of same patient.



6-D

(4-D) Both AP and lateral views of same patient after 5 weeks

RESULTS:

There were 18 patients included in this study, 13 (72.2%) males, and 5 (27.8%) females. Of all patients, 14 (11 males, 3 females) were below 50 years of age (average 31.7 years), and 4 (2 males, 2 females) were above 50 years (average 63.25 years) *P value of both age group 0.002*. (Figures 5, 6)

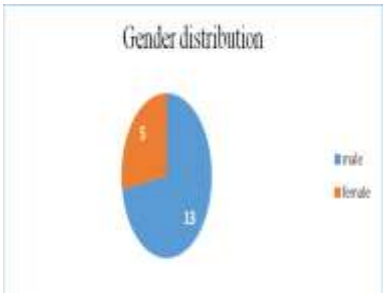


Figure 5: Gender distribution.

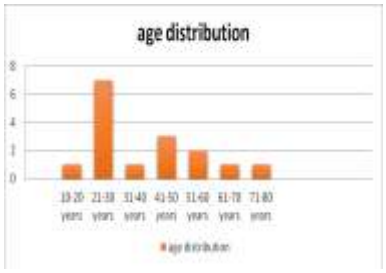


Figure 6: Age distribution.

Motor vehicle accident (MVA) was found in 10 (55.5%) patients (Figure 7). In young, active people, fractures were associated with vigorous activity, like sports in 3 patients (16.6%). Other causes include falls in 5 patients more than 50 years old (27.8%).

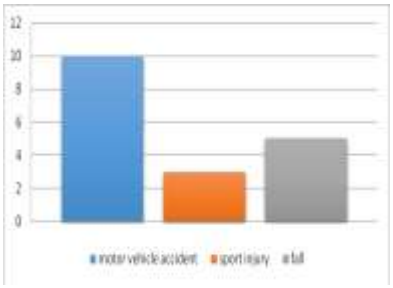


Figure 7: Causes of ankle fractures.

All patients had closed fractures that had been treated by open reduction and internal fixation, 10 of them (55.5%) had lateral malleolar fractures with talar tilt, 6 (33.3%) of them had bimalleolar fractures, and 2 (11.2%) had associated posterior malleolus fracture. The latter did not required fixation. Of all patients, one had superficial and one had deep infection postoperatively, the superficial infection resolved with local dressing and systemic antibiotics. Deep infection that occurred resulted in poor outcomes - cases was badly contaminated and had continuing problems with stiffness. The results of all patients were obtained clinically by both scoring systems (OMAS) and (LAS) are shown in table 1.

Table 1: The difference in scoring systems.

number	gender	age	BMI	OMAS	LAS
1	m	42	24.3	85	8
2	m	22	22.1	100	10
3	m	30	19.9	85	8
4	m	19	22.9	95	9
5	m	37	24.1	80	8
6	f	39	27.7	5	0
7	f	78	33.2	50	5
8	m	32	24	95	9
9	m	63	21.8	100	10
10	m	25	22.9	100	10
11	f	24	24.6	95	9
12	m	25	30.1	100	10
13	m	48	32.8	100	10
14	f	36	36.7	5	0
15	m	25	29.8	100	10

16	f	60	35.6	45	4
17	m	44	33.8	70	7
18	m	52	28.6	80	8
Statistics		38.9	27.4	*A=82.8 **StDev=26.6	*A=8.01 **StDev=2.7
				P value=0.995	

*A= average **StDev=standard deviation

50 years 57.5 (*P value* =0.001); LAS score for patients less than 50 years average score was 8.07 while those more than 50 years was 5.5 (*P value =0.0007*). (Figure 8)

According to the (OMAS) scoring system, there were 12 patients had excellent outcome, 3 had good, 2 had fair and one patient had poor results. 14 patients of less than 50 years their average OMAS score was 82.8, while those of more than

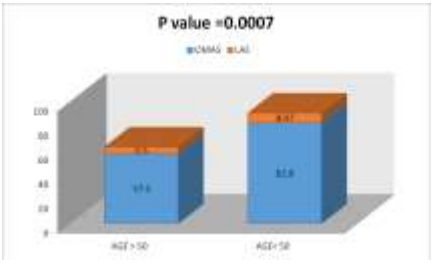


Figure 8: Score systems regarding age groups.

