Efficacy of Comprehensive Rehabilitation Therapy with Pulsed Electromagnetic Field for Improving Osteoporosis in Patients with Ankle and Foot Fractures

Yan Liang[1], Yiming Ma[2], Zhongxi Bai[1]
[1]*Shiyan Taihe Hospital, Shiyan, Hubei, China*
[2]*Shiyan Traditional Chinese Medicine Hospital, Shiyan, Hubei, China*

Abstract: Objective: To observe the efficacy of comprehensive rehabilitation therapy with pulsed electromagnetic field (PEMF) in the treatment of osteoporosis in patients with ankle and foot fractures. Methods: A total of 64 patients with osteoporosis complicated by ankle and foot fractures admitted to our hospital from April 2024 to April 2025 were prospectively enrolled. They were randomly divided into two equal groups using a random number table method. The control group (32 cases) received routine rehabilitation therapy, while the observation group (32 cases) received comprehensive rehabilitation therapy combined with PEMF. The recovery of ankle joint function and activities of daily living (ADL) of the patients were observed and compared between the two groups. Results: After treatment, the ankle joint function score of the observation group was significantly higher than that of the control group (P<0.05). The ADL score of the observation group was also significantly higher than that of the control group (P<0.05). Conclusion: Comprehensive rehabilitation therapy with PEMF for osteoporosis patients with ankle and foot fractures is conducive to improving ankle joint function, promoting patient recovery, and enhancing their activities of daily living.

Keywords: Pulsed Electromagnetic Field Comprehensive Rehabilitation Therapy; Ankle and Foot Fractures; Osteoporosis

1. Introduction

Osteoporosis complicated by ankle and foot fractures is a common clinical condition with a relatively high incidence. It features a long treatment cycle and certain therapeutic difficulties. To facilitate the recovery of impaired functions in such patients, it is necessary to formulate targeted rehabilitation treatment plans based on the characteristics of their conditions during the treatment process[1-2]. Comprehensive rehabilitation therapy with pulsed electromagnetic field is an important clinical intervention for the rehabilitation of fracture patients. It promotes the recovery of injured parts and improves joint function by utilizing bioelectric currents. This study aimed to observe the specific efficacy of comprehensive rehabilitation therapy with PEMF in the treatment of this group of patients.

2. Materials and Methods

2.1 General Data

A total of 64 patients with osteoporosis complicated by ankle and foot fractures admitted to our hospital from April 2024 to April 2025 were prospectively enrolled. They were randomly divided into two equal groups using a random number table method. The control group (32 cases) received routine rehabilitation therapy, and the observation group (32 cases) received comprehensive rehabilitation therapy combined with PEMF. In the control group, there were 17 males and 15 females, aged 52 to 75 years, with a mean age of (62.22±1.12) years. Their body mass index (BMI) ranged from 21 to 24 kg/m², with a mean value of (22.85±1.25) kg/m². In the observation group, there were 16 males and 16 females, aged 55 to 74 years, with a mean age of (62.35±1.68) years. Their BMI ranged from 21 to 24 kg/m², with a mean value of (22.74±1.52) kg/m². There was no statistically significant difference in the baseline data between the two groups (P>0.05).

2.2 Methods

The control group was given routine rehabilitation therapy. According to the patients' postoperative recovery status, they were timely guided to perform various

rehabilitation exercises. In the first week after surgery, when the patients' indicators stabilized, they were instructed to carry out straight leg raising exercises or seated knee extension exercises, which were assisted by rehabilitation physicians face-to-face, 20 minutes each time, twice a day. In the second week after surgery, the patients began to receive guidance on ankle resistance training or ankle inversion and eversion training, 20 minutes each time, twice a day. The single training duration or daily training frequency could be appropriately increased based on the patients' recovery and tolerance during training. For patients eligible for ambulation, standing exercises were gradually guided.

The observation group received comprehensive rehabilitation therapy combined with PEMF, with the same rehabilitation exercise protocol as the control group. During PEMF treatment, patients were instructed to place their ankle and foot within 20 cm of the PEMF therapy instrument. The pulse frequency was set at 20 Hz, the magnetic induction intensity at 4 mT, and the single treatment duration was controlled at 30 minutes, once a day.

Both groups received continuous rehabilitation treatment for 4 weeks.

2.3 Observation Indicators

Ankle joint function evaluation: The American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Scale was used to assess the improvement of patients' ankle joint function. The assessment covered four dimensions: joint movement, functional activity, foot alignment, and presence of pain. The score ranged from 0 to 25, which was positively correlated with the ankle joint function.

Comparison of activities of daily living: The Barthel Index was used to evaluate the patients' ADL, with a score ranging from 0 to 100. A higher score indicated better ADL.

2.4 Statistical Methods

All data in the study were processed using SPSS 26.0 statistical software. Measurement data (including Barthel Index scores and ankle joint function scores) were expressed as mean ± standard deviation, and compared using the t-test. Count data were expressed as percentage and compared using the chi-square test. A value of $P<0.05$ was considered statistically significant.

