*Al-Mukhtar Journal of Sciences* **38 (3): 239-247, 2023**
***ISSN: online 2617-2186 print 2617-2178***
**Journal Homepage**https://omu.edu.ly/journals/index.php/mjsc/index
**Doi:** https://doi.org/10.54172/mjsc.1253

# Rehabilitation Followings Surgical Fixation of Bimalleolar Fractures

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**ARTICLE HISTORY**

Received:
03 February 2023

Accepted:
19 July 2023

**Keywords:**
Olerud Molander Ankle scores; Non-weight bearing; Rehabilitation; Ankle fractures.

**Abstract:** Fractures of the ankle are the commonest type of lower limb fractures and one of the most not unusual type of fractures all over the world. Purpose was to ascertain how powerful and safe are interventions that are used for rehabilitation following surgical treatment of bimalleolar fractures. This was a prospective study conducted on 60 individuals who were subjected to surgical fixation of bimalleolar fractures within the period of 2015 to 2017 at Aljalaa trauma hospital in Benghazi - Libya. The patients were randomly divided according to the sort of rehabilitation protocol into; Group A: who commenced early weight bearing (EWB) by below knee orthosis, and Group B: who began non-weight bearing (NWB) exercises by means of axillary crutches. Olerud Molander Ankle score (OMAS) was used to assess clinical results. Group A had higher OMAS rating than group B but out a significant statistical difference, and there was no significant difference regarding SF-36 scores. No significant difference between early weight bearing rehabilitation and non-weight bearing one as regard functional outcomes. Considering patient's comfort, early functional improvement, and the low complication rate, early postoperative weight bearing and range of motion (ROM) exercises are recommended in subjects with surgically treated ankle fractures.

## التأهيل بعد العلاج الجراحي لكسور الكاحل

**الكلمات المفتاحية:**
مقيـ . . . .اس Olerud Molander للكاحـ . . ل؛ تحميل بدون الوزن؛ إعادة تأهيل؛ كسور الكاحل.

**المستخلص:** كسور الكاحل هي النوع الأكثر شيوعًا لكسور الأطراف السفلية ومن بين أكثر أنواع الكسـ ور شيوعًا في جميع أنحاء العالم. وكان الهدف هو تحديد فعالية وسلامة التدخلات المستخدمة لإعادة التأهيل بعد الترجيع المفتوح والتثبيت الداخلي لكسور الكاحل. حيث كانت هذه تجربة عشوائية محكومة مرتقبة أجريـ ت على 60 مريضًا خضعوا لترجيع مفتوح وتثبيت داخلي لكسور الكاحل ثنائية القطب في الفترة بين 2015 م –2017 م في مستشفى الجلاء للحوادث بنغازي – ليبيا. تم تقسيم المرضى حسب طريقة إعادة التأهيل إلى؛ المجموعة (أ): الذين بدأوا في التحميل المبكر للوزن (EWB) باستخدام دعامة أسفل الركبـ ة، والمجموعـ ة (ب): الذين بدأوا التمارين بدون تحميل للوزن (NWB) وذلك باستخدام العكازات الإبطية. وتـ م اسـ تخدام مقياس Olerud Molander للكاحل (OMAS) لتقييم النتائج السـ ريرية. وكـ ان OMAS أعلـ ى فـ ي المجموعة (أ) مقارنة بالمجموعة(ب) ولكن بدون فرق معتد به إحصائيًا، ولم يكن هناك فرقـ ا كبيـ را فيمـ ا يتعلق بنطاقات SF-36. لا يوجد فرق كبير بين إعادة التأهيل بتحميل الوزن المبكر وبين إعادة التأهيل بدون تحميل الوزن فيما يتعلق بالنتائج الوظيفية. وبالنظر الى راحة المريض، والنتائج الوظيفية المحسّنة مبكـ رًا، ونقص معدل المضاعفات المتزايد، نوصي بتمارين تحميل الوزن في وقت مبكر بعد الجراحة ومدى الحركة (ROM) في المرضى الذين يعانون من كسور الكاحل المعالجة جراحيًا.

