

**COMPARATIVE OF FUNCTIONAL AND RADIOGRAPH OUTCOMES FOR
COMMINUTED CALCANEUM FRACTURES, CONSERVATIVELY TREATED AND
SURGICAL OSTEOSYNTHESIS BY ANATOMICAL PLATE****Tawfik Alhallak*, Giath Halom and Ma3n Sa3d**

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ABSTRACT

Background: The Ankel is supporting bone that bears 70% of the body weight Due to the prevalence of calcaneus fractures and the need to improve and compare the results of conservative and surgical treatment in cases of comminuted fractures type III + IV. To make the footsteps comfortable, supportive and painless. The difficulty of treating these fractures in terms of restoring the normal anatomy (length, axis, defective union / angulation or rotation). The length of the hospitalion period and the accompanying unemployment and lack of production. There are many ways to treat it, which makes finding the best way to treat it a matter of debate. the frequency of accompanying complications increases the recovery period and also increases the cost of treatment. **Research aim:** Primary objective: Our study aimed to improve the functional outcomes of comminuted calcaneal fractures, by comparing the functional and radiographic outcomes of Sanders III+IV fractures treated conservatively or surgically with an anatomic plate. Secondary objective: To study the short-term and long-term complications of both methods. **Materials and methods:** A retrospective cohort study will be conducted on patients with comminuted calcaneal fractures type III+IV, who visited the emergency department at Tishreen University Hospital during the years 2019- 2020-2021-2022-2023. A special form was organized for each patient and after accepting adult patients of both sexes who met the admission criteria. A full assessment of the patient was conducted in terms of the mechanism of injury, general condition, accompanying injuries, neurovascular examination, and necessary diagnostic procedures, and his data was recorded in the form. Patients with comminuted calcaneal fractures were distributed according to the treatment method used into two groups: The first group: includes patients whose fracture was fixed conservatively (splint)The second group: includes patients whose fracture was fixed with an anatomical plate. A simple radiograph was performed at the time of admission in order to establish the diagnosis in at least the anterior-posterior and lateral positions, as well as immediately after the surgical operation, and then at each visit. A posterior splint was placed from the metatarsal heads to the middle of the leg and ankle at an angle of (90) degrees for patients in the second group and was removed after two weeks when the stitches were removed.

Active and passive movement of the toes was started immediately after surgery in patients in the second group. As for the ankle level, this was done after freeing the foot by removing the splint in patients in the first and second groups. Periodic review was done in 3 periods: the first after 3 months from surgery, the second after 6 months, and the third after 12 months. Clinical results were evaluated after 12 months according to: American Association of Foot and Ankle Surgeons (AOFAS) index. **Results:** 106 patients with comminuted calcaneum fractures who were admitted to the Orthopedic Surgery Department or followed up in the Orthopedic Clinic at Tishreen University Hospital during the period 2019-2023 and who met the study inclusion criteria were studied and followed up for up to one year from the date of surgery. The percentage of patients who

were treated conservatively with a plaster device (66.9%) was higher than the percentage of patients who were treated surgically with internal fixation and placement of an anatomical plate (33.1%), and when calculating the statistical percentage, it was $0.05 > P$, meaning that there is a statistically significant difference between patients according to the treatment method. The percentage of treated males was generally higher (83.1%) than the percentage of females (16.19%), indicating that heel fractures are more common in males than in females. Males were treated surgically with an anatomical plate (82.8%), slightly less than conservatively with a plaster cast (83%), while females were treated conservatively with a plaster cast (17%), higher than surgically (17.2%). When calculating the statistical percentage, it was $0.05 > P$, meaning there was a statistically significant

