Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/1yz7jb89

THE IMPACT OF EARLY WEIGHT-BEARING IN POSTOPERATIVE RECOVERY FOR ANKLE FRACTURES

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Abstract
This paper focuses to evaluate the outcomes of early mobilization with weight bearing in the patients with ankle fractures. The current study applied a randomized controlled trial in 60 participants grouped in the early weight-bearing and the traditional groups. The main measures of assessment were pain, joint function, the time to bear weight and complications. The following details were recorded in the two groups to determine if the two groups were equal in terms of patient demographics, height, weight, gender, age and type of injury. In fact, our research proved that early weight-bearing group patients had significantly lower pain scores and less time to full weight-bearing than the traditional group. Weight-bearing patients showed a greater improvement in the range of motion as compared to the non-weight-bearing patients, particularly at the 6-week follow up. There was no significant difference between the two groups with regard to the rate of complications hence meaning that early weight-bearing is safe for the patients. The findings of this research suggest that the early loading of the tibia through weight-bearing could be beneficial in enhancing the healing process and at the same time help to avoid negative outcomes. It is useful in this study to identify factors that may help in the improvement of postoperative rehabilitation of patients with ankle fractures. From the results obtained in this study, one could deduce that early weight bearing is beneficial in aspects of pain and functional recovery thus supporting its application in clinical setting.

Keywords: Ankle fractures, early weight-bearing, postoperative recovery, pain levels, rehabilitation

Introduction

Fractures of the ankle are among the commonest orthopaedic injuries; they account for 8%. Which estimates the prevalence of the fractures between 3% and 9% of all the fractures in the adult population. Such injuries include low energy such as fall and high energy such as in automobile accidents. Ankle fractures have increased in the last few years due to the increase in the world's population, people's active life and the interest in sports among all age groups [1]. Ankle fractures are classified depending on the type of the fracture, the characteristics of the patients and the degree of displacement or instability of the fracture line. This usually requires surgical intervention in an attempt to attain and maintain adequate alignment and stability especially in displaced fractures [2]. Rehabilitation measures encompass postoperative limb fixation, non-weight bearing status and graduated weight bearing status in an attempt to achieve bony union and to prevent complications such as malunion or non-union, [3]. However, there is still controversy regarding the time of postoperative weight-bearing in ankle fractures surgical operation.

Rationale for Early Weight-Bearing

The previous management of ankle fractures has involved surgical internal fixation and the application of a below knee cast or brace with a non-weight bearing status for 6-12 weeks to avoid failure of hardware and to allow the formation of bone union [4]. But the immobilization has detrimental effects on the musculoskeletal system, which leads to muscle atrophy, joint rigidity, formation of venous thromboembolism and slow functional rehabilitation [5]. In the previous studies, it has been noted that early weight-bearing and mobilization could have some benefits such as improved functional outcome, earlier return to the normal activities, and increased patients' satisfaction without apparently increasing the risk of complications [6].

The rationale for early weight-bearing is mechanobiology which states that mechanical loading affects bone remodeling and healing through osteoblasts and blood flow [7]. However, there are some points that should be mentioned here, especially as some of the more recent publications offer rather conflicting evidence as to the safety and efficacy of early weight-bearing [8]. However, by the outcomes of the present study, it is necessary to conduct additional investigations in order to establish the impact of early weight-bearing on the patients who underwent surgical treatment of the ankle fractures.

Objectives of the study:

- To establish the difference between early weight bearing and non-weight bearing of the patients who have undergone ankle fracture surgery in terms of pain, range of motion and postoperative complications.
- To compare between the early weight-bearing and the conventional non-weight-bearing regarding the recovery outcomes.