## INTRODUCTION

Fractures of the ankle are the commonest type of lower limb fractures and one of the most not unusual types of fractures everywhere with occurrence between 100 and 150 per 100,000 person/y and rising. More than half occurs during sport activities, revealing a healthy patient population (Reiner et al., 2013). The charges

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are high for the patients and community. The burden of these injuries is associated with surgery, hospitalization, and the time wasted in occupational incapacity. To minimize these prizes, early functional return is important (Del Buono et al., 2013). The preliminary non-surgical or surgical treatment of bimalleolar fracture serves to maintain the ankle anatomy and stability. Immobilization may assist to offer ideal conditions for fracture to heal. It contributes to decrease chance of malunion or nonunion. However, immobilization additionally increases the threat of joint stiffness, weakness, swelling and residual pain. Whilst immobilized, load-bearing is either limited or not allowed, with resultant generalized decrease of movements and activity. Rehabilitation is geared toward enhancing involvement in job and luxurious hobbies, regaining movement and minimizing pain and other disabilities (Canton et al., 2021).

The surgical indications are determined by the conformity of the joint. If joint is incongruent, fractures are usually managed by surgical methods to provide stability to the joint. The postoperative management protocols range notably from strict confinement in a plaster cast without load-bearing lasting for many weeks to prompt post-operative guarded mobilization. Immediate post-operative unprotected weight-bearing (WB) as permitted has been advised with caution (Güngör et al., 2022).

Many systemic audits were posted on special perspectives of postoperative management protocols, all failed to obtain distinct decision for the postsurgical regimen of bimalleolar fractures as they vary with respect to protection, ankle motion, and bearing weight. Non-randomized studies were implicated in these reviews and meta-analysis to potentiate displaying how effective and safe are the interventions which might be applied for rehabilitation following internal fixation of ankle fractures. Moreover, certain perspectives of the post-operative protocols were put in comparison.

## MATERIALS AND METHODS

This study is a prospective randomized controlled trial was conducted on a total of 60 individuals who were subjected to open surgical treatment of bimalleolar ankle fractures in the period between 2015 to 2017 at Al Jalaa Trauma Hospital in Benghazi - Libya. Inclusion criteria were: mentally and psychologically well and physically active patients, non-osteoporotic bone, body mass index (BMI) around 26, and closed fractures treated by open reduction and rigid internal fixation. Exclusion criteria were: geriatric and pediatric age groups, all open injuries, pilon fractures, multi trauma patients, trimalleolar fractures, bimalleolar fractures associated with foot fracture, bilateral ankle fractures, and patients with neuropathic and inflammatory joint diseases. There was 49 males and 11 females with median age of 35 years. To compare postoperative outcome, patients were assigned randomly to 2 patches; group A who started early weight bearing (EWB) by below knee orthosis, and group B who started non-weight bearing (NWB) exercises by using axillary crutches.

Patients were evaluated using clinical scoring system called modified Olerud and Molander ankle score modified from original score (OMAS) in 1984, which has the following scale:

**Pain:** no pain 25, mild (weather liable) 20, while sporting 15, when walking on normal ground 5, fixed and relentless 0.

**Stiffness:** none 10, morning stiffness 5, and constant stiffness 0.

Swelling: none10, evening time only 5, and persistent 0.

**Stair-ascending:** no problems10, affected 5, and not possible 0.

**Sports:** normal10, affected 5, and not possible 0.

**Supports:** no support 10, bandaging 5, and walking aid 0.

**Ordinary activity and job:** not changed 25, loss of speediness 20, shift to less demanding job 10, and severe work impairment 0.