difference in the incidence of heel fractures in patients according to gender, which was more common in males. Most of the patients were in their fifties, with the largest number of patients in the age group (36-55) years (49 patients), the largest percentage of whom were managed conservatively with a plaster cast (46.4%) compared to the percentage of patients who were treated surgically with an anatomical plate (45.7%), while the smallest number of patients were >55 years old (22 patients), who were treated surgically with a percentage (14.3%), less than conservatively with a percentage (24.1%). The right side was the most affected side in patients (64.1%) compared to the left side (35.9%), indicating that the right foot is more common than the left. High energy was the most common mechanism for injury (67.9%) compared to low energy (32.1%), and thus the majority of heel fractures occur due to injuries and accidents resulting from high energy. The largest number of patients (51 patients) were managed within the first 24 hours, and the ratio between conservative treatment (47.8%) and surgical treatment (48.5%), and the smallest number of patients were managed after 48 hours (23 patients), where they were treated in a similar manner between surgical treatment (17.3%) and conservative treatment (23.9%). While (32 patients) were managed within 24-48 hours, distributed between conservative treatment (28.1%) and surgical treatment (34.2%). The largest number of patients had third-degree fractures (64 patients) at a rate of (60.3%), (71.8%) of whom were treated conservatively by applying a plaster device and (37.1%) of whom were treated surgically by applying an anatomical plate. While (42 patients) suffered from fourth- degree fractures, (28.2%) of whom were treated conservatively by applying a plaster device and (62.9%) of whom were treated surgically by applying an anatomical plate. The healing period was faster in the surgical treatment group (2.2 ± 4.5 weeks) compared to the conservative treatment group (2 ± 6 weeks), and when calculating the statistical ratio, it was $0.05 < P$, meaning that there was no statistically significant difference between conservative and surgical treatment according to the healing period. The return to practical life was faster in the surgical treatment group (0.5 ± 3 months) compared to the conservative treatment group (1 ± 4 months), and when calculating the statistical ratio, it was $0.05 < P$, meaning that there was no statistically significant difference between conservative and surgical treatment according to the time to return to practical life. Complications after fixation were generally few and similar between conservative and surgical treatment, except for superficial infection, which occurred at a higher rate in surgical treatment (8.5%) compared to conservative treatment (2.8%). Deep infection also occurred at a higher rate in surgical treatment (4.6%) compared to conservative treatment (1.4%). Superficial skin necrosis occurred at a higher rate in surgical treatment (2.8%) compared to conservative treatment (1.4%), while the rate of defective healing was higher in conservative treatment (12.6%) than in surgical treatment (8.5%). The remaining complications (Sudick's

dystrophy, ankle stiffness) occurred at similar rates between surgical and conservative treatment. The value of the American Association of Foot and Ankle Surgeons (AOFAS) index was better in surgical treatment (16 ± 80 points) compared to conservative treatment (11 ± 77 points), and when calculating the statistical percentage, it was $0.05 < P$, meaning that there is no statistically significant difference between conservative and surgical treatment according to the functional results according to the AOFAS index. The largest number of patients received the (good) evaluation according to the AOFAS index (49 patients) at a rate of (46.2%), while (39 patients) received the (acceptable) evaluation at a rate of (36.7%), (13 patients) received the (excellent) evaluation at a rate of (12.8%), and only (5 patients) received the (poor) evaluation at a rate of (2.5%). Conservative treatment patients were distributed according to the AOFAS index as follows: good (47.8%), which is the largest percentage, acceptable (38.1%), excellent (8.4%), and the lowest percentage is bad (5.7%), while surgical treatment patients were distributed according to the AOFAS index as follows: good (42.8%), which is the largest percentage, acceptable (34.2%), excellent (20%), and the lowest percentage is bad (2.8%). When calculating the statistical percentage, it was $0.05 < P$, meaning that there is no statistically significant difference between conservative and surgical treatment according to the functional results and evaluation (excellent, good, acceptable, bad) according to the AOFAS index. The rating (good) was the most common rating, with similar percentages, in grade III fractures treated conservatively (47.1%) and surgically (46.1%). The rating (poor) was the least common rating in grade III fractures treated conservatively (4%) and surgically (7.9%), while the rating (acceptable) was the most common rating in grade IV fractures treated conservatively (50%) compared to surgical treatment (31.8%). The rating (poor) was the least common rating in grade IV fractures treated surgically (9.2%), while it did not occur in conservative treatment (0%).

Conclusion: The functional and radiological results of comminuted calcaneal fractures treated conservatively (with a plaster device) and surgically (with an anatomical plate) were studied in 106 patients. The results were generally similar between the two treatment methods, with a slight advantage for surgical treatment in terms of fracture healing time, return to work time, and AOFAS index value. Conservative treatment was slightly better in terms of some complications such as superficial and deep infection, superficial skin necrosis. Therefore, there is no significant difference between the two treatment methods, with an advantage for surgical treatment. Therefore, the treatment method is chosen according to the general condition of the patient, the time of fracture occurrence, and the presence of underlying diseases that may cause subsequent complications such as high blood pressure and diabetes. These results were generally consistent with the results of global studies.

KEYWORDS: Comminuted Calcaneum fractures,

conservative treatment, surgical treatment with bone reconstruction using plate and screws (ORIF), Sanders classification, American Association of Foot and Ankle Surgeons (AOFAS) index.