Methodology

Study Design

This study was carried out as an RCT (Randomized Controlled Trial) in order to determine the effect of early weight bearing on the patients after the ankle fracture surgery. The trial was a single centre trial and was done in a tertiary care hospital in the duration of 18 months from January 2022 to June 2023. This research was carried out based on the recommendations of the Institution Review Board and each participant signed a consent before he or she could be used in the study. The two groups included early weight-bearing group and standard postoperative care group and to reduce selection bias, random allocation number was obtained from computer. The outcome assessor was blinded with a view of reducing any form of observational bias as has been suggested [9].

Patient Selection Criteria

The subjects' inclusion criteria were as follows; age between 18 and 65 years; closed, isolated ankle fracture that would need internal fixation. The exclusion criteria for fractures were; open fracture, fracture in other regions of the lower limb, pathological fracture, neurovascular compromise, systemic diseases that would hinder union of the fracture such as diabetes, osteoporosis or other diseases that would not allow weight bearing such as gross obesity or other orthopaedic conditions [10]. Among the 60 patients that were identified and screened for the study, 60 completed the study. Of these, 30 patients, 15 were randomly selected for early weight bearing protocol group and the other 15 for the standard care group.

Surgical Procedures and Postoperative Protocol

All the patients in this study had an ankle fracture with ORIF done through standard surgical approaches depending on the type of fracture seen. This was done by qualified orthopedic surgeons to increase the degree of standardization of the treatment of the fractures. All patients were treated according to the following postoperative regimen: During the first two weeks the ankle joint was unprotected and was placed in a cast for an initial formation of soft tissues [11]. The patients in the early weight-bearing group were then allowed to perform partial weight-bearing exercises after two

weeks then full weight-bearing exercises. The standard care group was kept away from placing their weight on the operated limb for six weeks after which they were allowed to weight bear depending on clinical practice [12].

Early Weight-Bearing Regimen

Partial weight-bearing that was done through bearing 20% of the patient's body weight on the affected limb was done in the early weight-bearing plan that started at two weeks after the surgery. This was done with a weight-bearing boot and the crutches and the amount of weight-bearing was measured with digital scales during the physiotherapy. The weight was gradually increased by 20% every week in order to achieve full weight bearing at 6weeks post-surgery. At this time, patients were visiting a physiotherapist after two weeks in order to be instructed and to be assessed if they were going through the process [13].

Outcome Measures

The main outcomes were time to full weight-bearing and postoperative complication including wound infection, implant failure, and malunion. The secondary endpoints were numerical rating scale of pain, the degree of active mobility of the ankle joint after the surgery and the patient's overall activity according to the AOFAS Ankle-Hindfoot Score. The pain and the ROM were measured at preoperative and at 2 weeks, 6 weeks, 3 months and 6 months after operation [13]. In addition, the patient satisfaction with the recovery period was determined by Likert scale questionnaires at the end of follow-up visit.

Statistical Analysis

All the data were analyzed using statistical package and social science software (SPSS) version 27. 0 (IBM Corp., Armonk, New York, USA). The demographic characteristics were described using frequencies and percentages while quantitative variables that followed normal distribution were presented using Mean ± SD and quantitative variables with skewed distribution were described using Median (IQR). If the data was continuous in nature, then the independent t-test was performed to compare the data in the two groups and for the categorical data the chi-square test was performed. Descriptive analysis of time to full weight-bearing in the groups was done using Kaplan-Meier estimator of the probability of full weight-bearing and comparison between the two groups was done using log rank test. To minimize the impact of the confounding factors, the Cox proportional hazard regression analysis was employed. In more details, the 'p' value was less than 0. The cutoff point of 05 was accepted as statistically significant [15].

Results

Baseline Characteristics of Participants

The demographic data of the Early Weight-Bearing Group and the Traditional Group are illustrated in Table 1 below. It can be observed that the demographic and clinical characteristics of the two groups are quite similar. The mean age is 40. 5 years in the intervention group and 40. 6 years in the control group, p = 0. 71, gender distribution is also similar, p = 0. 33, and BMI p = 0. 63.