Male gender in this study was 13 patients, average OMAS score was 91.5, and average LAS was 9, female patients were average scored 40 and 3.6 by OMAS and LAS respectively. There was a high significant statistical difference between both male and female groups (*P value=0.0022*). (Figure 9)

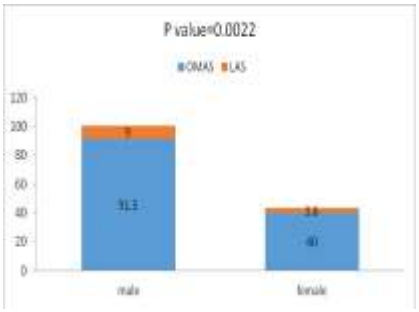


Figure 9: Score systems regarding gender.

Regarding the BMI, patients of less than 30 had average OMAS score 85 and LAS score 8.25. On the other hand, patients who had more than 30 BMI had average OMAS 61.6, and average LAS 6. There was high statistical significant difference between patients' groups regarding the BMI (*P value* =0.0001). (Figure 10).

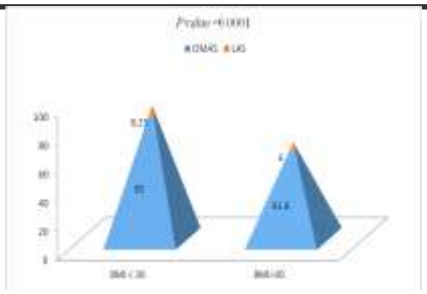


Figure 10: Score systems regarding BMI.

Clinically, the overall results were 11 patients (61.1%) had excellent results, and 3 patients (16.6%) had good outcome, and there were 2 patients in each fair and poor outcomes (11.1%) according to OMAS system.

DISCUSSION:

Open reduction and internal fixation is the foremost treatment employed for displaced ankle fractures. Results are generally favorable with the majority of patients having a good functional outcome. Proponents of open reduction and internal fixation suggest that restoration of the normal anatomy will reduce the risk of subsequent osteoarthritis due to incongruency of the joint [8,9].

Recently, the recommended and accepted treatment of Weber type C ankle injuries is open reduction and internal fixation, but, despite appropriate initial fracture reduction, painful osteoarthrosis and untable joint still develop in some patients [10,11].

In the older patient, there are concerns about poor fixation, poor bone quality and impaired wound healing which makes some authors believe that open reduction and internal fixation carries an unacceptable risk especially in women[8,12]. There is however, paucity of data on management of ankle fractures in our environment.

Ponzer et al[13] demonstrated satisfactory outcomes in 76%-83% of operatively treated type- B malleolar injuries. Makwana et al compared 22 cases of ORIF and 21 cases of conservatively treated patients with ankle fractures and found that ORIF treatment yielded a significantly higher functional outcome score and a significantly better range of movement of the ankle[14].

Although we did not compare the outcome of patients treated conservatively versus operatively, we were able to achieve 77.7% of all patients with satisfactory (excellent and good) results. This was shown a statistical significant difference between patients who are more and less than age of 50 (*P value* =0.0007*)*

Koval et al. examined the Medicare database and identified low rates of complications in elderly patients two years after surgery, they emphasized that there were low complication rates in their study in this age group patients in short term follow up[15].

The results of this study indicate that a some of patients continue to have symptoms and reported functional limitations still one year after surgically treated ankle fractures. 11.1% of the patients (poor outcome) reported ankle pain, swelling and problems when using stairs and reduced activities of daily life at mean of one year after surgery. 77.7% percent of excellent and good outcome patients were physically active and had returned to their pre-injury activity level one year after.

Subjective ankle function as measured by OMAS and LAS increased retrospectively.

In this study, the results from OMAS and LAS were of both statistical and clinical difference between males and females (*P value*=0.0022). This may be due to low sample size of females and the physical activity of males after surgery with the early physiotherapy and weight bearing.