The results were collected, and arranged in tables and subjected to statistical analysis by means of SPSS 22.0 for windows. Statistics testing for normal distribution was achieved using the Shapiro Walk test. Frequencies and relative percentages represented the qualitative variables. The difference between qualitative items was determined by $\chi 2$ test and Fisher test. The mean ± SD presented the quantitative parametric variables, and the median and range expressed the non-parametric variables. The difference for quantitative parametric items was extracted using independent t test and for quantitative non-parametric items Mann Whitney test was applied. To statistically compare the results P-value was used for level of significance, when P-value ≤ 0.05 this means significant, if p <0.001 it means highly significant difference but when P > 0.05 there is non-significant difference.

**Nature of the intervention:** Many interventions for rehabilitation are applied to manage the complications of bimalleolar fracture and immobilization. Rehabilitation can start while patient is immobilized, where the patient may begin early passive or active movements, or early weight bearing. Instead, rehabilitation can commence after the period of immobilization, where interference may involve exercise and manual therapy. Manners of immobilization entail casts (made from plaster of Paris or synthetic substances), half casts in form of back slabs, and orthotic devices (braces), and these were recognized as a part of the rehabilitation for our study where they may enhance or limit the initiation of other interventions during the immobilization period, like walking with weight bearing (WB exercise) (Deng et al., 2022).

## RESULTS

The mean age of patients in group A was 40.51 ± 10.45 years, 24 patients (80%) were males, and 6 (20%) patients were females with mean BMI was 26.12 kg/m$^2$. Meanwhile, the mean age of patients in group B was 37.64 ± 9.35 years, 25 patients (83.3%) were males, and 5 (16.7%) were females with mean BMI was 25.74 kg/m$^2$. Thirty-two patients came from rural areas and 28 were residents in urban areas. There was no significant difference between the groups regarding demographic data (Table 1).

Group A included 3 (10%) diabetic, and 4 (13.3%) hypertensive patients, with 13 (43.3%) were smokers. Group B had, 5 (16.7%) diabetic, and 3 (10%) hypertensive patients, with 11 (36.7%) were smokers. However, no significant difference was seen (Fig.1).

**Table: (1).** Socio-Demographic characteristics

| | | Group A (n=30) | Group B (n=30) | t / $\chi^2$ | P |
|---|---|---|---|---|---|
| Age (years) Mean ± SD | | 40.51 ± 10.45 | 38.64 ± 9.35 | 0.730 | 0.468 |
| Gender | Female | 15 (50%) | 15 (50%) | 0.127 | 0.639 |
| | Male | 15 (50%) | 15 (50%) | | |
| Residence | Rural | 15 (50%) | 17 (56.7%) | 0.268 | 0.605 |
| | Urban | 15 (50%) | 13 (43.3%) | | |
| BMI (kg/m$^2$) Mean ± SD | | 26.12 ± 3.57 | 25.74 ± 2.96 | 0.449 | 0.655 |

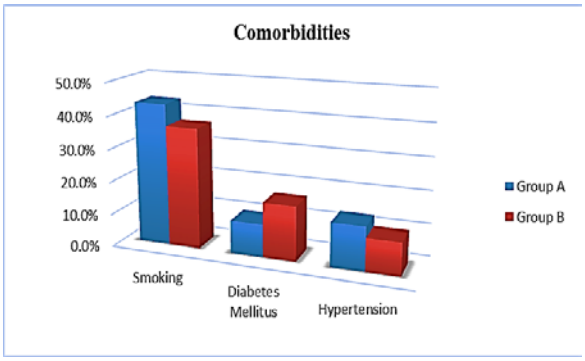


**Figure: (1).** Comorbidities distribution

Regarding group A, 21 patients (70%) had right side affected, and 9 patients (30%) had left side, with cause of fracture was direct fall in 10 patients (33.3%) and RTA in 7 patients (23.3%) and sports trauma in 13 patients (43.3%). In group B, 18 patients (60%) had

right side affected, and 12 patients (40%) had left side, with fracture caused by direct fall in 9 patients (30%), RTA in 6 patients (20%) and sports trauma in 15 patients (50%). However, P value stwo study groups (Table 2).