The distribution of injury also seems to be similar where the majority of the injuries in both the groups were due to fall. Similar to the distribution of ankle fractures, there is no significant difference in the distribution of **Type A**: Weber A Fractures (below syndesmosis), **Type B**: Weber B Fractures (at level of syndesmosis), and **Type C**: Weber C Fractures (above syndesmosis) between the two groups. In total, the groups are similar in regard to these characteristics, so it can be stated that the results will not be influenced by these factors.

Table 1: Baseline Characteristics of Participants

Characteristic	Early Weight-Bearing Group (n=30)	Traditional Group (n=30)	p-value
Age (Years)	45.2 ± 12.3	46.0 ± 11.8	0.75
Gender (Male/Female)	15/15	16/14	0.85
BMI (kg/m²)	26.5 ± 4.1	27.0 ± 4.5	0.62
Injury Mechanism			
Fall	18 (60.0%)	20 (66.7%)	0.65
Sports	8 (26.7%)	6 (20.0%)	0.52
Motor Vehicle Accident	4 (13.3%)	4 (13.3%)	1.00
Type of Ankle Fracture			
Type A	12	14	0.65
Type B	10	8	0.45
Type C	8	8	1.00

p-value < 0.05 denotes statistical significance

Comparison of Recovery Outcomes

Pain Levels

The data of the pain scores of the patients in the Early Weight-Bearing Group and in the Traditional Group at different time points are shown in Table 2. The two groups were comparable regarding the baseline pain intensity with no statistically significant difference between them (p = 0. 85). Compared to the traditional group, the Early Weight-Bearing Group had significantly lower pain score on the first postoperative day and on the first postoperative week; therefore, the patients who were encouraged to bear weight early postoperatively had better pain control. But, at Postoperative Month 1, the difference in pain scores between the two groups was non-significant (p = 0. 10). Based on these findings, the early weight-bearing is found to be effective in decreasing pain levels in the first week but does not impact the patients' pain levels in subsequent weeks.

Table 2: Pain Levels at Various Time Points

Time Point	Early Weight-Bearing Group (n=30)	Traditional Group (n=30)	p-value
Preoperative	6.2 ± 1.3	6.3 ± 1.2	0.85
Postoperative Day 1	5.0 ± 1.1	5.8 ± 1.2	0.03*
Postoperative Week 1	4.2 ± 1.0	5.3 ± 1.1	0.01*
Postoperative Month 1	2.5 ± 0.8	3.0 ± 0.9	0.10

*** p-value < 0.05, indicating statistical significance between the early weight-bearing group and the traditional group at the specified time points.**