The distribution between men and women in the studied group could be expected as ankle fractures occur in men more often in younger ages, whereas women injure more frequently after the age of 50 [15].

Many studies have evaluated outcome and subjectively scored function after surgically treated ankle fractures [7,9,15,16,17,18], but none of these studies have evaluated outcome in the elderly specifically. The only study found publishing OMAS results for different age groups is that of Lash *et al.* including 74 patients, 22 men and 52 women, 22–89 years of age. A mean score of 76 points was found in the age group 17–40, 79 points in the age group 41–60 and 84 points in the age group 61–89 two years

after injury showing improved results with age [16].

Earlier studies including also younger age groups showed better function as measured by OMAS one year after injury compared to our results in this study. Hedström *et al.* evaluated lateral malleolar fractures and found an OMAS of median 88 points in patients with a mean age of 42 years. Although the ages in that study ranged from 16–71 years the results were presented as median values for the total sample[5]. Lehtonen *et al.* studied surgically treated ankle fractures in patients mean 41 years of age and found a median OMAS of 90 [14] and van Laarhoven *et al.* found an OMAS of median 95 points in patients with a mean age of 36 (range 17–77) years showing excellent scored function [19]. Both Egol *et al* Nilsson *et al.* and. reported that an age over 40 increased the risk of poorer scored function one year after surgery [9,18] and also three years after [9]. The OMAS results from the group over 40 years of age were comparable to the group in the present study. These outcomes support the findings that younger age groups reach better function and that adult persons with the same type of fractures should not be regarded as a homogenous group. Age should be taken into consideration when evaluating results after ankle fracture.

The use of OMAS in the elderly could be questioned as it includes the items 'jumping', 'running' and 'squatting', functions that might be difficult only due to higher age. Because of that not only the median values of OMAS but also the results from the separate items have been analyzed and presented as it gives more detailed information about function. The experience of pain, stiffness, problems when stair-walking and reduced activity of daily life were more frequent in the present age group compared to the results including patients 18–64 years of age. However, the impossibility to jump, run and squat were most frequent reported and it cannot be excluded that higher age was a contributing reason for this[9].

There was a significant correlation between OMAS and LAS but the figures from LAS were higher and we believe that one reason might be the three items mentioned above. LAS include some sort of expected recovery as well and it is possible that subjects at higher ages do not expect to reach full recovery after a surgically treated ankle fracture. This might explain the diversity between the results from the two scores. It is possible that the patients had adapted to and accepted a lower activity level.

It is probably more important for elderly to recover function as fast as possible since bone mass density, proprioception and muscle force already are decreased due to the higher age.

In regards of BMI, Lubbeke et al. emphasized in their study after 22 years of index surgery, reported advanced osteoarthritis in 37 of 102 patients (36.3%) had significant risk factor identified regarding the fracture type, presence of medial malleolus fracture, fracture dislocation, and increased BMI with the length of follow up time[20].

This is correlated to our results that there was significant difference between patients of more than 30 BMI and those who are less.

In another cross sectional study data suggests that obesity does not impact the incidence of nonunions. In both Chi-squared and survival analysis, no association was discovered when using a cutoff of BMI $\geq$ 30. When BMI and weight were analyzed in continuous form, no significant associations were seen[21].

Limitation of this study is the lack of a non-injured control group and information of baseline function before injury. Furthermore we recorded some pre-injury information about physical activity level although first at six month follow-up and we are aware that this information might be uncertain. Finally our study included a follow up time of only one year.

It is probably even more important to follow the elderly over a longer time as functions recover more slowly compared to younger age groups. Future studies are needed to elucidate whether outcomes improve or impair with time.

CONCLUSION:

Type C ankle fractures are complex injuries that are notorious to the surgeons in orthopedic field that requires special care and meticulous handling to the fragments and soft tissues as well. The early follow up time shows better results in male gender, younger age group, and non-obese patients.

A long follow up time is required for this type of injury in order to base the evidence of these parameters and to evaluate the functional outcome.

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