**Table: (2).** Fracture characteristics

| Side | Group A (n=30) | Group B (n=30) | $\chi^2$ | P |
|---|---|---|---|---|
| Rt. | 21 (70%) | 18 (60%) | 0.417 | 0.659 |
| Lt. | 9 (30%) | 12 (40%) | | |
| Cause | | | | |
| RTA | 7 (23.3%) | 6 (20%) | | |
| Fall | 10 (33.3%) | 9 (30%) | 0.272 | 0.873 |
| Sports | 13 (43.3%) | 15 (50%) | | |

According to Lauge-Hansen classification, group A had 13 patients (43.3%) with supination-external rotation (SER), 3 patients (10%) with supination-adduction (SA), 9 patients (30%) with pronation-adduction (PA), and 5 patients (16.7%) with pronation-external rotation (PER), while group B had 12patients (40%) with SER, 5 patients (16.7%) with SA, 10 patients (33.3%) with PA, and 3 patients (10%) with PER. No significant difference was found between the groups.

Group A had higher OMAS rating than group B but out a significant statistical difference (Table 3). No statically significant difference was seen between the two groups with respect to SF-36 scores (Table 4).

**Table: (3).** Clinical evaluation using Olerud Molander ankle score (OMAS)

| OMAS | Group A (n=30) | Group B (n=30) | t | p |
|---|---|---|---|---|
| After 6 weeks Mean± SD | 52.1 ±20.56 | 43.51 ± 21.75 | 1.57 | 0.121 |
| After12weeks Mean± SD | 70.24 ±14.73 | 65.83 ± 18.47 | 1.02 | 0.311 |
| After 6 months Mean± SD | 87.2 ± 13.54 | 80.49 ± 17.67 | 1.65 | 0.104 |

**Table: (4).** Postoperative SF-36

| | Group A (n=30) | Group B (n=30) | t | p |
|---|---|---|---|---|
| Physical functioning Mean ± SD | 76.28 ± 16.73 | 74.63 ± 21.54 | 0.331 | 0.742 |
| Role-physical functioning Mean ± SD | 28.67 ± 36.85 | 24.27 ± 35.61 | 0.471 | 0.640 |
| Bodily pain Mean ± SD | 81.22 ± 17.3 | 76.32 ± 18.31 | 1.07 | 0.291 |
| General health perception Mean ± SD | 79.44 ± 18.62 | 81.73 ± 14.61 | 0.530 | 0.598 |
| Fatigue Mean ± SD | 75.61 ± 15.45 | 74.55 ± 16.29 | 0.259 | 0.797 |
| Social functioning Mean ± SD | 86.57 ± 22.34 | 84.9 ± 20.26 | 0.303 | 0.763 |
| Emotional functioning Mean ± SD | 13.78 ± 24.37 | 10.92 ± 32.68 | 0.384 | 0.702 |
| Mental health Mean ± SD | 84.64 ± 12.18 | 81.57 ± 15.34 | 0.858 | 0.394 |

Complications seen in group A included one patient (3.3%) with superficial infection, and in group B included 3 patients (10%) with superficial infection, one patient (3.3%) with reflex sympathetic dystrophy (RSD), and one patient (3.3%) with deep venous thrombosis (DVT). However, P value did not show significant difference among the two groups.

With respect to the type of fixation in lateral or medial malleolus P value did not show significant difference between the group A and group B (Table 5 and Fig.2).

