Asia Pacific Science Press

Asia Pacific Journal of Clinical Medical Research
ISSN(O):3079-8345
ISSN(P):3079-8337
Vol. 1 No.1 (2025)

Early Weight-Bearing Following Ankle Fractures: Is the 1 Week Weight-Bearing Regimen Superior to the 4 Week Regimen?

Ziru Niu[1], Xiangyu Shen[1], Jielong Wang*

School of Physical Education and Sports, Soochow University, Suzhou, China.

Corresponding author: Jielong Wang, jlwang@suda.edu.cn

Abstract: Background: Early weight bearing can accelerate the recovery of ankle function, but the timing of weight bearing has not been clarified. In this study, the efficacy and safety of weight-bearing at 1 week and 4 weeks after ankle fracture were further investigated.**Methods:** Forty-six postoperative ankle fracture patients were enrolled and divided into 1-week group (23) and 4-week group (23) according to randomized numerical table method. All patients underwent routine rehabilitation. On this basis, weight-bearing was started at 1 week after surgery in the 1-week group and at 4 weeks after surgery in the 4-week group. Both groups underwent a 6-week trial intervention. Ankle pain and function were assessed by VAS, AOFAS, and OMAS scales at 2, 4, and 6 weeks after treatment.**Results:** There was no statistically significant difference in the general data of patients in the 2 groups before surgery ($P > 0.05$). At 2 weeks postoperatively, the VAS of the 1-week group was higher than that of the 4-week group, and the scores of the Pain item in AOFAS and Swelling item in OMAS were lower than that of the 4-week group. At 4 weeks postoperatively, the VAS was higher in the 1-week group than in the 4-week group. At 6 weeks postoperatively, the VAS was lower in the 1-week group than in the 4-week group, and the scores of the Pain, Maximum walking distance, and Sagittal motion items in the AOFAS, and the scores of the Stiffness and Swelling items in the OMAS were higher than in the 4-week group.**Conclusions:** A rehabilitation strategy of early weight-bearing implemented 1 week after surgery in patients with ankle fractures can effectively reduce the degree of ankle stiffness and accelerate the recovery of ankle function in patients.

Keywords: Ankle Fracture; Early Weight Bearing; Postoperative Rehabilitation; Healing Effect

Published: Apr 16, 2025

DOI: https://doi.org/10.62177/apjcmr.v1i1.226

Fracture of the ankle joint (FAJ) is a prevalent intra-articular fracture seen in clinical practice, representing approximately 3.92% of all systemic fractures.[12]Current research indicates that early mobilization plays a key role in the recovery process of ankle fractures. [6, 13] However, the initiation point for weight-bearing after ankle fracture during postoperative rehabilitation is still controversial. Several studies have suggested starting weight-bearing between 2 to 6 weeks postoperatively,[2, 5, 14] while some more radical approaches suggest initiating weight training as early as the day after surgery.[13]

The aim of this single-blind randomized controlled study was to compare short-term rehabilitation outcomes in ankle fracture patients at 1 week (study group) and 4 weeks of weight-bearing (control group) after surgery.

1.Material And Methods

1.1 Subject Recruitment

G*Power 3.1.9.7 was employed to compute the statistic. Based on prior studies, [16] with a statistic of 0.8, alpha of 0.05, and effect size of 0.37, each group's minimum sample size was 21 (total 42). Accounting for a 10% dropout rate, the study's minimum sample size was 46. Before intervention, all subjects consented and signed the form, then randomized into 1-week and 4-week groups. The technical roadmap is in Figure 1. The same researcher did the cluster randomization.

In the 1-week group, patients started weightbearing one week after surgery, and in the 4-week group, four weeks after. Both had similar surgeries and post-op care. The same therapist did routine and early weight-bearing rehab.

Rehab for both groups had quadriceps isometric contraction training, ankle joint active-passive flexion from post-op day 2, and daily medium-frequency electrical stimulation on the operated leg. Weight-bearing was applying weight for movement, like walking with axillary cane or foot-supported walker under doctor's guidance with both feet on the ground.