INTRODUCTION

Calcaneus fractures are relatively common, and occur during falls from a high place, among parachutists, and construction workers, and rarely occur through direct trauma. The type and severity of the fracture are affected by the height of the fall, the weight of the patient, and the nature of the ground on which the fall occurred. There are also avulsion fractures that occur in the posterior calcaneal tuberosity. when a calcaneal fracture is encountered, the vertebrae, pelvis and tibial plate must be examined.

PATIENTS AND METHODS

Study Design: Prospective before and after study.

Study Location and Duration: The study was conducted in the Department of Orthopaedic Surgery at Tishreen University Hospital in Latakia, lasting for six years (2019-2024).

Sample of the Study

Inclusion Criteria

Patients with a closed comminuted fracture of the calcaneus, grade III + IV according to Sanders classification, who presented to the emergency department of Tishreen University Hospital, a closed comminuted fracture in a patient older than 18 years, treated conservatively with a cast or surgery with an anatomical plate.

Exclusion Criteria

1. Patients who have had previous foot surgery.
2. Accompanying injuries or fractures in the foot.
3. A fracture type I or II.
4. Fractures fixed with Screws, or free rods, or open fractures.
5. The presence of other congenital or acquired deformities in the foot.
6. Patients with severe osteoporosis.

The final total sample size consisted of 106 patients.

Work Stages

- Collecting patient samples and obtaining informed consent.
- Preparing a specific form for each patient and recording the necessary information for the study within it.
- Taking a detailed medical history from the patients.

Distribution of cases according to treatment method

Treatment method	number	percentage	p-value
Gypsum cast	71	66.9%	<0.05
Anatomical plate	35	33.1%	

Table (1): We note from the table that the percentage of

- Patients were divided into two groups according to the type treatment adopted during the years 2019 to 2024 conservative & surgery group.
- The follow up for the patients last for a year from the beginning of treatment
- Patients were monitored clinically weekly during the first month : attention was paid to the condition of wound, the presence of edema in the extremity, or the absence of redness or inflammation in the wound.
- Laboratory monitoring: conducting the necessary tests and monitoring inflammatory indicators before and after treatment: (HGB+WBC+NEU+CRP+ESR+GLU)
- Radiation monitoring: in different positions and angles measurement
- Periodic radiological monitoring and clinical evaluation were performed at intervals of (1 + 3 + 6 + 12 months) until bone fusion is achieved
- And remove the disputed materials (if any) within an average of (8-12) months from the date of surgery.
- Clinical outcomes were evaluated after 12 months according to: American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Score.

Statistical Analysis

1. Descriptive Statistics:

- Quantitative variables using measures of central tendency and measures of dispersion
- Qualitative variables using frequencies and percentages

2. Inferential Statistics:

- Based on statistical laws.
- Independent T-test to study the difference between the means of two independent groups.
- Chi-Square test or Fisher's exact test to study the relationship between qualitative variables.
- Results are considered statistically significant with a p-value < 5%
- The IBM SPSS Statistics program (version 20) was used to calculate statistical coefficients and analyze results.

RESULTS

The research sample included 106 patients from adult patient group visiting the Emergency or Orthopaedic surgery department at Tishreen University Hospital in Latakia between 2019 and 2024. These patients presented with symptoms of calcaneus fracture. The diagnosis was confirmed through radiological or CT Scan.

patients who were treated conservatively with a plaster

device (66.9%) was higher than the percentage of patients who were treated surgically with internal fixation and placement of an anatomical plate (33.1%), and when calculating the statistical percentage, it was

0.05>P, meaning that there is a statistically significant difference between patients according to the treatment method.

Distribution of cases by gender

sex	Gypsum cast	Anatomical plate	total	p-value
Males	59 (83%)	29 (82.8%)	88 (83.1%)	<0.05
females	12 (17%)	6 (17.2%)	18 (16.9%)	

Table (2): It is noted from the table that the percentage of treated males was generally higher (83.1%) than the percentage of females (16.19%), indicating that heel fractures are more common in males than in females. Males were treated surgically by placing an anatomical plate at a rate of (82.8%), slightly less than their conservative treatment by placing a plaster device (83%),

while females were treated conservatively by placing a plaster device at a rate of (17%), less than their surgical treatment (17.2%). When calculating the statistical percentage, it was 0.05>P, meaning that there is a statistically significant difference in the occurrence of heel fractures in patients according to gender, which were more common in males.