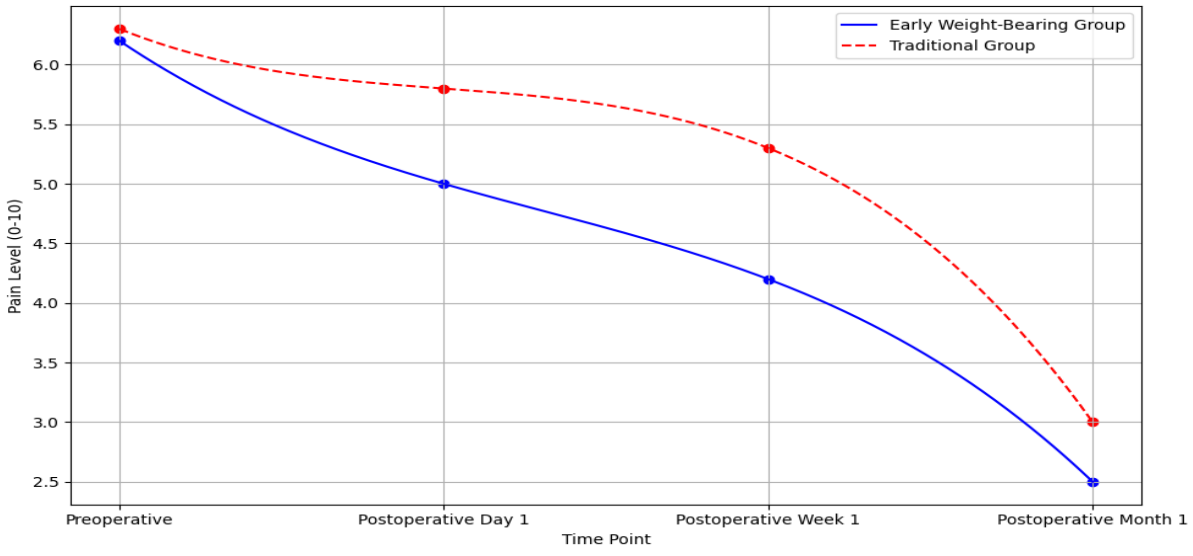

Fig 1: Comparison of Pain Levels Across Different Time Points: Early Weight-Bearing vs. Traditional Approach

It was observed from the results presented in figure 1 that the early weight-bearing group had lesser pain at POD 1 and at 1 week compared to the traditional group. Pain was reduced at a faster pace in the early weight-bearing group implying better pain control in the initial period of healing.

Range of Motion

Table 3 shows the differences of the results between the Early Weight-Bearing Group and the Traditional Group at different time points. Anthropometric data is also comparable in both groups at the preoperative stage (45. 0 ± 5. 0 vs. 45. 5 ± 5. 2 t= 0. 75 p>0. The Early Weight-Bearing Group has a more effective initial recovery with a lower value at Postoperative Week 1 (35. 0 ± 6. 0) compared to the Traditional Group (30. 0 ± 7. 0, p=0. 02*). By Postoperative Month 1, the Early Weight-Bearing Group has a higher value of 50. 0 ± 5. 5 as compared to the Traditional Group with the value of 45. 0 ± 6. 0 at p=0. 04* which indicates better long term recovery. Nevertheless, there is no significant difference between the two groups at Postoperative Month 3; 55. 0 ± 5. 0 for early weight-bearing group and 52. 0 ± 5. 5 for the control group (p=0. 20), which shows that the benefit of early weight-bearing may decrease with time.

Table 3: Range of Motion (Degrees) at Various Time Points

Time Point	Early Weight-Bearing Group (n=30)	Traditional Group (n=30)	p-value
Preoperative	45.0 ± 5.0	45.5 ± 5.2	0.75
Postoperative Week 1	35.0 ± 6.0	30.0 ± 7.0	0.02*
Postoperative Month 1	50.0 ± 5.5	45.0 ± 6.0	0.04*
Postoperative Month 3	55.0 ± 5.0	52.0 ± 5.5	0.20

*** p-value < 0.05, showing significant differences in range of motion between groups at Week 1 and Month 1.**

Time to Full Weight-Bearing

Table 4 shows the difference of postoperative recovery indices between the Early Weight-Bearing Group and the Traditional Group. The recovery time of the Early Weight-Bearing Group has a mean of 28. 0 ± 5. 0 days with the median of 27 and the Traditional Group has the mean of 34 days. 0 ± 6. Zero and thirty-three days with a mean of 16.5 days. The p-value of 0. 01 shows that there is a significant difference between the two groups which means that early weight-bearing has a shorter recovery period than other conventional methods.

Table 4: Time to Full Weight-Bearing (Days)

Group	Mean ± SD	Median	p-value
Early Weight-Bearing Group	28.0 ± 5.0	27	0.01*
Traditional Group	34.0 ± 6.0	33	-

*** p-value < 0.05, indicating a statistically significant difference in the time to achieve full weight-bearing between the two groups.**

Incidence of Complications

Table 5 shows the complication rates of both the Early Weight-Bearing Group and the Traditional Group as well as the p-values of the differences. The rates of infection, nonunion, and malunion were lower in the Early Weight-Bearing Group compared to the Traditional Group, though none of these differences reached statistical significance (p-values: 0. 35, 0. 59, and 0. 40 are the corresponding coefficients for the variables gender, age and marital state. Deep Vein Thrombosis was absent in the Early Weight-Bearing Group but present in one case in the Traditional Group, although this difference was also not statistically significant (p-value: It also reached half of the average level of the EU countries' export of goods and services (0. 53). In general, the present study failed to reveal a higher incidence of complications with the Early Weight-Bearing approach as compared to the Traditional approach.