**Table: (5).** Fixation types of lateral and medial malleolus

| Lateral malleolus fixation: | Group A (n=30) | Group B (n=30) | $\chi^2$ | p |
|---|---|---|---|---|
| 2x screws fixation | 3 (10%) | 2 (6.7%) | 0.311 | 0.856 |
| Screw fixation and neutralization plate | 19 (63.3%) | 17 (56.6%) | | |
| Neutralization plate | 6 (20%) | 4(13.3%) | | |
| Dorsolateral buttress plate | 2 (6.7%) | 7(23.3%) | | |
| Medial malleolus fixation: | | | | |
| 1x screw fixation | 2 (6.7%) | 2 (6.7%) | 2.75 | 0.601 |
| 1x screw fixation and K. wire | 20(66.6%) | 23 (76.6 %) | | |
| 2x screws fixation | 2 (6.7%) | 1 (6.7%) | | |
| Not applicable/no fixation required | 6 (20%) | 4 (13.3%) | | |

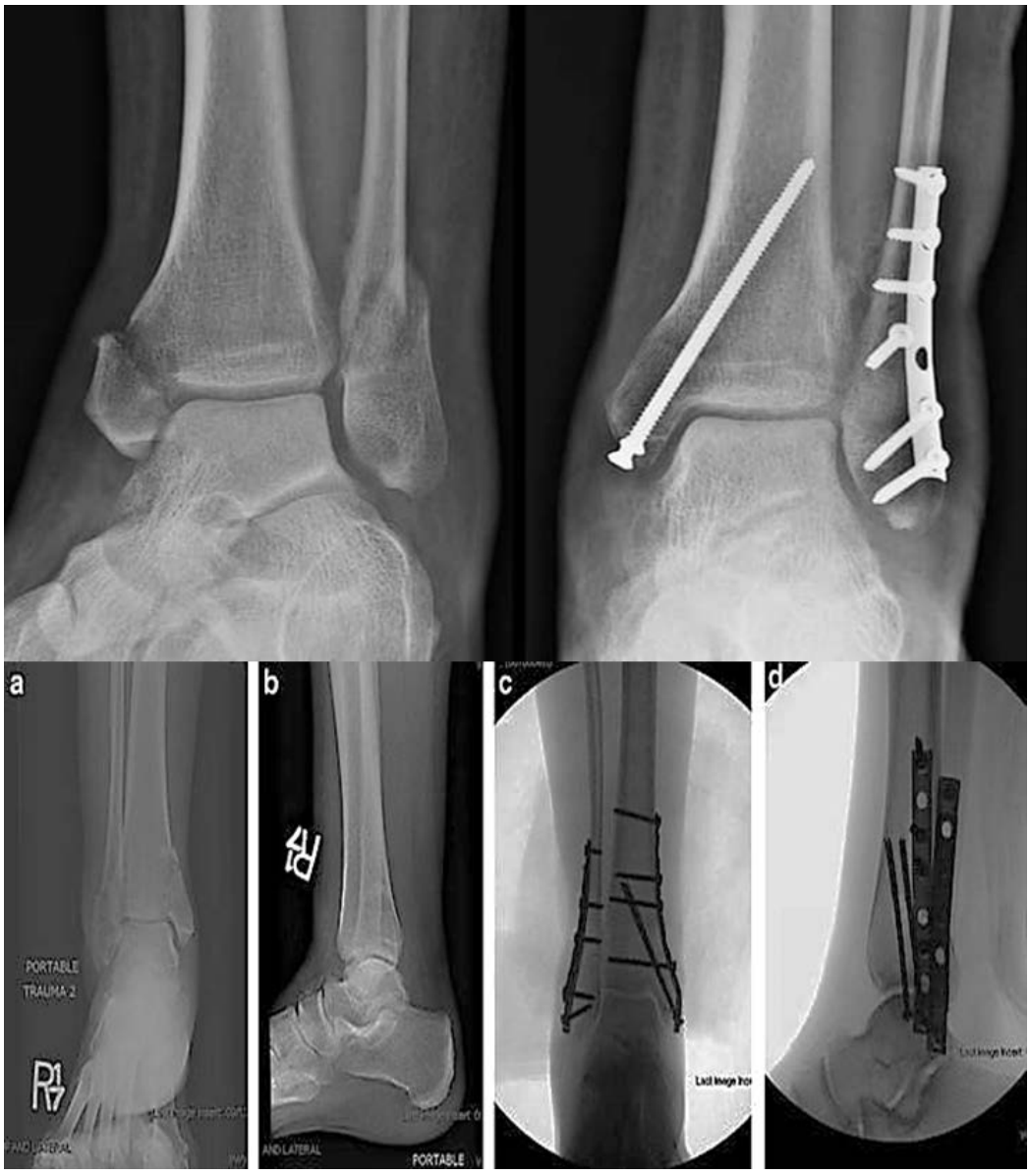


**Figure: (2).** Bimalleolar fractures treated by open reduction and internal fixation using isolated screws or plate with screws for medial malleolus, and plate and screws for lateral malleolus.

## DISCUSSION

In this study, we aimed to decide how powerful and safe are interventions that are used for rehabilitation following internal fixation of bimalleolar fractures. Majority of patients with bimalleolar fractures, whether surgically fixed or dealt with non-operatively, have a tendency to bitch of stiffness, edema and pain which is referred to as 'fracture disease'. This might be attributed to pain and the deprivation of joint from normal physiological stresses, which ends by stiffness. It has been seen that as much as 77% of affected individuals suffer from ankle stiffness following elimination of cast in bimalleolar fractures. Most of these sequelae take place in the first two of weeks of immobilization. Even though the evidence is conflicting, most researches point to the fact that early rehabilitation following ankle fractures might prevent these sequelae in the short period. Prolonged inspections did not reveal significant differences regarding early mobilization and immobilization following bimalleolar fractures. Nevertheless, most studies that favor early active rehabilitation program as superior relate the results from subjects treated in cast postoperatively relative to subjects who adopted early range of motion exercises program. The knowledge is scarce on the importance and effects of different standardized rehabilitation programs.