1.2 Inclusion criteria and exclusion criteria

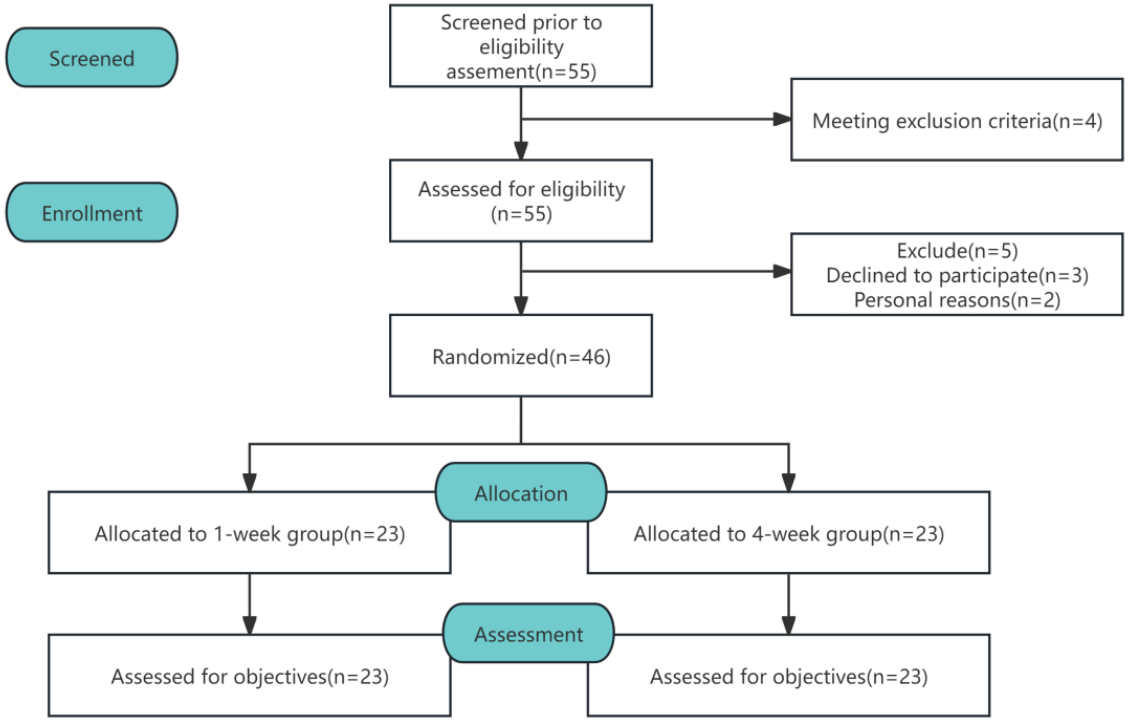
Inclusion criteria: (1) Closed ankle fractures. (2) Surgery was completed within 48 hours after fracture or after 1 week when the soft tissue swelling subsided. (3) The surgical approach was conventional incision and reduction with internal fixation. (4) All patients and their families gave informed consent to this study.

Exclusion criteria: (1) Open fracture or pathologic fracture. (2) Combined vascular ligament injury and neurological dysfunction. (3) Severe organ disease and diabetes mellitus and other underlying diseases affecting postoperative healing. (4) Mobility or cognitive disorders, poor compliance.