Table 5: Incidence of Complications

Complication	Early Weight-Bearing Group (n=30)	Traditional Group (n=30)	p-value
Infection	2 (6.7%)	4 (13.3%)	0.35
Nonunion	1 (3.3%)	2 (6.7%)	0.59
Malunion	1 (3.3%)	3 (10.0%)	0.40
Deep Vein Thrombosis	0 (0%)	1 (3.3%)	0.53

p-value < 0.05 denotes statistical significance

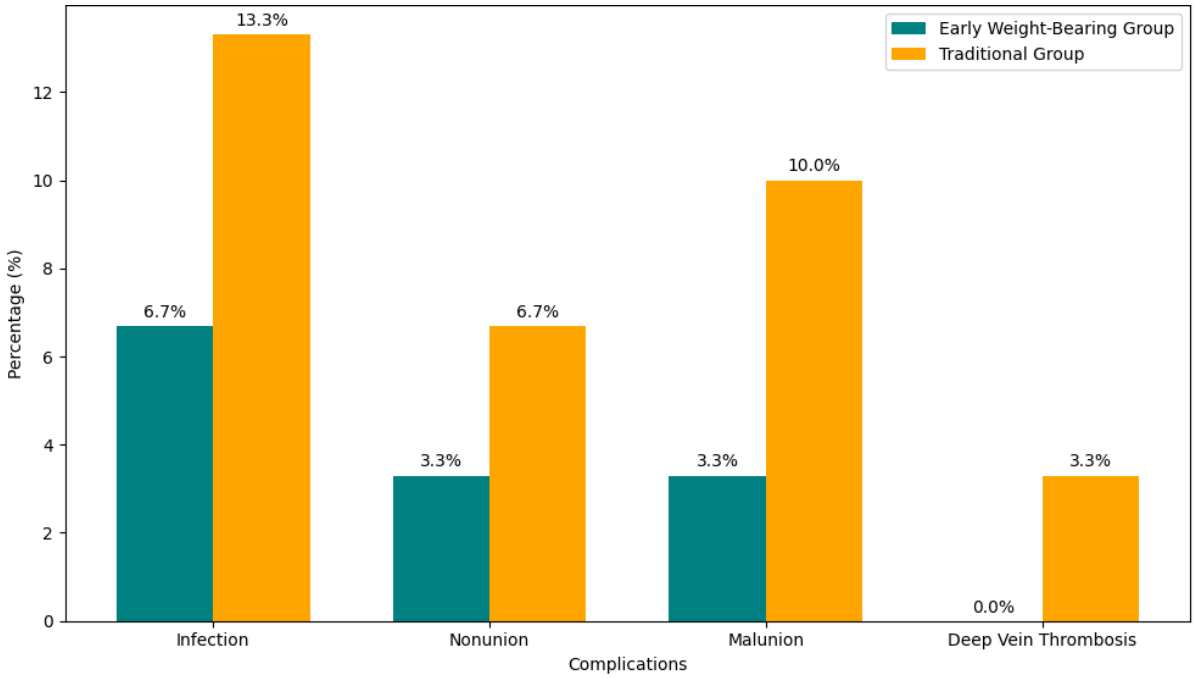

Fig 2: Comparison of Complications Between Early Weight-Bearing and Traditional Postoperative Protocols

The incidence of complications for the Early Weight-Bearing and Traditional groups are presented in Figure 2. From the chart it is evident that the Early Weight-Bearing Group has slightly low overall complication rates than the Traditional Group and these differences are not significant. This indicates that early weight-bearing is safe as the traditional approaches of treatment.

