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Original Research Article

Clinical efficacy of Gushukang Jiaonang in osteoporosis and its effects on bone metabolism in patients: A retrospective study

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Abstract

Purpose: *To investigate the clinical efficacy of Gushukang Jiaonang in the prevention and treatment of osteoporosis, and its effect on patients' bone metabolism based on its use in traditional Chinese medicine.*

Methods: *Retrospective analysis was conducted on 108 patients with osteoporosis discharged from the North Hospital Affiliated Hospital of Gansu University of Traditional Chinese Medicine, from January 2021 to January 2023. Patients were divided into study group (n = 54) and control group (n = 54). Control group received oral calcitriol and calcium tablets, while study group orally received calcitriol and calcium tablets and Gushukang Jiaonang capsules in addition. Clinical symptom improvement scores, bone mineral density, serum phosphorus and calcium, and blood alkaline phosphatase levels were compared between the groups.*

Results: *After treatment, total amino terminal prolonging peptide of collagen I in the blood of study group was significantly higher than before treatment ($p < 0.05$). Osteocalcin was significantly increased before and after treatment in the two groups ($p < 0.05$). Vitamin D levels were significantly increased before and after treatment, and the difference was statistically significant ($p < 0.05$).*

Conclusion: *Gushukang Jiaonang provides patients with efficient, comprehensive and precise prevention and treatment of osteoporosis. It also promotes positive disease regression, which in turn contributes to increase in bone mineral density in individuals. Long-term investigations with a larger population size, more indices as well as multicenter control should be carried out to provide sufficient theoretical basis for use in clinical practice.*

Keywords: *Gushukang Jiaonang, Osteoporosis, Clinical efficacy, Bone metabolism, Application effect*

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INTRODUCTION

Osteoporosis is considered in modern medicine as a systemic disorder of bone metabolism characterized by low bone mass and destruction of the microstructure of bone tissue with a reduced ratio of bone mineral composition to bone matrix, leading to increased brittleness of bones and susceptibility to fracture [1]. Its pathological changes are mainly thinning and reduction in the number of bone trabeculae as well as thinning of bone mass, which increases load on the remaining trabeculae and reduces the strength of trabeculae.

Osteoporosis is a systemic disease that occurs with age and degenerative changes in bone, which has a slow onset and long course and has a greater impact on the quality of life of patients [2]. According to Traditional Chinese Medicine (TCM), “kidney essence” mainly acts on bones, which is the source of bone biochemistry and makes bones strong. The essential cause of osteoporosis is attributed to deficiency of kidney energy. With progression of osteoporosis, body gradually becomes deficient in kidney essence, which in turn leads to the loss of bone nourishment and causes onset of bone fragility [3].

Current treatment of osteoporosis in Chinese medicine is mainly based on kidney tonification. It has been suggested that Gushukang Jiaonang is useful in treating osteoporosis and can do this via regulation of body metabolism. It causes an increase in bone density, and bone formation process, promotes restoration of bone mass as well as bone remodeling, and is able to exert a certain inhibitory effect on the action of osteoclasts which is important especially for osteoporosis [4].

Changes in bone mineral density, blood phosphorus, blood calcium, bone metabolism, liver and kidney function and systemic symptoms were compared before and after treatment with Gushukang Jiaonang, thus observing its clinical efficacy and mechanism of action for osteoporosis [5]. This is necessary to provide further theoretical basis and clinical experience for the treatment of osteoporosis.

METHODS

Subjects

Data of 108 patients discharged from North Hospital Affiliated Hospital of Gansu University of Traditional Chinese medicine with osteoporosis admitted from January 2021 to January 2023 were selected for retrospective analysis. Patients were divided into two groups of 54 persons each (study and control groups) according to intervention protocol. Diagnostic criteria were bone density which is defined as mean value of bone density of 2^{nd} - 4^{th} vertebrae of lumbar spine measured by dual-energy x-ray bone densitometry (DEXA), of less than 2.0 standard deviations or more. This study was approved by the ethics committee of Gansu University of Traditional Chinese Medicine (approval no. 21-EC-3), and complied with international guidelines for human studies. Signed, written informed consent were obtained from the patients and/or guardians.