1.3 Clinical evaluation

Basic preoperative data were collected. The following relevant data were collected at 2, 4, and 6 weeks postoperatively in both groups:(1) Ankle Hindfoot Scale (AOFAS) : a functional system score for the ankle and hindfoot that was developed and recommended by the American Association of Foot and Ankle Surgeons.[10] (2) Olerud Molander Ankle Rating Scale (OMAS): the OMAS is a scoring system for evaluating the outcome of patients with ankle fractures proposed, and it is very widely used in ankle fracture scoring.[11] (3)Visual analogue scale (VAS): The VAS score is a clinical evaluation method used to assess subjective pain in subjects.[12]

Figure 1. Flowchart of the trial from the baseline. All patients were assessed posttreatment (at 6 weeks) and at long-term follow-up



It should be noted that due to limited follow-up duration and imaging exams, some components of the AOFAS ankle-hindfoot system score and OMAS rating scale, such as abnormal gait, specific physical activities and ankle-hindfoot couldn't be

assessed. Moreover, due to site constraints, the walking distance item in the OMAS ankle scoring scale was changed from one block to 100 meters.[13]

1.4 Statistical analysis

The 2 groups (1-week vs 4-week) were compared at the 2, 4 and 6 weeks post-surgery for the outcomes (VAS,OMAS and AOFAS etc.) and analyze the relevant data together with the baseline informationThe data obtained from the study were processed using SPSS27.0 software, and the normality test and the test of variance alignment were carried out first. If the data obeyed the normal distribution, the statistical description of the quantitative data was carried out by means of the mean and the standard deviation (), and the comparisons were made by using the repeated measures ANOVA if the variance was aligned, or the t'test if the variance was not aligned. If the data did not obey the normal distribution, the median or the quartile spacing was described. the qualitative data were described by the chi-square test (y), and the ranked data were tested by rank sum test. $P < 0.05$ was considered to be a statistical difference. If the data did not obey normal distribution, the median or interquartile spacing was used to describe the data. the chi-square test (y) was used for qualitative data, and the rank-sum test was used for hierarchical data. $P < 0.05$ was considered to be statistically different.

2.Results

2.1 Paticipants

A total of 55 individuals diagnosed with FAJ were enrolled in the study between July 2023 and November 2024, with 9 patients failing to complete the full assessment or treatment. The participant flow is shown in Figure 1. No wound infections or adverse postoperative complications were observed. Imaging assessments revealed indistinct fracture lines and no abnormal bone alignment, detachment, loosening, or fixation breakage in all patients. There were no statistically significant differences in preoperative characteristics like gender, age, and Lange-Hansen fracture typing between the two groups ($P>0.05$), as presented in Table 1.

Table 1. Baseline demographics and fracture pattern (n = 46)

Demographic factor	1-week group	4-week group	χ^2/t	p
Gender				
Male	12	13	0.088	0.767
Female	11	10		
Age(years)	44.30±15.58	45.83±13.66	0.352	0.726
Lange-Hansen				
SA	5	5		
SER	2	2		
PER	14	13	1.037	0.904
PA	2	2		
PD	0	1		

Outcomes of VAS after receiving the intervention in the 1-week and 4-week group

As shown in Table 2, there were significant main effect of groups for VAS scores in both groups, time, and significant interaction effect of time of and groups($p<0.05$ of all). The results of the simple effect test showed that the between-group simple effect were significant at 2, 4, and 6 weeks postoperatively ($p<0.05$ of all).,and significant simple effect for time of measurement in the weight bearing condition at 1 and 4 week postoperatively($p<0.05$ for both). Multiple comparisons revealed that in the weight-bearing condition at 1 and 4 week postoperatively, VAS values measured at 2, 4, and 6 weeks postoperatively decreased sequentially, all at the level of significance ($p<0.001$ of all).

Table 2. Visual analogue scale ($\overline{X} \pm s$)

	Time			Time	Groups	Time and groups
Groups	2 weeks	4 weeks	6 weeks	p^1	p^2	p^3
1-week group	7.47±0.59	5.32±0.44	2.03±0.61	<0.001	0.004	<0.001
4-week group	6.53±0.46	4.97±0.46	2.60±0.53abc			

a represents a significant simple effect for time between the two groups($P < 0.05$)

b represents a significant simple effect for gruops between the two groups($P < 0.05$)

c represents a significant interaction effect of time and groups between the two groups($P < 0.05$)