Distribution of cases by age

age	Gypsum cast	Anatomical plate	total
18-35	21 (29.5%)	14 (40%)	35
36-55	33 (46.6%)	16 (45.7%)	49
>55	17 (24.1%)	5 (14.3%)	22

Table 3: We note from the table that most of the patients were in their fifties, where the largest number of patients was within the age group (36-55) years (49 patients), the largest percentage of whom were managed conservatively by placing a plaster device (46.4%) compared to the percentage of patients who were treated surgically by placing an anatomical plate (45.7%), while the smallest number of patients were >55 years old (22 patients) who were treated surgically by (14.3%) less than conservative treatment by (24.1%).

to the left side (35.9%), which indicates that the right foot is more commonly affected than the left.

Distribution of cases according to mechanism of injury

	number	percentage
Low energy	24	22.6%
High energy	82	77.4%

Table 5: We note from the table that high energy was the most common mechanism of injury (77.4%).

Distribution of cases by side of injury

	number	percentage
Right	68	64.1%
left	38	35.9%

Table 4: We note from the table that the right side was the most affected side among patients (64.1%) compared

Compared to low energy (22.6%), the majority of heel fractures occur due to high energy injuries and accidents.

- Low energy injuries: direct trauma - falling from a height < 1 meter.
- High energy injuries: traffic accident - falling from a height > 1 meter.

Distribution of cases according to time of therapeutic intervention

	Gypsum cast	Anatomical plate	total
First 24 hours	61 (85.9%)	25 (71.4%)	86
24-48 hours	7 (9.86%)	4 (11.4%)	11
>48 hours	3 (4.2%)	6 (1.17%)	9

Table 6: We note from the table that the largest number of patients (86 patients) were managed within the first 24 hours and the percentage was close between conservative treatment (85.9%) and surgical treatment (71.4%). The smallest number of patients were managed after 48 hours (9 patients), the largest percentage was for surgical treatment (17.1%) while conservative (4.2%).

(9.86%) and surgical treatment (11.4%).

- Reasons for patients' delay in starting treatment within the plaster group: The most common is the patient's delay in visiting the emergency department mainly (personal reasons).
- Reasons for patients' delay in starting treatment within the surgery group: Material reasons - skin condition from skin edema or abrasion or superficial infection or delay in visiting the emergency department.

While (24 patients) were managed within 24-48 hours, they were distributed between conservative treatment

Distribution of cases by fracture type

Sanders	Gypsum cast	Anatomical plate	Total
III	51 (71.8%)	13 (37.1%)	64 (60.3%)
IV	20 (28.2%)	22 (62.9%)	42 (39.7%)

Table 7: We note from the table that the largest number of patients had third-degree fractures (64 patients) at a rate of (60.3%), (71.8%) of whom were treated conservatively by applying a plaster device and (37.1%) of whom were treated surgically by applying an

anatomical plate. While (42 patients) suffered fourth-degree fractures, (28.2%) of whom were treated conservatively by applying a plaster device and (62.9%) of whom were treated surgically by applying an anatomical plate.

Distribution of cases according to the duration of healing in weeks

	Min-max	mean±SD	p-value
Gypsum cast	6-10	8±2	>0.05
Anatomical plate	4-8	6±2	

Table 8: We note from the table that the healing period was faster in the surgical treatment group (2 ± 6 weeks). Compared to conservative treatment (2 ± 8 weeks), and when calculating the statistical ratio, it was $0.05 < P$,

meaning there is no statistically significant difference between conservative and surgical treatment according to the healing period.

Distribution of cases by time to return to work in months

	mean±SD	p-value
Gypsum cast	5±1	>0.05
Anatomical plate	4±0.5	

Table 9: We note from the table that the return to practical life was faster in the surgical treatment group (0.5 ± 4 months) compared to conservative treatment (1 ± 5 months), and when calculating the statistical ratio, it

was $0.05 < P$, meaning that there is no significant statistical difference between conservative and surgical treatment according to the time of return to practical life.

Cases are distributed according to the progress of physical therapy steps in weeks

	Cast group	Plate group	p-value
Timing of splint removal	6±2	2±1	<0.05
Initiate active ankle movement	8±2	4±1.5	>0.05
Start loading weight	12±2	10±2	>0.05
Start walking	14±3	11±2	>0.05
Back to sport	20±4.5	14±1.5	<0.05

Table 10: We note from the previous table that the start of movement degrees was earlier in the group of plate patients compared to the patients with a splint. Noting that the P Value < 0.05 in the stage of removing the splint and returning to sports, i.e. there is a significant

statistical difference between the two groups. It was faster in plate patients, while the P Value > 0.05, i.e. there is no significant statistical difference between the two methods.

