

Original Article

Warming acupuncture-moxibustion combined with Bushen Qianggu Recipe effectively improves bone metabolism in osteoporosis patients

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Abstract: Background: Osteoporosis (OP) increases the risk of fractures in older adults, with no effective treatment options at present. Objectives: To analyze the effects of warming acupuncture-moxibustion (WAM) combined with Bushen Qianggu Recipe on bone metabolism, bone mineral density (BMD), and pain intensity in OP patients. Methods: This retrospective study involved 103 patients with OP who were admitted to Wuhan Hospital of Traditional Chinese Medicine between July 2021 and December 2023. The control group consisted of 47 cases given WAM and the research group consisted of 56 cases receiving WAM + Bushen Qianggu Recipe (Rehmanniae Radix 15 g, Radix Rehmanniae Preparata 15 g, Poria cocos 10 g, yam 10 g, rhizoma alismatis 10 g, raspberry 10 g, medlar 10 g, Schisandra chinensis 10 g, Semen Cuscutae 10 g, Epimedium 10 g, Polygonatum sibiricum Red. 10 g, Drynaria 10 g, and Eucommia ulmoides 10 g). Bone metabolism markers (procollagen type I N-terminal propeptide (PINP) and bone-specific alkaline phosphatase (B-ALP)), BMD (lumbar vertebrae at L_{2,4}, femoral neck, and distal 1/3 of the radius), pain intensity (visual analog score (VAS)), dysfunction (Oswestry Dysfunction Index), quality of life (Short-Form 36 Item Health Survey (SF-36)), and overall treatment efficacy were analyzed comparatively. Results: Compared with the baseline (before treatment) and post-treatment levels in the control group, the research group showed a reduction in PINP and B-ALP, an increase in BMD at the lumbar vertebrae L_{2,4}, femoral neck, and distal 1/3 of the radius, and a decrease in VAS and Oswestry Disability Index scores. Additionally, the research group performed better across various dimensions of the SF-36 scale and had a higher overall effective rate. Conclusions: WAM combined with Bushen Qianggu Recipe is effective in alleviating pain intensity and improving bone metabolism, BMD, and quality of life in OP patients; therefore it is deserving of clinical promotion.

Keywords: Warming acupuncture-moxibustion, Bushen Qianggu Recipe, osteoporosis, bone metabolism, bone mineral density, pain intensity

Introduction

As a common chronic metabolic bone disorder, osteoporosis (OP) is featured by impaired bone strength, which significantly increases the risk of fractures, especially in postmenopausal women and older age groups [1-3]. Census data indicate that there are approximately 10.2 million cases of OP in individuals over the age of 50, with a higher prevalence in women compared to men (16.5% vs. 5.1%) [4]. Previous studies have shown that factors like age, gender, body mass index (BMI), and a fracture history may increase the risk of OP-related fractures [5]. The primary goals of OP treatment are to reduce the fracture risk, minimize bone loss,

prevent disability, and control pain, and the preventive measures include muscle-building training, balance training, and smoking and alcohol cessation [6]. The treatment of OP encompasses both non-pharmacologic and pharmacologic approaches, each with its own pros and cons, and no universally effective treatment has yet been established [7]. This study intends to explore the optimal therapy for OP from the perspective of pharmacological intervention, hoping that it can provide a new reference for the treatment of OP.

Traditional Chinese medicine (TCM) is widely applied to treat various diseases, including OP, due to its low incidence of adverse effects and