2.2 Outcomes of AOFAS after receiving the intervention in the 1-week and 4-week group

The results are shown in Table 3:

The main effect of time and the interaction effect between measurement time and group for the Pain were significant ($p<0.001$ for both). The results of the simple effect test showed significant simple effect for groups when tested 2 and 6 weeks postoperatively, ($p<0.05$ for both), and significant simple effect for time of measurement in the weight-bearing condition at 1 and 4 weeks postoperatively ($p<0.001$ for both). Multiple comparisons revealed that in the weight-bearing condition at 1 week postoperatively, the Pain item scores progressively increased at 2, 4, and 6 weeks postoperatively, all at the level of significance ($p<0.001$). In the weight-bearing condition at 4 weeks postoperatively, the Pain item scores at 2 weeks postoperatively were lower than those measured at 4 and 6 weeks postoperatively and reached the level of significance ($p<0.001$).

The main effect of time for the Activity limitations, support requirement was significant ($p<0.001$). The simple effect test showed significant simple effect for time of measurement in the weight-bearing condition at 1 and 4 weeks postoperatively ($p<0.001$ for both).

The main effect of groups,time and the interaction effect of time and groups for the Maximum walking distance was significant ($p<0.05$ of all). The results simple effect test showed that the simple effect of groups was significant when tested at 6 weeks ($p<0.001$),and a significant simple effect for time of measurement in the weight bearing condition at 1 and 4 weeks postoperatively($p=0.001$). Multiple comparisons revealed that the Maximum walking distance,blocs item scores progressively increased in the weight-bearing condition at 1 week postoperatively, and reached the significance level at 2, 4, and 6 weeks postoperatively ($p=0.029$). In the weight-bearing condition at 4 weeks postoperatively, the Maximum walking distance,blocs score at 2 weeks postoperatively was lower than that measured at 4 and 6 weeks postoperatively and reached the significance level ($p<0.001$).

The main effect of time for the Walking Surfaces in the AOFAS was significant ($p<0.001$). A simple effect test showed a significant simple effect for time of measurement in the weight-bearing condition at 1 and 4 weeks postoperatively($p<0.001$ for both).

The main effect of group,time and the interaction effect of time and groups for Sagittal motion in the AOFAS were significant ($p<0.05$ of all). A simple effect test showed significant simple effect for time of measurement in the weight-bearing condition at 1 and 4 weeks postoperatively ($p<0.001$),and the simple effect of groups was significant when tested at 6 weeks postoperatively($p<0.001$). Multiple comparisons revealed that in the weight-bearing condition at 1 week postoperatively, the Sagittal motion item scores at 2 weeks postoperatively differed from those at 4 and 6 weeks postoperatively and reached the level of significance ($p<0.001$). In the weight-bearing condition at 4 weeks postoperatively, the Sagittal motion score at 2 weeks postoperatively was lower than at 4 weeks postoperatively and reached the significance level ($p=0.004$).

The main effect of time for the Hindfoot motion scale test was significant ($p<0.001$). A simple effect test showed a significant simple effect for time of measurement in the weight-bearing condition at 1 and 4 weeks postoperatively ($p<0.05$ for both).

The main effect of time of Ankle-hindfoot stability was significant ($p=0.007$). A simple effect test showed a significant simple effect for time of measurement in the weight-bearing condition at 1 and 4 week postoperatively ($p=0.01$ for both).

All other results not mentioned were not statistically different ($p > 0.05$), details of which can be seen in Table 3.