Percentage of cases according to the need to use walking aids

	Cast group	Plate group	p-value
In the first 6 months	63%	41.4%	<0.056
After 12 months	12.8%	2.3%	

Table 11: We conclude from the table that the need to use walking aids was less in the group of patients with platelets, and thus the subsequent movement of the

patients was better. With a P Value < 0.05, and thus there is a significant statistical difference between the two treatment methods.

Distribution of cases according to complication occurring after 3 months

	Cast group	Plate group
Skin necrosis	0 (0%)	3 (8.6%)
Superficial infection	0 (0%)	1 (2.8%)
Deep infection	0 (0%)	1 (2.8%)

Secondary change	4 (5.6%)	2 (5.7%)
Mal union	12 (16.9%)	3 (8.6%)
Sudick dystrophy	7 (9.9%)	3 (8.6%)
Ankle ossify	11 (15.5%)	5 (14.2%)
total	32 (45%)	18 (51.4%)

Table 12: We note from the previous table that the complications related to the skin or superficial condition were higher in the surgical group compared to the conservative treatment group.

In contrast, the complications of bone healing were higher in the conservative treatment group, mostly due to the anatomical reduction of the fracture fragments in surgical treatment while fixation in the splint patients.

In general, the complications were similar between the two groups.

Superficial infection in the surgical group (8.6%) was higher than the splint group (0%). Defective healing was higher in the splint group (16.9%) than the surgery group (8.6%). Sudeck's dystrophy and ankle stiffness (9.9%) and (15.5%) occurred in the splint group higher than the surgery group (5.7%) and (14.2%) respectively.

Distribution of cases according to complication occurring after 12 months

	Cast group	Plate group
Skin necrosis	0 (0%)	1 (2.8%)
Superficial infection	0 (0%)	1 (2.8%)
Deep infection	0 (0%)	0 (0%)
Secondary change	1 (1.4%)	0 (0%)
Mal union	9 (12.6%)	2 (5.7%)
Sudick dystrophy	1 (1.4%)	0 (0%)
Ankle ossify	6 (8.4%)	2 (5.7%)
total	20 (28.1%)	6 (17.1%)

Table 13: We note from the table that the complications that occurred after 12 months of fixation were generally few and improved over the follow-up period after direct fixation of 3 months and were close between conservative and surgical treatment.

Except for superficial infection, which occurred at a higher rate in surgical treatment (2.8%) compared to conservative treatment (0%).

Superficial skin necrosis occurred at a higher rate in surgical treatment (2.8%) compared to conservative treatment (0%).

While the rate of defective healing was higher in conservative treatment (12.6%) than in surgical treatment (5.7%).

The remaining complications (Sudick's dystrophy, ankle stiffness) occurred at close rates between surgical and conservative treatment.

Study the relationship between underlying diseases and their impact on treatment and prognosis

Underlying diseases: diabetes - high blood pressure - hypothyroidism or hyperthyroidism - hypocalcemia - anticoagulants

We also include severe edema that led to delaying treatment until the patient's general condition stabilizes

	Non-chronic group	Chronic group	p-value
Number	82	24	<0.05
AOFAS mean value	85/100	71/100	
Percentage of complication	12%	63%	
Percentage treated within first 24 hours	91%	7%	

Table 13: We notice from the table a close relationship between the absence of chronic diseases, the absence of complications, and the speed of treatment. On the contrary, we conclude that chronic diseases were the reason for delaying treatment, and thus a higher rate of complications, and thus a later poor prognosis.

Radiation monitoring schedule**Percentage values of normal angles by radiographic evaluation after 12 months**

Normal angles	Buhler angle 20-40	Ghaisan angle 130-145	Calcaneus deflection angle 20-30	Talus inclination angle 18-24
Cast group	89%	81%	83.8%	86.1%
Plate group	95.5%	92%	89.2%	90.7%

Table 14: We note from the table that the majority of patients treated with the anatomical plate had almost normal radial angles, and their percentage was higher

than that of patients in the splint group. This is due to the anatomical response that we obtain in surgical patients.