high efficacy [8]. Warming acupuncture-moxibustion (WAM) combines TCM moxibustion and acupuncture, in which acupoints are needled and burning moxa pillars are loaded on the top of the needles to produce a heat sensation [9]. Previous analyses have revealed that WAM can increase the bone mineral density (BMD) of the femoral neck and greater trochanter and alleviate chronic pain in patients with primary OP [10]. Additionally, moxibustion has been found to enhance the positive effects of anti-OP medications on bone metabolic indices [11]. The Bushen Qianggu Recipe, as a herbal formula for tonifying the kidneys in TCM, consists of herbs such as *Rehmanniae Radix*, *Radix Rehmanniae Preparata*, *Poria cocos*, yam, rhizoma *alismatis*, raspberry, medlar, *Schisandra chinensis*, *Semen Cuscutae*, *Epimedium*, *Polygonatum sibiricum* Red., *Drynaria*, and *Eucommia ulmoides*. This formula has been shown to effectively increase BMD and reduce fracture risk in OP patients [12]. Zhang XG et al. [13] found that Bushen Qianggu Recipe, in capsule form, can improve thigh bone density and calcium levels in an OP rat model, thereby reducing the risk of fractures.

Given the limited research on the combined effects of WAM and Bushen Qianggu Recipe on bone metabolism, BMD, and pain intensity in patients with OP, this study aims to provide new insights into the treatment of OP.

Materials and methods

General data

This retrospective study was approved by the Ethics Committee of Wuhan Hospital of Traditional Chinese Medicine, and informed consent was obtained from all participants. The study involved 103 OP patients who were treated from July 2021 to December 2023. Among them, 47 cases in the control group were given WAM, while 56 cases in the research group received WAM combined with Bushen Qianggu Recipe.

Eligibility and exclusion criteria

Inclusion criteria: all patients were diagnosed with primary OP by Chinese and Western medicine diagnostic criteria [14]; no contraindications to medication or WAM; no use of medica-

tion affecting bone metabolism in the past month; no physical disability; complete clinical case data; normal communication and cognitive skills and good compliance.

Exclusion criteria: other orthopedic diseases; rheumatoid arthritis, hyperparathyroidism, and secondary OP; severe cardiac, pulmonary, or renal insufficiency; autoimmune deficiencies or coagulation disorders; hyperphosphatemia or hypercalcemia; or severe mental disorders.

Treatment methods

The control group received WAM therapy. Acupoints selected for treatment included Dazhu, Xuanzhong, Weizhong, Mingmen, Zusanli, Taixi, and Shenshu. After routine disinfection, filiform needles were inserted directly or obliquely to a depth of 1.0 to 1.5 inches. After obtaining qi, the uniform reinforcing-reducing method was applied. A spacer was placed on the acupoint, and a 2 cm moxa stick was placed on the needle handle, pinched tightly and securely. The moxa stick was then ignited to perform WAM, with three treatments per acupoint. Patients were treated once every other day.

In addition to the above treatment, the research group was additionally administered with Bushen Qianggu Recipe. Bushen Qianggu Recipe included *Rehmanniae Radix* (15 g), *Radix Rehmanniae Preparata* (15 g), *Poria cocos* (10 g), yam (10 g), rhizoma *alismatis* (10 g), raspberry (10 g), medlar (10 g), *Schisandra chinensis* (10 g), *Semen Cuscutae* (10 g), *Epimedium* (10 g), *Polygonatum sibiricum* Red. (10 g), *Drynaria* (10 g), and *Eucommia ulmoides* (10 g). These herbs were prepared as TCM granules and were dissolved in 50 mL of hot water, twice a day for 3 months.

Testing indicators

(1) Changes in bone metabolism markers. A total of 3 mL of blood was drawn from the elbow vein before and after treatment and the serum was obtained via centrifugation to determine the contents of bone-specific alkaline phosphatase (B-ALP) and the N-terminal propeptide of type I procollagen (PINP) by enzyme-linked immunosorbent assay. The operation process strictly followed the instructions of the kits

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Table 1. General data of 103 OP patients

Data	Control group (n=47)	Research group (n=56)	χ^2/t	P
Gender			0.342	0.559
Male	22 (46.81)	23 (41.07)		
Female	25 (53.19)	33 (58.93)		
Age (year)	62.55±7.62	63.68±7.47	0.758	0.450
Course of disease (year)	3.79±1.72	4.18±1.91	1.080	0.283
BMI	21.96±2.40	22.77±2.76	1.573	0.119
Family disease history			1.416	0.234
Yes	13 (27.66)	10 (17.86)		
No	34 (72.34)	46 (82.14)		

Note: OP, osteoporosis; BMI, body mass index.