In a recent retrospective-controlled trial of multicenter origin conducted by Smeeing et al. to study three interventions for rehabilitation: unprotected NWB, protected WB as tolerated and unprotected WB after surgical fixation of ankle supination external rotation injury only. The published post hoc analysis embraced 115 participants in the three interventions. They concluded that the unprotected WB mobilization regimen enhanced short-term functional results without increasing complication rate (Smeeing et al., 2015). This study was included at interim analysis, and reported that the mean age of the involved subjects is 39.0 (± 14.4) years, with range of 18 - 65 years, 61 of which (53.0%) are males. This is compatible with our results. In comparison with our findings, the trial of Latham et al. intended to know if exercise done at home with minimal ground contact supervised by physiotherapist increased the hip score after termination of conventional hip fracture rehabilitation program, and showed that at recruitment, the value for mean age of subjects is 78 years (SD ± 9.9 years); 69% are females. Based on age, baseline function, or gender there were no significant differences between individuals who disappeared to follow-up (53 pts.; 27 belong to control and 26 to intervention group) and individuals who finished the follow up at 9 months. Those disappeared from follow up constituted 21.6% of the randomized sample (Latham et al., 2014).

In line with our findings is Zeng's study of 160 ankle fracture patients (58 males and 102 females, aged 41.71 ± 14. 51 years) undergoing open reduction and internal fixation, grouped into the non-enhanced recovery after surgery or enhanced recovery after surgery based on the treatment procedure. The statistical data (sex, age, fracture type, dislocation, and associated diseases) were similar between both cohorts with p value $>0.05$ (Zeng et al., 2022). Current preferences in early rehabilitation challenge with conventional NWB concept and no strong consensus to clarify the optimum intervention. This perhaps is reflected by the confronting publications referring to the evaluation of WB programs after bimalleolar fracture surgical treatment (Swart et al., 2015). Some studies have investigated three types of interventions after bimalleolar fracture surgical fixation: non weight bearing early mobilization, early weight-bearing mobilization and immediate weight-bearing mobilization, a few reported encouraging results, while others warned about elevating complication levels (Kearney et al., 2021). In our study, OMAS was higher in group A (WB group) compared to group B (NWB group) but without statistically significant difference. Earlier trials involving even younger population demonstrated improved performance