Table3. AOFAS Ankle-Hindfoot System Score($\overline{X} \pm s$)

		Time			Time	Groups	Time and groups
Note	Groups	2 weeks	4 weeks	6 weeks	p^1	p^2	p^3
Pain	1-week group	2.17±4.21	13.91±8.91	26.95±11.05	<0.001	0.307	<0.001
	4-week group	4.21±5.10	15.65±10.80	17.39±6.90ac			
Activity limitations, support requirement	1-week group	4.13±2.83	4.83±0.65	7.65±1.56	<0.001	0.193	0.107
	4-week group	4.52±2.99	4.83±1.00	6.09±2.30a			
Maximum walking distance	1-week group	0.69±0.97	3.08±1.67	4.30±1.02	<0.001	0.001	0.021
	4-week group	0.69±0.97	2.47±1.64	2.73±1.05abc			
Walking Surfaces	1-week group	1.04±1.46	2.60±1.94	4.13±1.01	<0.001	0.087	0.615
	4-week group	0.91±1.41	2.08±1.83	3.43±0.84a			
Sagittal motion (flexion plus extension)	1-week group	2.78±1.88	5.04±2.16	5.73±2.02	<0.001	0.069	0.014
	4-week group	2.43±1.99	4.34±2.05	3.17±1.52ac			
Hindfoot motion (inversion plus eversion)	1-week group	1.43±1.53	2.87±1.91	4.17±1.74	<0.001	1	0.424
	4-week group	1.82±1.49	3.00±1.80	3.65±1.79a			
Ankle-hindfoot stability (anteroposterior, varus-valgus)	1-week group	4.17±4.08	5.217±3.89	6.60±3.10	0.007	0.209	0.969
	4-week group	3.13±3.99	4.522±4.05	5.91±3.59a			

a represents a significant simple effect for time between the two groups($P < 0.05$)

b represents a significant simple effect for gruops between the two groups($P < 0.05$)

c represents a significant interaction effect of time and groups between the two groups($P < 0.05$)

2.3 Outcomes of OMAS after receiving the intervention in the 1-week and 4-week group

The results are shown in Table 3:

The main effect of time for the Pain was significant ($p<0.001$). The results of the simple effect test showed significant simple effect for measurement time in the weight-bearing condition at 1 and 4 weeks postoperatively ($p < 0.001$ for both).

The main effect of groups for the Stiffness was significant ($p < 0.001$), and the interaction effect between time and group was significant ($p=0.002$). The results of the simple effect test showed that the simple effect of groups was significant when tested 6 weeks postoperatively($p<0.001$). Multiple comparisons revealed that in the 1-week postoperative weight-bearing condition, the 2-week postoperative Stiffness score was lower than the 6-week and reached the level of significance ($p=0.001$). In the weight-bearing condition at 4 weeks postoperatively, Stiffness scores at 2 and 4 weeks postoperatively were higher than those measured at 6 weeks postoperatively and reached the level of significance, respectively ($p=0.024$).

There were significant main effect of groups,time and interaction effect of time and groups for the Swelling ($p<0.05$ of all). A simple effect test showed significant simple effect for group when tested 2 and 6 weeks postoperatively($p< 0.001$ for both),and significant simple effect for time of measurement in the weight-bearing condition at 1 and 4 weeks postoperatively($p<0.001$). Multiple comparisons revealed that in the 1-week postoperative weight-bearing condition, Swelling scores measured at 2, 4, and 6 weeks postoperatively increased sequentially, all at the significance level ($p=0.004$).

The main effect of time for the Supports was significant ($p<0.001$). A simple effect test showed significant simple effect for time in the weight-bearing condition at 1 and 4 week postoperatively ($p<0.05$ for both).

The main effect of time for the Activity was significant (p<0.001), and the interaction effect between time and group was significant (p=0.01). The results of the simple effect test showed a significant simple effect of measurement time in the weight-bearing condition at 1 and 4 weeks postoperatively (p < 0.001). Multiple comparisons revealed that in the 1-week postoperative weight-bearing condition, Activity scores measured at 2, 4, and 6 weeks postoperatively increased sequentially, all at the significance level (p < 0.001). In the weight-bearing condition at 4 weeks postoperatively, Activity scores at 2 weeks postoperatively were lower than those measured at 4 and 6 weeks postoperatively and reached the level of significance (p<0.001).