(Wuhan AmyJet Scientific Inc., NNDC-EKX-8VOX8L-96, RD-PINP-Hu).

(2) Bone Mineral Density (BMD). Bone densitometry (Dongguan GOSUN Electronic Precision Technology Co., Ltd., GS-delta558) was employed for measurements of the lumbar spine L₂₋₄, femoral neck, and distal 1/3 of the radius BMD before and after the intervention in both groups.

(3) Pain intensity. The pre- and post-interventional pain intensity was assessed using the Visual Analog Scale (VAS) [15], with a score ranging from 0 to 10, which is proportional to the pain intensity.

(4) Dysfunction. The Oswestry dysfunction index was used to evaluate functional changes before and after the intervention; the scale contains 10 entries, each with a score of 0 to 5, with a higher score suggesting more severe dysfunction.

(5) Quality of life. Post-treatment quality of life was measured using the Short-Form 36 Item Health Survey (SF-36) from eight domains [16], namely, role-physical (RP), physical functioning (PF), bodily pain (BP), mental health (MH), role-emotional (RE), general health (GH), vitality (VT), and social functioning (SF), each with a total score of 100. Better quality of life is indicated by higher scores.

(6) Treatment efficacy. Efficacy assessment criteria: an increase in BMD and complete or near-complete resolution of pain are considered markedly effective; a significant rise in BMD and significant alleviation of pain are consid-

ered effective; no significant changes in BMD and pain are considered ineffective.

In this study, bone metabolism, BMD, dysfunction, and efficacy were the primary measurements, while pain intensity and quality of life were secondary measurements.

Statistical methods

In this study, both the measurement and counting data were imported into SPSS 19.0 software package for statistical analyses. Measurement data, statistically described by mean ± SEM, were compared between groups by t-test and within groups before and after treatment with paired t-test; counting data were expressed by the rate (percentage) and compared by the χ^2 test. $P < 0.05$ was considered statistically significant.

Results

General data of OP patients

There were no significant differences in general data such as gender, age, and disease course between the two groups (all $P > 0.05$) (**Table 1**).

Effects of WAM combined with Bushen Qianggu Recipe on bone metabolism in OP patients

Bone metabolism was assessed by measuring PINP and B-ALP levels. It was found that there was no marked inter-group difference in these two indexes before the intervention (all $P > 0.05$). Post intervention, PINP and B-ALP showed significant reduction ($P < 0.05$), with even lower levels in the research group (all $P < 0.05$) (**Figure 1**).

Impacts of WAM combined with Bushen Qianggu Recipe on BMD in OP patients

The BMD of the two groups was evaluated at three sites: lumbar vertebrae L₂₋₄, femoral neck, and distal 1/3 of the radius. There was no remarkable difference in the pre-interventional BMD of the aforementioned parts (all $P > 0.05$). Post-intervention, BMD increased in both groups (all $P < 0.05$), with a more pronounced increase in the research group ($P < 0.05$) (**Figure 2**).

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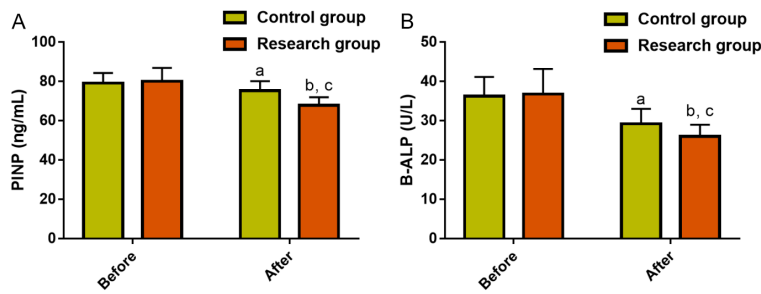


