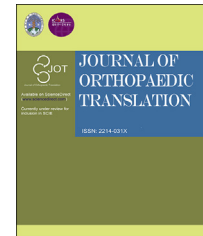


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## ORIGINAL ARTICLE

# Characteristics of bone biochemical indices in elderly women with osteoporotic intertrochanteric fracture

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**KEYWORDS**bone biochemical indices;  
bone density;  
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secondary fractures

**Summary** *Background:* This study aimed to explore the characteristics of bone biochemical indices, including bone mineral density (BMD), metabolic markers in elderly women with osteoporotic intertrochanteric fracture and their relevance in secondary fracture.

*Methods:* The standard for follow-up from 58 elderly women was established to analyse the BMD in the injured hip, healthy hip, and the vertebra at 1 week and 12 months after fracture. The serum levels of total procollagen type N-terminal propeptide (tPINP) and the age-related type I cross linked C-telopeptide ( $\beta$ -CTX) were recorded and compared between those patients with and without secondary fractures within 12 months.

*Results:* Twelve months after fracture, the serum levels of tPINP and  $\beta$ -CTX were significantly higher than the baseline values ( $p < 0.01$ ). The tPINP baseline in patients with secondary fracture was significantly lower than that in the rest patients without secondary fracture ( $p < 0.01$ ). The  $\beta$ -CTX baseline was notably higher than that without secondary fracture ( $p < 0.01$ ). BMD values of the three periods had no significantly difference.

*Conclusion:* The serum level of tPINP and  $\beta$ -CTX is of great value in earlier and more sensitively reflecting the condition of bone turnover in body and more accurately predicting the subsequent fracture risk combined with a lower BMD.

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## Introduction

With the improvement of living standards in recent decades, people are living significantly longer than before. Therefore, the world is gradually developing into an ageing society and a series of resulting problems have become increasingly prominent. Owing to the weakening of body function, elderly people usually have varying degrees of osteoporosis. Particularly, postmenopausal women with dramatically decreased oestrogen have shown more severe osteoporosis [1,2].

As a systemic disease of the skeleton, osteoporosis can bring a great increase of skeletal fragility and risk of fracture [3] due to the reduced bone mass and damage to the bone microstructure [4,5]. Normally, fractures of vertebrae, proximal femur, and wrist are regarded as the typical osteoporotic fractures [4]. Proximal femur (hip) fracture is strongly related to low bone mineral density (BMD) and has become the international norm of osteoporosis and causes more disability than the other two types of osteoporosis fracture [4]. To make matters worse, 10–20% of patients die during the first year after a hip fracture according to Steven [4]. In general, BMD is merely one of the contributors to bone strength, which is also associated with other factors such as bone microstructure and remodelling levels, which can be accurately measured by bone biochemical indices [6,7]. Therefore, studying the dynamic change of BMD, the serum level of bone biochemical indices and dynamically monitoring bone mass, bone formation and bone resorption markers of postoperative elderly women with hip fracture are of significant for the early diagnosis and treatment of osteoporosis, as well as the predication of secondary osteoporotic fracture (SOF) and improvement of quality of life. Intertrochanteric fracture, which is a common type of hip fracture, is selected as an example in this work.

Our research aimed to explore the change in BMD and the serum level of bone biochemical indices within 12 months in elderly women with unilateral intertrochanteric fracture. Simultaneously, these biochemical indices in such women who had SOF or not during follow-up were collected and compared, which were expected to obtain better bone remodelling level and predict more accurately the risk of SOF.

## Materials and methods

The clinical study was approved by the Ethics Committee of the First Affiliated Hospital of Soochow University, and written informed consent was obtained from all participants and was performed in accordance with the ethical standards of the Declaration of Helsinki of 1964. Fifty-eight elderly female patients (postmenopausal women with a mean age of  $80.5 \pm 7$  years; range 65–96 years) who were clearly diagnosed with unilateral intertrochanteric fracture (in accordance with fragility fracture) by radiography in our department, from March 2011 to December 2013, and treated with Gamma 3 nail fixation were selected randomly. The specific selection process was as follows: 102 patients were enrolled and 44 cases were excluded: not meeting inclusion criteria ( $n = 22$ ); declined to participate

( $n = 14$ ); and other reasons ( $n = 8$ ). The remaining 58 participants were required to meet the following criteria: (1) to eliminate the interference by oestrogen, all female patients were not less than 60 years old and had been in menopause for  $> 5$  years; (2) without antiosteoporosis treatment before fracture; (3) according to the patients' medical history, their fracture types were all conformed to first fragility fractures; SOF occurred without severe trauma, tumour, or tuberculosis and was diagnosed via computed tomography scan; (4) patients with delayed union or nonunion diagnosed by computed tomography scan were excluded; and (5) all participants were ruled out with diabetes, thyroid function hyperfunction, hyperparathyroidism, malignant tumour, and history of taking thyroid hormone or steroids. All participants were informed of the nature of this study. BMD of bilateral hip joints and lumbar vertebra of 58 participants were measured by dual energy X-ray absorptiometry before surgery. The results obtained within 1 week after fracture were set as baseline and were compared with data that were collected 12 months after fracture. Blood samples collected within 4 hours and 12 months after fracture were analysed by chemiluminescence immunoassay to acquire the two typical bone biochemical indices of total serum procollagen type N-terminal propeptide (tPINP) and age-related type I crosslinked C-telopeptide ( $\beta$ -CTX). Due to the lack of bone biochemical indices data before fracture, data collected at 4 hours after fracture were adopted as approximate baseline values as reported by Ivaska et al [8] based on the unobvious change of bone biochemical indices within 4 hours after fracture. Participants were divided into two groups (A: with SOF; B: without SOF) in accordance with whether SOF (hip, vertebral, wrist, and other fracture) occurred during 12 months follow-up. All women with SOF diagnosed clearly conformed to the following exclusion criteria: (1) traffic accident, high fall injury, and other severe trauma that led to subsequent fracture; and (2) pathological fracture. Meanwhile, the BMD of bilateral hip joints and lumbar vertebrae and these two typical bone biochemical indices described above in Groups A and B was collected and analysed.

Data are presented as mean  $\pm$  standard deviation. The differences in BMD and serum level of tPINP and  $\beta$ -CTX between 4 hours and 12 months after fracture were compared by paired samples *t* test. A value of  $p < 0.05$  showed that the difference was statistically significant between these groups.

## Results

Baseline characteristics of patients with SOF are shown in Table 1. The change in BMD and bone biochemical indices in elderly women with osteoporotic intertrochanteric fracture undergoing fracture healing is shown in Table 2. Twelve months after injury (namely 6 months after bone union was completed), the serum levels of tPINP and  $\beta$ -CTX, which represented the condition of bone formation and bone resorption, were still significantly higher than the baseline ( $p < 0.01$ ). According to the World Health Organization osteoporosis diagnosis principles [9], the value of BMD at 12 months follow-up did not differ significantly compared with

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