All other results not mentioned were not statistically different (p > 0.05), details of which can be seen in Table 4.

Table 4. Olerud Molander Ankle Rating Scale（）

		Time			Time	Groups	Time×Groups
Note	Groups	2 weeks	4 weeks	6 weeks	p¹	p²	p³
Pain	1-week group	3.04±2.49	13.26±7.32	22.82±4.72	<0.001	0.194	0.36
	4-week group	2.39±2.55	13.04±9.50	19.34±6.62a			
Stiffness	1-week group	4.78±5.10	7.8±4.22	9.13±2.88	0.294	<0.001	0.002
	4-week group	5.22±5.10	5.22±5.10	1.74±3.88bc			
Swelling	1-week group	1.52±3.51	5.65±3.78	9.13±1.93	<0.001	0.019	<0.001
	4-week group	7.17±4.21	7.39±3.95	6.08±3.67abc			
Supports	1-week group	1.30±2.24	5.21±3.19	7.39±2.55	<0.001	0.895	0.25
	4-week group	1.95±2.49	4.13±3.58	7.60±2.55a			
Activity	1-week group	3.04±4.70	12.17±4.47	18.04±2.915	<0.001	0.021	0.01
	4-week group	3.91±4.9	11.08±4.25	13.26±4.158abc			

a represents a significant simple effect for time between the two groups(P < 0.05)

b represents a significant simple effect for gruops between the two groups(P < 0.05)

c represents a significant interaction effect of time and groups between the two groups(P < 0.05)

3.Discussion

In our study, postoperative ankle fracture patients underwent varying weight-bearing timing in conjunction with conventional rehabilitation.It shows that the time main effect was significant for the majority of the indicators, which represents a positive effect of weight-bearing activity and rehabilitation on postoperative ankle fracture patients.

3.1 Pain

Analysis of pain indicators in Table 2 shows that patients in the 1-week group were more prone to ankle pain 2 weeks postoperatively. This might be due to early weight-bearing and ambulation potentially worsening mechanical nerve damage from fractures, intraoperative trauma, and surgical incisions, releasing inflammatory mediators and pain-causing substances. This could increase pain receptor sensitivity, lower the pain threshold, and lead to more postoperative pain.[18] Additionally, early mobilization after surgery may cause anxiety and fear in patients, activating the anterior cingulate cortex in the brain and intensifying pain perception.[17]

Moreover, although pain in both groups gradually decreased with increasing postoperative time, there was no statistically

significant difference in pain levels at 4 weeks postoperatively. At 6 weeks, patients in the 4-week group had more pain than those in the 1-week group. Note that although the comparison of VAS scores between the two groups showed a significant difference at 6 weeks, the difference in their means was relatively small (2.03 vs. 2.60), and the pain scores in the AOFAS indicated that the pain levels of patients in both groups were in the mild to moderate range.

The lack of statistical difference in pain scores between the two groups in Table 4 could be due to the scoring criteria of the pain scale, which evaluates pain during walking on different surfaces. It's observed that most patients in the 1-week group, after 2 weeks postoperatively, were restricted to indoor ambulation, which might not completely match the scale's assessment parameters.

3.2 Swell

Data in Tables 3 and 4 show that patients in the 1-week group had a higher incidence of ankle joint swelling at 1 week than those in the 4-week group. This difference may result from early weight-bearing and poor venous return in the limb. The gravitational force on damaged blood vessels and soft tissues due to fracture and surgical trauma triggers the release of inflammatory mediators like TNF-α and prostaglandin E2, increasing vascular permeability and causing blood, lymphatic fluid, and tissue fluid to accumulate in the interstitial space, worsening swelling. Also, early weight-bearing intensifies soft tissue stimulation at the injury site, leading to more tissue fluid exudation, potentially hindering blood supply and circulation, and increasing swelling and discomfort.[4, 19] Through continuous stimulation, joint function gradually improves and tissue fluid exudation decreases.