3. Results

3.1 Comparison of Ankle Joint Function

After treatment, the ankle joint function score of the observation group was significantly higher than that of the control group ($P<0.05$). See Table 1 for details.

Table 1. Analysis of Ankle Joint Function Recovery in the Two Groups (mean ± SD)

Group	Number of Cases	Functional ActivityJoint Movement		Functional ActivityJoint Movement		Presence of PainFoot Alignment		Presence of PainFoot Alignment	
		Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment
Observation	32	13.25±1.33	22.45±1.25*△	14.25±1.34	22.68±1.47*△	14.68±1.78	22.04±1.35*△	12.85±1.56	21.85±1.35*△
Control	32	13.17±1.24	16.85±1.45*	14.31±1.42	17.68±1.78*	14.74±1.34	17.68±1.05*	12.77±1.07	20.58±1.45*
t	-	1.458	26.411	0.357	25.085	0.458	29.458	0.732	14.785
P	-	0.323	<0.001	0.715	<0.001	0.638	<0.001	0.425	<0.001

*Note: *P<0.05 vs. before treatment; △P<0.05 vs. control group

3.2 Comparison of Activities of Daily Living

After treatment, the ADL score of the observation group was significantly higher than that of the control group ($P<0.05$). See Table 2 for details.

Table 2. Comparison of Activities of Daily Living in the Two Groups (mean ± SD)

Group	Number of Cases	Barthel Index	
		Before Treatment	After Treatment
Observation	32	62.85±2.15	76.45±1.86*△
Control	32	62.11±2.23	71.77±1.98*
t	-	0.758	14.402
P	-	0.845	<0.001

*Note: *P<0.05 vs. before treatment; △P<0.05 vs. control group

4. Discussion

Osteoporosis complicated by ankle and foot fractures is common in clinical practice, and the recovery of fracture sites in such patients is relatively slow. During the postoperative

recovery period, it is necessary to formulate timely rehabilitation treatment plans according to the changes in patients' conditions to accelerate the recovery of impaired functions. Routine rehabilitation therapy can help restore the impaired joint function, but the recovery rate of patients is relatively slow[3-4].

PEMF rehabilitation therapy is also highly applicable in the rehabilitation of this group of patients. During PEMF treatment, it can promote local microcirculation, stimulate osteocyte proliferation, accelerate the recovery of bone tissue at the fracture site, and thus facilitate fracture healing. The combination of routine rehabilitation therapy and PEMF in the treatment of osteoporosis patients with ankle and foot fractures can accelerate osteocyte proliferation at the fracture site from multiple dimensions, inhibit bone resorption, indirectly increase bone mineral density, and promote the recovery of impaired functions in patients[5-6]. The observation results showed that under this combined rehabilitation treatment regimen, the ankle joint function and ADL of the observation group improved rapidly and were significantly higher than those of the control group, indicating that this rehabilitation treatment regimen can effectively promote patient recovery.

In conclusion, comprehensive rehabilitation therapy with PEMF for osteoporosis patients with ankle and foot fractures is conducive to improving ankle joint function, promoting patient recovery, and enhancing their activities of daily living.

References

[1] Chen JJ, Hu JB, Jiang XW, et al. Application of Low-Frequency Pulsed Electromagnetic Field Combined with Visual Feedback Balance Training in Rehabilitation of Patients with Osteoporotic Vertebral Compression Fractures after Vertebroplasty [J]. Chinese Journal of Bone and Joint Injury, 2025, 40 (11): 1176-1179.

[2] Zhou LN, Zheng T, Peng TZ. Effect of Low-Frequency Pulsed Electromagnetic Field Combined with Acupuncture on Fracture Healing and Functional Recovery [J]. Chinese Medicine Modern Distance Education of China, 2025, 23 (10): 127-129.

[3] Yao MM, Zhang Y, Zhang YN, et al. Efficacy of Comprehensive Rehabilitation Training with Pulsed Electromagnetic Field for Improving Osteoporosis in Patients with Ankle and Foot Fractures [J]. Journal of Nursing Administration, 2025, 25 (05): 444-448.

[4] Liu LJ, Wu DD, Chu JX, et al. Effect of Low-Frequency Pulsed Electromagnetic Field Combined with Exercise Intervention on Bone Mineral Density and Quality of Life in Elderly Patients with Osteoporosis [J]. Jilin Medical Journal, 2025, 46 (01): 27-31.

[5] Wei ZL, Gao YH, Shen DS, et al. Effect of Puerarin Combined with Pulsed Electromagnetic Field on Mineralization and Maturation of Osteoblasts [J]. Journal of Air Force Medical University, 2025, 46 (05): 639-644.

[6] Xiao F, Huang L, Wang L. Magnetic Nanomaterials and Magnetic Field Effects for Accelerating Bone Injury Repair [J]. Chinese Journal of Tissue Engineering Research, 2025, 29 (04): 827-838.