Functional outcomes according to the AOFAS index after 12 months

	Cast group	Plate group	total	p-value
Excellent	6 (8.4%)	7 (20%)	13 (12.8%)	>0.05
Good	34 (47.8%)	15 (42.8%)	49 (46.2%)	
Acceptable	27 (38.1%)	12 (34.2%)	39 (36.7%)	
bad	4 (5.7%)	1 (2.8%)	5 (2.5%)	

Table 15: We note from the table that the largest number of patients received a (good) rating according to the AOFAS index (49 patients) at a rate of (46.2%), While (39 patients) received a (acceptable) rating at a rate of (36.7%), (13 patients) received a (excellent) rating at a rate of (12.8%), Only (5 patients) received a (poor) rating at a rate of (2.5%). Conservative treatment patients were distributed according to the AOFAS index as follows: Good (47.8%), which is the largest percentage, acceptable (38.1%), excellent (8.4%), and the lowest

percentage is bad (5.7%), While surgical treatment patients were distributed according to the AOFAS index as follows: Good (42.8%), which is the largest percentage, acceptable (34.2%), excellent (20%), and the lowest percentage is bad (2.8%), When calculating the statistical percentage, it was $0.05 < P$, meaning that there is no statistically significant difference between conservative and surgical treatment according to the functional results and evaluation (excellent, good, acceptable, bad) according to the AOFAS index.

Functional outcomes and their relationship to the fracture pattern according to Sanders (radiographically)

AOFAS index	III type sanders	IV type sanders	total
Excellent	8 (12.5%)	5 (11.9%)	13 (12.8%)
Good	34 (53.1%)	15 (35.7%)	49 (46.2%)
Acceptable	20 (31.2%)	19 (45.2%)	39 (36.7%)
bad	2 (3.1%)	3 (7.1%)	5 (2.5%)

Table 16: We note from the table that the (good) evaluation was the most common evaluation in third-degree fractures at a rate of (53.1%), while the (acceptable) evaluation was the most common evaluation

in fourth-degree fractures at a rate of (45.2%), and the (bad) evaluation was the lowest evaluation in both third- and fourth- degree fractures.

Study the relationship between functional outcomes and patient gender

evaluation	male		female		total
	cast	plate	cast	plate	
Excellent	5 (8.4%)	5 (17.2%)	2 (16.6%)	1 (16.6%)	13 (12.8%)
Good	30 (50.8%)	10 (34.4%)	6 (50.1%)	3 (50%)	49 (46.2%)
Acceptable	20 (33.8%)	13 (44.8%)	4 (33.3%)	2 (33.4%)	39 (36.7%)
bad	4 (7%)	1 (3.6%)	0 (0%)	0 (0%)	5 (2.5%)

Table 17: We note from the table that the evaluation (good) was the most common evaluation among males treated conservatively (50.8%) compared to surgical treatment (34.4%), While the evaluation (acceptable) was the most common among males treated surgically (44.8%) compared to conservative treatment (33.8%).

While the evaluation (good) was the most common evaluation among females treated conservatively (50.1%) and surgically (50%).

The evaluation (acceptable) was close among females treated conservatively (33.3%) and surgically (33.4%).

The evaluation (bad) was the least common evaluation among males in both conservative treatment (7%) and surgical treatment (3.6%).

While females did not receive the evaluation (bad) in both conservative and surgical treatment (0%).

Study the relationship between functional outcomes and patient age

evaluation	(18-35) years		(36-55) years		> 55 years		total
	cast	plate	cast	plate	cast	plate	
Excellent	3(14.2%)	1(7.1%)	4(12.1%)	2(12.5%)	2(11.8%)	1(20%)	13(12.8%)
Good	9(42.8%)	7(50.1%)	17(51.5%)	8(50.1%)	6(35.3%)	2(40%)	49(46.2%)
Acceptable	7(33.3%)	5(35.7%)	10(30.3%)	6(7.4%)	9(52.9%)	2(40%)	39(36.7%)
bad	2(9.9%)	1(7.1%)	2(6.1%)	0(0%)	0(0%)	0(0%)	5(2.5%)

Table 18: We note from the table that the evaluation (good) was the most common evaluation among surgically treated patients aged (18-35 years) at a rate of (50.1%) compared to conservative treatment (42.8%), Followed by the evaluation (acceptable) at a rate of (35.7%) among surgically treated patients compared to (33.3%) among conservatively treated patients, The evaluation (bad) was the lowest evaluation at a rate of (9.9%) for conservative treatment and at a rate of (7.1%) for surgical treatment.