Inclusion criteria

Patients with confirmed diagnosis of osteoporosis and osteoporotic vertebral compression fracture (age: male ≥ 60 years old, female ≥ 55 years old); patients with clinical manifestations of low back and extremity pain, lower extremity weakness, cold chills, lower extremity cramps, and frequent nocturnal urination; patients in which imaging examination showed that posterior wall of injured vertebral body was intact, spinal canal was normal, and spinal cord and nerve roots were not significantly compressed; patients that are able to cooperate with the doctors to complete various scoring and related test examinations, and tolerate long-term oral osteoporotic granules with good compliance were included in this study.

Exclusion criteria

Female patients with less than 2 years of natural menopause, those with secondary osteoporosis such as hyperparathyroidism, osteochondrosis, rheumatoid arthritis, multiple myeloma and other serious comorbidities; or those with advanced deformity, disability and loss of labor force; patients with serious primary diseases such as cardiovascular and hematopoietic system; patients with psychosis or dementia, hormone replacement therapy and calcitonin within the last three months, 15 days of continuous application of ditenglomerate within the last six months; patients who are in critical condition and when it is difficult to make a definite evaluation of effectiveness and safety of the new drug.

Drug administration

Clinical data of both groups were assessed**.** Control group was treated with conventional oral calcitriol and calcium tablets, specific therapeutic dosage was as specified in the instruction manual, and treatment duration was 3 months. In

addition to treatment administered to control group, study group was treated with Gushukang capsule, (Gushukang granules; Liaoning Kangchen Pharmaceutical Co. Ltd; approval no. Z20003255), at a dose of 10mg single dose, 3 times per day, taken with boiled water after meals, starting from the first day after surgery for 3 months.

Evaluation of parameters/indices

Bone density level used to assess the degree of osteoporosis in patients before and after treatment was measured using a dual-energy x-ray bone densitometer (EXA-3000, China). The sites of testing were the ulna and burn bone of both upper limbs, and the T-Score values were recorded.

Blood calcium, phosphorus and alkaline phosphatase levels

Venous blood of patients was collected early before breakfast to determine calcium, phosphorus and alkaline phosphatase levels. Furthermore, amino end prolongation peptide of type I collagen, middle end of N segment osteocalcin, β collagen special sequence and vitamin D activities were also used to assess bone metabolic indices.

Statistical analysis

All statistical data were entered into Excel and SPSS 28.0 was used for statistical calculation. Measurement data conforming to normal distribution were expressed as mean ± standard deviation (SD) and independent sample t-test was used. Count data were compared by chi-square test, while rank data were compared by rank sum test. $P < 0.05$ was considered statistically significant.

RESULTS

Clinical data

The mean age, gender and body mass index of patients in study group were not significantly different from those of control group ($p > 0.05$; Table 1).

Bone density

There was no significant difference in bone mineral density (BMD) indices of femoral neck and Ward's triangle before and after treatment in control group ($p > 0.05$), however there was a significant difference in L_2-L_4 and greater trochanter of the lumbar spine in study group after treatment compared to before treatment and compared to control group ($p < 0.05$). Finally, no significant difference was observed between the two groups before treatment ($p > 0.05$). See Figure 1.

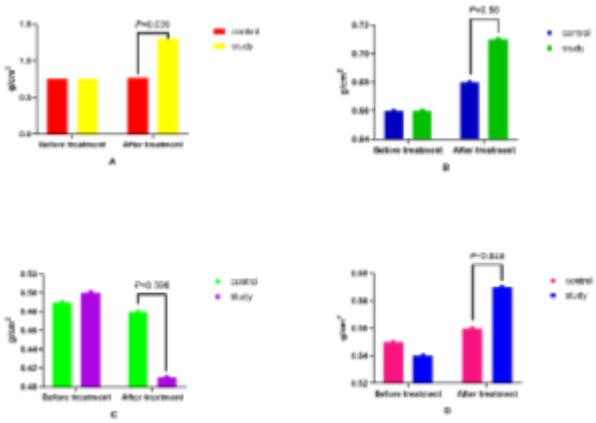

Figure 1: Comparison of bone mineral density (BMD). Bone density indices of femoral neck (B) and Ward's triangle (C), lumbar L_2-L_4 (A), and greater trochanter (D). There was no significant difference ($p > 0.05$) in the BMD efficacy grade between the two groups after treatment. There was no significant difference in the comparison of effective rates ($p > 0.05$)

Blood calcium, blood phosphorus and alkaline phosphatase

As shown in Figure 2, before treatment, blood calcium, blood phosphorus and alkaline phosphatase indices of the two groups were similar and not significantly different ($p > 0.05$). After treatment, the difference in blood calcium, blood phosphorus and alkaline phosphatase indices between the two groups was statistically significant ($p < 0.05$).