Figure 1. PINP and B-ALP levels before and after intervention in both groups. A. PINP levels reduced in both groups and were even lower in the research group after intervention. B. B-ALP levels reduced in both groups and were even lower in the research group after the intervention. Note: ^aP<0.05, versus pre-treatment; ^bP<0.01, versus pre-treatment; ^cP<0.05, versus control group. PINP, Procollagen Type I N-Terminal Propeptide; B-ALP, bone alkaline phosphatase.

Influences of WAM combined with Bushen Qianggu Recipe on pain intensity of OP patients

The influence of WAM combined with Bushen Qianggu Recipe on the pain intensity of OP patients was assessed using VAS scores. No marked inter-group difference was identified in VAS scores before the intervention ($P>0.05$). After treatment, the scores were significantly reduced ($P<0.05$), particularly in the research group ($P<0.05$) (**Figure 3**).

Effect of WAM combined with Bushen Qianggu Recipe on dysfunction in OP patients

The effects of WAM combined with Bushen Qianggu Recipe on the dysfunction of OP patients were analyzed by assessing the Oswestry Dysfunction Index before and after the intervention in both groups. The two groups were not statistically different in the Oswestry dysfunction index before the intervention ($P>0.05$). However, post-intervention, the index was reduced in both groups and was even lower in the research group ($P<0.05$) (**Figure 4**).

Impacts of WAM combined with Bushen Qianggu Recipe on quality of life in OP patients

By evaluating the postinterventional SF-36 scores, the effect of WAM combined with Bushen Qianggu Recipe on patients' quality of life was analyzed. The results showed significantly higher postinterventional SF-36 scores in the research group compared to the control group ($P<0.05$) (**Figure 5**).

Influences of WAM + Bushen Qianggu Recipe on efficacy in OP patients

The number of markedly effective, effective, and ineffective cases in the two groups was counted, and it was found that the research group had a significantly higher total effective rate than the control group ($P<0.05$) (**Table 2**).

Discussion

According to TCM theory, osteoporosis (OP) belongs to the category of bone fistulas, characterized by clinical manifestations such as kidney essence deficiency and blood stasis obstruction. Treatment traditionally focuses on tonifying the kidney, strengthening the bone, and activating blood [17]. Warming acupuncture-moxibustion (WAM), a TCM approach that combines the advantages of acupuncture and moxibustion, has the effect of warming and dredging the meridians, regulating blood circulation, and relieving pain, which can be used in the treatment of OP patients to effectively relieve pain and dysfunction [18]. In Bushen Qianggu Recipe, Radix Rehmanniae Preparata and Epimedium can nourish yin and blood, and tonify the marrow; Poria cocos and yam can strengthen the spleen and kidneys, and dissolve dampness; Polygonatum sibiricum Red. is effective in strengthening the body resistance; Eucommia ulmoides and Drynaria can nourish the kidneys, strengthen the bones, relieve pain, and regulate blood circulation. Together, these herbs enhance liver tonification, kidney nourishment, and tendon and bone strengthening [19-22].

In this study, 103 OP patients were enrolled. The control group received WAM treatment as a standalone treatment, and the research group received WAM combined with Bushen Qianggu Recipe. Post-intervention assessments showed that serum PINP and B-ALP were significantly reduced in the research group compared to the control group, indicating that WAM combined with Bushen Qianggu Recipe more greatly improves bone metabolism for patients with OP than WAM alone. PINP, a bone turnover marker,