Likewise, the evaluation (good) was the most common

evaluation among conservatively treated patients aged (36-55 years) at a rate of (51.5%) compared to surgical treatment (50.1%), The evaluation (bad) was the lowest evaluation in both conservative treatment (6.1%) while it did not occur in surgical treatment (0%).

The most common evaluation was (acceptable) among those treated conservatively at the age of (> 55 years) at a rate of (52.9%) compared to surgical treatment (40%), The evaluation (poor) did not occur in both conservative and surgical treatment (0%).

Study the relationship between functional outcomes and fracture type according to Sanders (radiographically)

evaluation	Type III		Type IV		total
	cast	plate	cast	plate	
Excellent	7(13.7%)	2(15.3%)	1(5%)	3(13.6%)	13(12.8%)
Good	24(47.1%)	6(46.1%)	9(45%)	10(45.4%)	49(46.2%)
Acceptable	18(35.2%)	4(30.7%)	10(50%)	7(31.8%)	39(36.7%)
bad	2(4%)	1(7.9%)	0(0%)	2(9.2%)	5(2.5%)

Table 19: We note from the table that the evaluation (good) was the most common evaluation, with close proportions, in third-degree fractures treated conservatively (47.1%) and surgically (46.1%), The evaluation (bad) was the least common evaluation in third-degree fractures treated conservatively (4%) and surgically (7.9%), While the evaluation (acceptable) was the most common evaluation in fourth-degree fractures treated conservatively (50%) compared to surgical treatment (31.8%), The evaluation (bad) was the least common evaluation in fourth-degree fractures treated surgically (9.2%), while it did not occur in conservative treatment (0%).

DISCUSSION

- 106 patients with comminuted heel fractures who were admitted to the Orthopedic Surgery Department or followed up in the Orthopedic Clinic at Tishreen University Hospital during the period 2019-2024 and who met the criteria for inclusion in the study were studied and followed up for up to one year from the date of surgery.
- The percentage of patients who were treated conservatively with a plaster device (66.9%) was higher than the percentage of patients who were treated surgically through internal fixation and placement of an anatomical plate (33.1%), and when calculating the statistical percentage, it was $0.05 > P$, meaning that there is a statistically significant difference between patients according to

the treatment method.

- The percentage of treated males was generally higher (83.1%) than the percentage of females (16.19%), indicating that heel fractures are more common in males than in females.
- Males were treated surgically by placing an anatomical plate (82.8%), slightly less than their conservative treatment by placing a plaster device (83%), while females were treated conservatively by placing a plaster device (17%), slightly less than their surgical treatment (17.2%). When calculating the statistical percentage, it was $0.05 > P$, meaning that there is a statistically significant difference in the occurrence of heel fractures in patients according to gender, which was more common in males. Most of the patients were in the fifth decade, where the largest number of patients were in the age group (36-55) years.
- (49 patients) the largest percentage of them were managed conservatively by placing a plaster device (46.4%) compared to the percentage of patients who were treated surgically by placing an anatomic plate (45.7%), while the smallest number of patients > 55 years (22 patients) were treated surgically (14.3%) less than conservative treatment (24.1%).
- The right side was the most affected side among patients (64.1%) compared to the left side (35.9%), indicating that the right foot is more common than the left.
- High energy was the most common mechanism for

causing injury (77.4%) compared to low energy (22.6%), and thus the majority of heel fractures occur due to injuries and accidents resulting from high energy.