when subjected to OMAS a year following the fracture in contrast to the findings in the current research. A mean of 91 points was found by Tropp in a collection of 30 patients having unimalleolar/ bimalleolar/ or trimalleolar fractures with an average age of 26 (Tropp & Norlin, 1995). Egol and Nilsson disclosed that patients older than 40 have extended possibility of less functional score after one year of surgery and even three years later (Egol et al., 2000; Nilsson et al., 2003). The results of OMAS for ages more than 40 years were almost similar to what we found in our study. These results promote the findings that younger ages achieve superior outcome and that adult having identical fractures better not be considered as a congruent group. The age must be regarded as an important issue when evaluating consequences after ankle fracture.

In this study, there was no significant difference between the groups regarding the SF-36 scores. Segal reported that SF-36 ratings showed significant differences among 3 ankle fracture groups (uni/bi/tri malleolar) and normal individuals in all 8 sub-test groups and in the summarizing scores (physical health summary; PHS and mental health summary; MHS) but no significant variations among ankle fracture groups in all SF-36 sub-test groups (Segal et al., 2014). This goes in harmony with our findings. In his systemic review Black revealed significantly better results for many parameters including improved early dorsiflexion, time to FWB, early come back to work and briefer hospitalization (patient aged <60 y.) in the early WB group (Black et al., 2013). This is in accord with our results. Also, in line with our findings, Latham reported that no critical negative events encountered that were attributed to the intervention. One negative occurrence that might be attributed to the interventional procedure is mild to moderate pain. Pain is regarded as an adverse event when it continued longer than 48 hours and when candidates had to adjust their daily activities or have medicine. Twenty-three patients in the intervention group experienced pain of mild to moderate severity. Both groups had numerous health issues that were irrelevant to interventions included in the study, this is compatible with high level of comorbid conditions in this community (Latham et al., 2014). A study conducted by Dehghan showed that no difference in return to work (RTW). At 6 weeks postoperatively, EWB subset had notably increased ROM of ankle (41 against 29, with $P < 0.0001$); OMAS (45 against 32, with $P = 0.0007$), and SF-36 ratings on the objective (51 against 42, with $P = 0.008$) and intellectual (66 against 54, with $P = 0.0008$) elements. However, no differences were seen related to infections or surgical site problems, and no failure of implants or redisplacement were encountered. The patients who started delayed WB got more sessions of scheduled or executed surgery for implant extraction as a result of plate irritation (19% against 2%, with $P = 0.005$) (Dehghan et al., 2016). This augments our conclusion in the present study. Vioreanu reported that the patients who started earlier movement with a portable cast got improved clinical score ratings (OMAS and American Orthopedic Foot and Ankle Score; AOFAS) at 9 and 12 weeks postoperatively, and resumed work activity earlier (after 67 days) compared with patients who started NWB in the below - knee cast (after 95 days), with $p < 0.05$. No statistical difference is seen among the two groups at 6 months regarding life quality (SF-36 Survey). The early mobilization cohort had postoperative infection rate of 10% (one superficial and two deep) (Vioreanu et al., 2007).

## CONCLUSION

This study revealed no significant difference between WB rehabilitation and NWB one as regard functional outcomes. Considering patient's comfort, early functional improvement, and the low complication rate, early postoperative WB and ROM exercises are recommended in subjects with surgically treated ankle fractures. However, both the surgeon and the patient have to be alert of

the potential hazard of wound problems linked to this method of treatment, so the accelerated rehabilitation protocol should be tailored to patient. Further studies on larger sample size and large geographical scale are suggested to emphasize our findings.

**Duality of interest:** The authors declare that they have no duality of interest associated with this manuscript.

**Author contributions:** Contribution is equal between authors.

**Funding:** No specific funding was received for this work.

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