3.3 Joint stiffness

Analysis of the anterior-posterior activity data in Table 2 and joint stiffness metrics in Table 4 showed no statistically significant difference in ankle joint mobility between the 1-week and 4-week postoperative groups. The stiffness in the 1-week postoperative group improved as postoperative time increased, perhaps due to swelling improvement. In the 4-week group, patients had ankle joint stiffness with restricted dorsiflexion and extension 6 weeks after surgery. This stiffness might result from the accumulation of lymphocytes, mast cells, and macrophages in the joint capsule because of prolonged immobilization, along with increased expression of inflammatory factors like TGF-β1, which stimulate fibroblasts and lead to joint capsule fibrosis.[10] Prolonged immobilization also causes contracture and stiffness in muscles like the calf triceps, fibularis longus, and tibialis anterior, as well as in the joint capsule and peripheral ligaments, further restricting ankle joint mobility.[9]

3.4 Walk

From the Maximum walking distance item in Table 3, the maximum walking distance of patients in the 1-week group gradually increased as time advancesand and was greater than that of the 4-week group at 6 weeks postoperatively. There are three possible reasons:

Firstly, according to Wolff's law,[20] bone grows faster under stress. As the 1-week group started weight-bearing earlier than the 4-week group, their bones might have healed better and could endure the stresses from walking for longer and at higher speeds.

Secondly, early weight-bearing activity prevents joint stiffness (as mentioned before) and slows muscle atrophy. Compared to the 4-week group, patients in the 1-week group may have stronger and more enduring peri-ankle muscles, enabling them to walk longer distances.

Finally, weight-bearing activity can stimulate the metabolism of articular cartilage and surrounding soft tissues, which may help restore joint function.[11] Patients in the 1-week group might have better functional ankle motion when they began weight-bearing activity earlier.

3.5 Work and daily activity

The study findings indicate that the work and daily activity scores in the 1-week group increased with postoperative time, but which in the 4-week group increased only at 4 weeks postoperatively and then stagnated.This phenomenon may be attributed to ankle joint stiffness from prolonged braking. These factors can lead to various adaptive changes in muscles resulting in muscle mass loss or atrophy, ultimately leading to muscle dysfunction. Muscle and joint dysfunction can restrict activities

such as walking, running, and climbing stairs. Previous studies have shown a 30% loss of muscle mass over several weeks of disuse.[3, 8] The long-lasting effect of joint stiffness and muscle mass loss due to prolonged braking have been documented.[15]

At 6 weeks postoperatively, both patient groups scored corresponds to 'same as before the injury' and 'decreased speed', indicating that the limitation in work and daily activities of postoperative ankle patients at 4 weeks is mainly lead to a drop in pre-injury work speed, not a change in work nature or difficulty.

3.6 Postoperative complication

None of the early weight-bearing patients exhibited abnormal foot alignment in postoperative imaging, so the foot alignment item of the AOFAS Ankle-Hindfoot Rating Scale was not included in analysis, which aligns with previous research results.[1]

Conclusion

The ankle joint, due to its unique anatomical structure, is liable to injuries and fractures, and has a surgical rate of around one-fourth. [7] Such injuries often occur among the working population, and the long period of postoperative rehabilitation can greatly affect patients' financial earnings and social contributions. Conducting weight-bearing activities one week after surgery may speed up the recovery of ankle joint function and relieve stiffness. Adopting a more relaxed attitude towards early postoperative activity after ankle fracture surgery might benefit patients and society as a whole.

Funding

no

Conflict of Interests

The author(s)declare(s) that there is no conflict of interest regarding the publication of this paper.

References

[1] Al-Hourani K, Stoddart M and Chesser TJS. Syndesmotic fixation in unstable ankle fractures: does early post-operative weight bearing affect radiographic outcomes? Injury 2019.

[2] Bando K, Takegami Y and Ando T, et al. Early weight bearing and mobilization decrease perioperative complications in patients after ankle fracture; The retrospective multicenter (tron group) study. J Orthop Sci 2023; 28: 651-655.