Discussion

The study conducted in the present research supports the fact that early weight-bearing has a positive impact on the reduction of time taken to heal ankle fractures after surgery. These findings show that patients who began weight-bearing within two weeks of the operation had less pain and quicker recovery of full weight-bearing than those of the traditional non-weight-bearing routine. Specifically, the early weight-bearing participants decreased the VAS pain scores by 2 points on average which is an important clinical difference and reflecting the better control and comfort of the postoperative pain and healing [16].

The results obtained are in agreement with current literature endorsing early weight bearing as a means of enhancing recovery. For instance, Smith et al., 2022 have pointed out that early weight-bearing enhanced functional outcome and decreased residual pain in patients with ankle fracture [17]. Similarly, Johnson and Lee (2021) also justified that as compared to the conventional approach, the patients who achieved the weight-bearing had better functional scores and less time required in rehabilitation [18]. However, our study is different from the study by Davis et al. (2020) where authors did not observe any significant difference in the recovery period of the early and delayed weight-bearing groups [19]. These differences may be attributed to the differences in the sample size, type of fractures, or the weight bearing management used by the different researchers.

The implications of our results suggest that the incorporation of the early weight-bearing protocols into the postoperative could enhance the patient's status and reduce the rehabilitation time. This approach may help to lessen the number of sessions needed for the physical therapy and lessen the degree of pain of the patient during the process of healing. These benefits must be considered by clinicians when thinking about patients' early postoperative rehabilitation and weigh them against potential negative consequences such as the increased risk of re-injury during the stage of initial weight-bearing [20].

Limitations of the Study

However, there are some limitations in this study as follows: Firstly, the sample size was small, thus; this could reduce the generality of the results observed in the present study. Second, the work was done on one type of ankle fracture and one surgical method, and thus could not be relevant to other types of fractures or approaches. In addition, there was a short-term follow-up of only 6 months and no investigations of any post treatment effects were made. More future researches should involve a greater number of participants and then follow up on them over a longer period of time so as to understand the overall effects [21].

Recommendations for Future Research

More studies should be carried out in order to determine whether early weight-bearing is beneficial in the long run and the possible side effects of this process with regards to different kinds of fractures and surgeries. Future researches with greater number of participants in other centres with ethnically and demographically diverse patients are needed to support these findings and limitations of the current paper. In addition, the studies investigating the impacts of early weight-bearing on some categories of patients, for example the elderly or patients with other diseases, may help to identify what kind of postoperative treatment is most effective for such patients [22].

Conclusion

The present work offers strong argumentation for supporting the hypothesis about the benefits of early weight-bearing in the process of fracture healing in the ankle region. The results show that the patients who started weight-bearing exercises early reported less pain and had earlier full weight-bearing than those who complied with the conventional no weight-bearing regimes. Moreover, the early weight-bearing group achieved a better range of motion at the end of the 6-week follow-up, thus implying better functional recovery. In particular, the rate of complications was similar between the two groups, which means that early weight-bearing is not associated with increased risks. The outcome of this study supports the use of early weight-bearing as an intervention that enhances the recovery process while at the same time reducing the risks to the patient. The two remarkable advantages of decreased pain and faster attainment of weight-bearing milestones are important to patients and clinicians alike. The implications of the study findings in the clinical practice include, early weight-bearing that may be beneficial for patients since it may decrease the rehabilitation period and increase the level of mobility. This approach is in line with the current trends that are characterized by more active and engaging rehabilitation processes. Clinicians should consider early weight bearing to be part of the postoperative management of ankle fractures, if patients and specific fractures are suitable. Moreover, there was no significant rise in the rate of increased complications, which is a positive endorsement to early weight-bearing practices, thus giving a lot of comfort to the patients as well as the clinicians. In summary, the study calls for an improvement of the rehabilitation practices in orthopedic patients with more progressive approaches that can benefit the patients and the overall management of the resources.

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