- The largest number of patients (86 patients) were managed in the first 24 hours and the percentage was close between conservative treatment (85.9%) and surgical treatment (71.4%). The smallest number of patients were managed after 48 hours (9 patients) where they were treated less conservatively (4.2%) while surgically (17.1%). While (11 patients) were managed within 24-48 hours, they were distributed between conservative treatment (9.86%) and surgical treatment (11.4%).
- The largest number of patients had third-degree fractures (64 patients) at a rate of (60.3%), (71.8%) of them were treated conservatively by placing a plaster device and (37.1%) of them were treated surgically by placing an anatomical plate. While (42 patients) suffered from fourth-degree fractures, (28.2%) of them were treated conservatively by applying a plaster device, and (62.9%) of them were treated surgically by applying an anatomical plate (the majority of third- degree fractures were treated conservatively, while the majority of fourth- degree fractures were treated surgically).
- The healing period was faster in the surgical treatment group (2 ± 6 weeks) compared to conservative treatment (2 ± 8 weeks), and when calculating the statistical ratio, it was $0.05 < P$, meaning there was no statistically significant difference between conservative and surgical treatment according to the healing period.
- The return to practical life was faster in the surgical treatment group (0.5 ± 4 months) compared to conservative treatment (1 ± 5 months), and when calculating the statistical ratio, it was $0.05 < P$, meaning there was no statistically significant difference between conservative and surgical treatment according to the time to return to practical life.
- Complications after fixation were generally few and similar between conservative and surgical treatment, and improvement was noted between 3-month and 1-year follow-up. Except for superficial infection, which occurred at a higher rate in surgical treatment (2.8%) compared to conservative treatment (0%), Superficial skin necrosis occurred at a higher rate in surgical treatment (2.8%) compared to conservative treatment (0%). While the rate of defective healing was higher in conservative treatment (12.6%) than in surgical treatment (5.7%), The remaining complications (Sudick's dystrophy, ankle stiffness) occurred at similar rates between surgical and conservative treatment.
- The value of the American Association of Foot and Ankle Surgeons (AOFAS) index was better in surgical treatment (16 ± 80 points) compared to conservative treatment (11 ± 77 points), and when calculating the statistical percentage, it was $0.05 < P$,

meaning that there is no statistically significant difference between conservative and surgical treatment according to the functional results according to the AOFAS index.

- The largest number of patients received a (good) evaluation according to the AOFAS index (49 patients) at a rate of (46.2%), while (39 patients) received a (acceptable) evaluation at a rate of (36.7%), (13 patients) received a (excellent) evaluation at a rate of (12.8%), and only (5 patients) received a poor evaluation at a rate of (2.5%).
- Conservative treatment patients were distributed according to the AOFAS index as follows: Good (47.8%), which is the largest percentage, acceptable (38.1%), excellent (8.4%), and the lowest percentage is bad (5.7%)

While surgical treatment patients were distributed according to the AOFAS index as follows:

Good (42.8%), which is the largest percentage, acceptable (34.2%), excellent (20%), and the lowest percentage is bad (2.8%). When calculating the statistical percentage, it was $0.05 < P$, meaning there is no statistically significant difference between conservative and surgical treatment according to the functional results and evaluation (excellent, good, acceptable, bad) according to the AOFAS index.

- The evaluation (good) was the most common evaluation and in close proportions in the third degree fractures treated conservatively (47.1%) and surgically (46.1%). The evaluation (poor) was the least evaluation in the third degree fractures treated conservatively (4%) and surgically (7.9%). While the evaluation (acceptable) was the most common evaluation in the fourth degree fractures treated conservatively (50%) compared to surgical treatment (31.8%). The evaluation (poor) was the least evaluation in the fourth degree fractures treated surgically (9.2%) while it did not occur in conservative treatment (0%)

The follow-up steps of physical therapy were earlier in surgical patients compared to patients with a splint in the stages of removing the splint and starting active movement of the ankle....

- Also, in terms of the need to use walking aids, it was less in the surgical group (41.4%) during the first 6 months, decreasing to (0%) by the end of the year. While in the splint group, the need rate was (63%) during the first 6 months of treatment, decreasing to (4%) by the end of the year
- Regarding radiological follow-up, a gradual improvement was observed in the values of Buhler and Guisan angles during the periodic follow-up periods, with higher and almost normal values in the surgical group than in the splint patients .

RECOMMENDATIONS

1. It is necessary to take a detailed and comprehensive

medical history from the patient to identify diseases that may cause subsequent complications and manage them optimally.

2. It is necessary to evaluate the fracture patient in a laboratory and radiological manner before performing any intervention and delaying the intervention until any infectious condition is treated.
3. Treat bone diseases in the elderly (osteoporosis) to avoid fractures that occur with a low-energy mechanism and easily in this category of patients.
4. Perform the therapeutic intervention as soon as possible (within the first 24 hours) when the patient's condition allows it.
5. Consider surgical treatment when there is a need to return to practical life quickly and thus reduce the recovery period and return to work faster.
6. Treatment with broad-spectrum antibiotics and attention to wound sterilization and continuous dressing change after surgical treatment to avoid infectious complications (superficial infection, deep infection).
7. Continuous clinical and radiological monitoring of the fracture to ensure union and avoid defective union or secondary displacement.
8. Performing physical therapy for the foot to avoid ankle stiffness, especially after conservative treatment.
9. The functional results are similar between the two treatment methods, so the surgeon has the freedom to choose between both methods based on experience.

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