Table 1: Comparison of baseline information between the two groups of patients (n = 54)

Group	Age (years)	Gender (Male/Female)	Body mass index (kg/m^2)	Duration of illness (years)	Blood pressure (mmHg)	
					Systolic pressure	***Diastolic pressure***
Control	56.90±1.71	14/40	28.05±2.23	5.35±1.29	125.3±6.4	78.3±3.2
Study	55.10±1.62	13/41	28.40±2.03	5.10±1.31	124.6±6.1	78.6±3.6
T	0.377	0.040	-0.821	-0.480	0.161	
P-value	0.051	0.841	0.414	0.632	0.688	

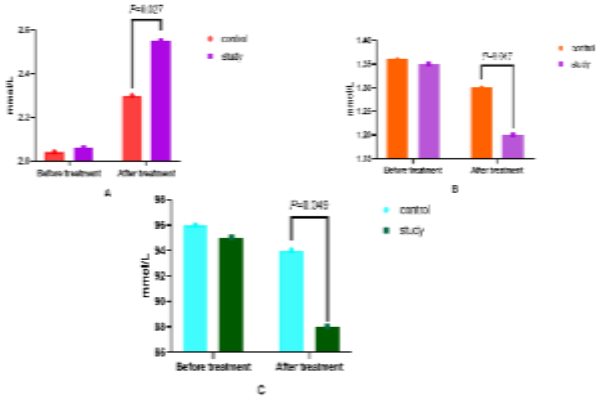

Figure 2: Comparison of blood calcium, blood phosphorus and alkaline phosphatase. Blood calcium (A), blood phosphorus (B), and alkaline phosphatase (C)

Bone metabolic indices

Comparing before and after treatment between the same groups, the total blood I collagen amino-terminal prolonged peptide was improved in study group after treatment than before treatment ($p < 0.05$), while there was no statistically significant difference between the two groups ($p > 0.05$). There was a statistically significant increase in osteocalcin before and after treatment results in both groups ($p < 0.05$). There was no statistically significant difference between the two groups before and after treatment in the decrease of beta collagen special sequence ($p > 0.05$). There was also a significant increase ($p < 0.05$) in vitamin D levels after treatment in both groups but this effect was not significantly different between both groups after treatment (Figure 3).

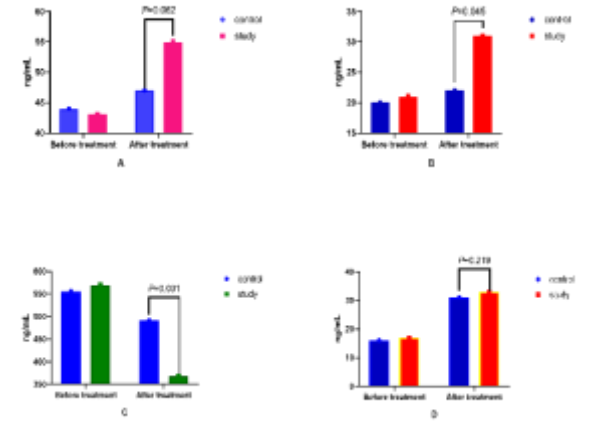

Figure 3: Comparison of type I collagen amino-terminal extension peptide, osteocalcin, β-collagen specific sequence and vitamin D. Total blood I collagen amino-terminal prolongation peptide (A), osteocalcin (B) beta collagen special sequence (C), vitamin D (D)

DISCUSSION

Osteoporosis is a systemic skeletal disease characterized by low bone mass and microstructural destruction of bone tissue, leading to increased brittleness, reduced strength and susceptibility to fracture [6]. The main pathological mechanism of osteoporosis is an abnormal bone metabolic balance. Bone metabolism is a dynamic balance consisting of bone resorption and bone reconstruction. The process of bone resorption and bone reconstruction is influenced by various humoral, biochemical, mechanical and other environmental factors as well as hormones and various growth factors. The autocrine effects of local regulatory factors have direct or indirect physiopathological regulation of proliferation, differentiation, matrix synthesis and mineralization of bone spectrum cells [7]. Impairment of this regulatory mechanism leads to loss of balance in bone formation-resorption coupling, resulting in bone loss [8].