[3] Berg HE, Larsson LL and Tesch PA. Lower limb skeletal muscle function after 6 wk of bed rest. American Physiological Society 1997.

[4] Bestwick-Stevenson T, Wyatt LA and Palmer D, et al. Incidence and risk factors for poor ankle functional recovery, and the development and progression of posttraumatic ankle osteoarthritis after significant ankle ligament injury (sali): the sali cohort study protocol. BMC Musculoskelet Disord 2021; 22: 362.

[5] Bretherton C, Claireaux H and Achten J, et al. Protocol for the weight-bearing in ankle fractures (wax) trial: a multicentre prospective non-inferiority trial of early versus delayed weight-bearing after operatively managed ankle fracture. BMC Musculoskelet Disord 2021.

[6] C B, L D and T B. Early weight bearing in elderly patients with ankle fractures reduces care needs and maintains independence. Foot and ankle surgery : official journal of the European Society of Foot and Ankle Surgeons 2023; 29: 63-66.

[7] Flynn JM, Rio RD and Pizá PA. Closed ankle fractures in the diabetic patient. Foot Ankle Int 2000; 21: 311-319.

[8] Hather BM, Adams GR and Tesch PA, et al. Skeletal muscle responses to lower limb suspension in humans. Journal of applied physiology (Bethesda, Md. : 1985) 1992; 72: 1493-1498.

[9] Hirata K and Akagi R. Contribution of muscle stiffness of the triceps surae to passive ankle joint stiffness in young and older adults. Front Physiol 2022; 13: 972755.

[10] Kaneguchi A, Kaneguchi A and Kaneguchi A, et al. Low-level laser therapy prevents treadmill exercise-induced progression of arthrogenic joint contracture via attenuation of inflammation and fibrosis in remobilized rat knees. Inflammation 2019; 42: 857-873.

[11] Kaneguchi A, Yamaoka K and Ozawa J. The effect of the amount of weight bearing on articular cartilage early after acl

reconstruction in rats. Connect Tissue Res 2023; 64: 186-204.

[12] Koval KJ, Lurie J and Zhou W, et al. Ankle fractures in the elderly: what you get depends on where you live and who you see. J Orthop Trauma 2005; 19: 635-639.

[13] Lee SJ, Choi Y and Choi S, et al. Early return to daily life through immediate weight-bearing after lateral malleolar fracture surgery. Int J Environ Res Public Health 2022; 19.

[14] Lee SJ, Choi Y and Choi S, et al. Early return to daily life through immediate weight-bearing after lateral malleolar fracture surgery. Int J Environ Res Public Health 2022; 19.

[15] Lorente A, Gandía A and Mariscal G, et al. Quality of life and complications in elderly patients after pronation rotation type iii ankle fractures treated with a cast and early weight-bearing. BMC Musculoskelet Disord 2021; 22: 1-8.

[16] Merkle TP, Hofmann N and Knop C, et al. Partial weight-bearing following ankle fracture: what's the actual load in early recovery? Arch Orthop Trauma Surg 2024; 144: 3113-3119.

[17] Min Z. Neural mechanisms underlying anxiety–chronic pain interactions. Trends Neurosci 2016; 39: 136-145.

[18] Wang J, Zheng K and Wen Q, et al. Sufentanil combined with nalmefene reduce the adverse events in recovery period of patients undergoing uvulopalatopharyngoplasty - a randomized controlled trial. Heliyon 2023; 9: e13241.

[19] Wang J, Zheng K and Wen Q, et al. Sufentanil combined with nalmefene reduce the adverse events in recovery period of patients undergoing uvulopalatopharyngoplasty - a randomized controlled trial. Heliyon 2023; 9: e13241.

[20] Wolff J. Dmw-deutsche medizinische wochenschrift. 19.47 ed, 1892, p.1222-1224.