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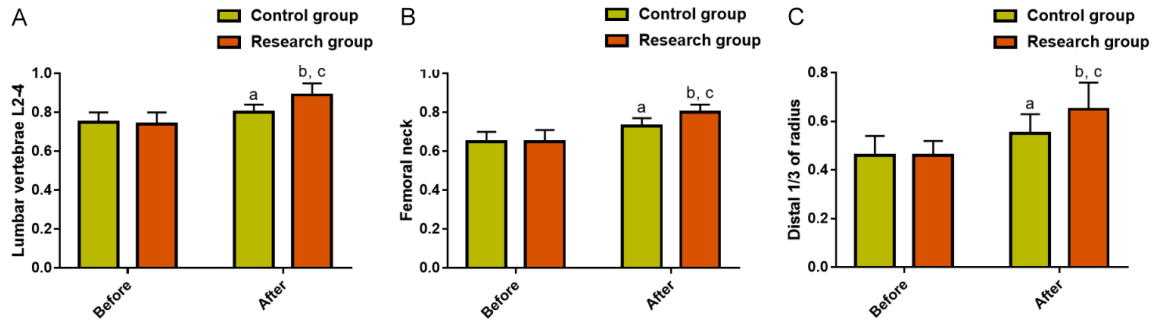


Figure 2. Impacts of WAM combined with Bushen Qianggu Recipe on BMD in OP patients. A. The post-intervention BMD (lumbar spine L₂₋₄) was higher in the research group than pre-intervention as well as in the control group. B. The post-intervention BMD (femoral neck) was higher in the research group than pre-intervention as well as in the control group. C. The post-intervention BMD (at the distal 1/3 of the radius) was higher in the research than pre-intervention as well as in the control group. Note: ^aP<0.05, versus pre-treatment; ^bP<0.01, versus pre-treatment; ^cP<0.05, versus control group. WAM, warming acupuncture-moxibustion; BMD, bone mineral density; OP, osteoporosis.

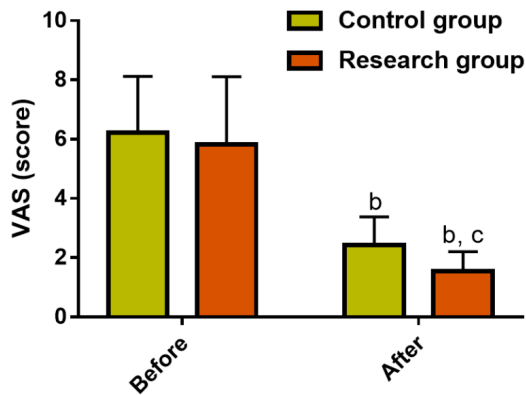


Figure 3. Impacts of WAM combined with Bushen Qianggu Recipe on pain intensity in OP patients. Note: ^aP<0.05, versus pre-treatment; ^bP<0.01, versus pre-treatment; ^cP<0.05, versus control group. WAM, warming acupuncture-moxibustion; VAS, visual analogue scale; OP, osteoporosis.

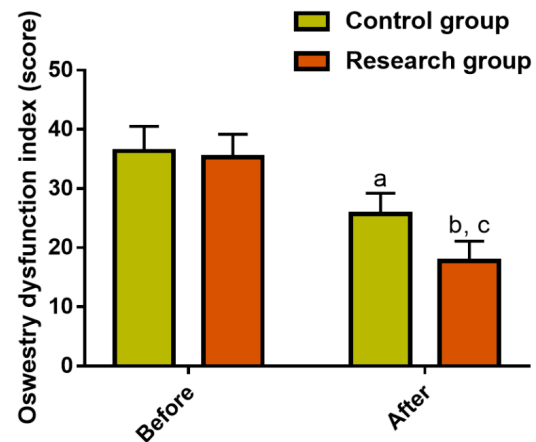


Figure 4. Impacts of WAM combined with Bushen Qianggu Recipe on dysfunction in OP patients. Note: ^aP<0.05, versus pre-treatment; ^bP<0.01, versus pre-treatment; ^cP<0.05, versus control group. WAM, warming acupuncture-moxibustion; OP, osteoporosis.

holds potential as a therapeutic target for OP [23]. In addition, serum PINP levels may also reflect femoral neck and lumbar spine BMD to some extent, with a negative correlation between the PINP and BMD [24]. B-ALP, a marker of bone formation, is negatively correlated with BMD in the femoral neck and Ward's triangle in OP patients [25, 26]. Based on the above, the results of the bone metabolism indexes in this study imply that WAM combined with Bushen Qianggu Recipe can increase BMD to a certain extent by down-regulating serum PINP and B-ALP.