The rate of bone loss is reduced by supplementing with calcium and vitamins. Calcium D provides the body with required calcium elements and vitamin D and help in absorption of calcium and phosphorus to achieve the effect of making bones strong. Gushukang Jiaonang Zhong Yao Yang Lei is the main outcome of tonifying the kidney and strengthening bone matrix [9]. *Astragalus membranaceus* tonifies the qi and helps regulate the immune function of the body. The effect of *Salvia miltiorrhiza* is to tonify blood and dispel *chi*. *Gushukang Jiaonang's* multiple components have good regulatory effect on the symptoms of blood cholera due to osteoporosis and promote bone growth while tonifying the kidney to achieve the effect of bone strengthening. A Study on osteoporosis rats found that Gushukang Jiaonang was able to significantly shorten the cycle of osteoblast formation, which in turn contributed to rapid proliferation of osteoblasts [10].

Gushukang Jiaonang has the following drug components: *Herba epimedii*, Shu Di Huang, *Astragalus membranaceus, Salvia miltiorrhiza, Drynaria bonii,* and other herbal ingredients such as *Herba epimedii, Drynaria bonii,* which tonifies the kidney and strengthens bones. Shu Di tonifies Yin and nourishes the marrow, *Astragalus membranaceus* benefits Qi and nourishes the blood and Dan Shen invigorates blood and disperses phlegm to relieve pain. Because patients with osteoporosis generally conform to TCM dialectical typology of kidney deficiency, blood checking and blood deficiency,

symptoms are characterized by back pain, lumbar and knee weakness, and difficulty in walking [11]. Therefore, Gushukang Jiaonang achieves better clinical efficacy in treating the pathological conditions of osteoporosis. *Herba epimedii* has the effect of tonifying the waist, and knee and strengthening the heart [12].

Modern pharmacological studies have shown that *Herba epimedii* extract has the effect of increasing androgenic hormones. Radix Rehmanniae has antioxidant, immunomodulatory, blood-improving, and antitumor effects, which indirectly create a good *in vivo* environment for the recovery of osteoporosis [13]. The mechanism of action of *Salvia miltiorrhiza* in the process of fracture healing is to increase *in vivo* content of bone formation protein, metastatic growth factor and basic fibrous growth factor. With the significant differences seen in study group compared to control group, this infers that *Salvia miltiorrhiza* promotes the formation of osteoblasts [14].

It has been demonstrated in literature through animal studies that total ketones of *Astragalus membranaceus* produced a significant improvement in bone density in experimental mice with osteoporosis. It was also inferred from that Study that its likely mechanism of action may be via increase in estrogen level in the body, thus promoting growth of osteoblasts in bone metabolism [15]. *Drynaria bonii* has the effect of activating blood, healing injuries, relieving pain and connecting bones, as well as strengthening tendons and bones, and treating lumbago and weakness of the feet and knees [16]. *Drynaria bonii* has a significant effect on differentiation and formation of osteoblasts and calcification of osteocytes. With economic development, improvement of people's standard of living, and the great convenience brought by technology, people's activity is decreasing and metabolic diseases are increasing. With this, the incidence of osteoporosis is gradually increasing, yet Osteoporosis is not widely known. The side effects and high economic costs of Western medical treatment have led people to turn to traditional Chinese medicine, which uses the method of evidence-based treatment [17]. Gushukang capsule has obtained evidence-based medical evidence for this type of syndrome through clinical practice and animal studies [18].

Limitations of this study

The small sample size and short duration of this study limited the reliability of observed indices and could not reflect the entirety of the objective. Therefore, long-term investigations with a large number of samples with multiple indices as well as multicenter control should be carried out to provide sufficient theoretical basis for application in clinical practice.

CONCLUSION

This study has reported the successful use of *Gushukang Jiaonang* to treat osteoporosis and bone mineral density. Bone metabolism has been used as the main parameter for evaluating efficacy, because changes in bone mineral density are difficult to observe in a short period, while changes in bone metabolism are more sensitive to response after treatment.

DECLARATIONS

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None provided.

Ethical approval

This study was approved by the Ethics Committee of Gansu University of Traditional Chinese Medicine, China (approval no. 21-EC-3).

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by them.

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