Our study showed that post-intervention BMD in the research group was higher than that of

for pre-intervention and the control group in the lumbar vertebrae L₂₋₄, the femoral neck, and the distal 1/3 of the radius, indicating that the intervention of WAM combined with Bushen Qianggu Recipe in patients with OP positively affects BMD in these areas for OP patients. Song J et al. [27] found that active polysaccharides extracted from *Eucommia ulmoides* (one of the components of Bushen Qianggu Recipe) can exert anti-OP effects through various pathways, such as ameliorating oxidative stress by regulating the balance of intestinal flora, improving bone metabolism and strengthening osteogenic function by regulating the extracel-

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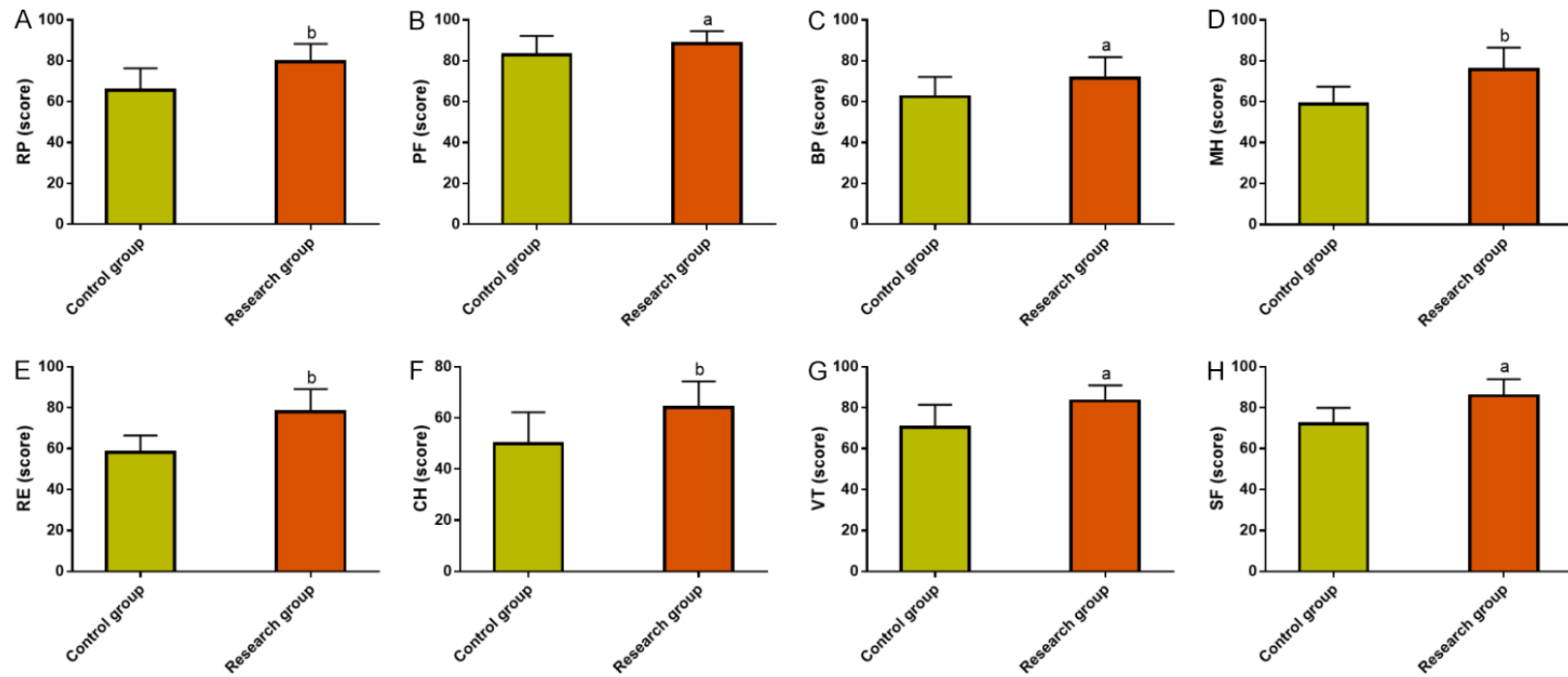


Figure 5. Impacts of WAM combined with Bushen Qianggu Recipe on quality of life in OP patients. A. Comparison of role-physical (RP). B. Comparison of physical functioning (PF). C. Comparison of bodily pain (BP). D. Comparison of mental health (MH). E. Comparison of role-emotional (RE). F. Comparison of general health (GH). G. Comparison of vitality (VT). H. Comparison of social functioning (SF). Note: ^aP<0.05 and ^bP<0.01, versus control group. WAM, warming acupuncture-moxibustion; OP, osteoporosis.

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Table 2. Comparison of treatment efficacy between the two groups

Efficacy	Control group (n=47)	Research group (n=56)	X ²	P
Markedly effective	16 (34.04)	30 (53.57)		
Effective	20 (42.55)	21 (37.50)		
Ineffective	11 (23.40)	5 (8.93)		
Total effective rate	36 (76.60)	51 (91.07)	4.081	0.043

Note: OP, osteoporosis.

ular signal-regulated kinase (ERK)/c-Jun N-terminal kinase (JNK)/nuclear factor erythroid 2-related factor 2 (Nrf2) axis to improve bone metabolism, and enhancing osteogenesis. In another study by Fang XH et al. [28], osteosynthesis increases trabecular BMD by promoting bone formation and inhibiting bone resorption, and the therapeutic mechanism may be related to its modulation of the bone morphogenetic protein 2 (BMP2)/Mothers Against DPP Homolog 1 (Smad) signaling pathway. In our study, the research group demonstrated reduced VAS and Oswestry dysfunction index scores after the intervention, indicating reduced pain intensity and alleviated dysfunction compared to the pre-intervention and the control group. Additionally, higher SF-36 scores from all eight dimensions were observed in the research group after the intervention, indicating that WAM combined with Bushen Qianggu Recipe has a significant effect on enhancing patients' quality of life in all aspects. Finally, efficacy evaluation demonstrated a higher total effective rate in the research group compared to the control group (91.07% vs. 76.60%), suggesting that the intervention of WAM combined with Bushen Qianggu Recipe offers more favorable therapeutic outcomes for OP patients.

This study has several limitations. First, the mechanism underlying the impact of WAM combined with Bushen Qianggu Recipe on bone metabolism of OP patients was not explored. Further research is needed to elucidate the mechanism of this therapy. Second, this study did not delve into the factors related to treatment efficacy in OP patients. Additional follow-up analysis is needed to identify the optimal conditions for treatment effectiveness. Third, the long-term prognosis of patients was not analyzed. Analyzing long-term outcomes is beneficial to further understand the sustained impact of WAM combined with Bushen Qianggu Recipe on the prognosis of OP patients. Future research will address these limitations by exploring the mechanisms of action, identifying

factors influencing efficacy, and evaluating long-term prognostic impacts.

In summary, the treatment of OP patients with WAM combined with Bushen Qianggu Recipe can down-regulate serum PINP and B-ALP levels and improve the BMD of the

lumbar vertebrae L₂₋₄, femoral neck, and distal 1/3 of the radius, thus exerting significant therapeutic effects. This approach effectively reduces pain and dysfunction while enhancing quality of life, making it a valuable option for clinical practice.

Disclosure of conflict of interest

None.

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