

Original Research Article

Effect of the combination of Huoxue Busui decoction and hollow screw internal fixation on treatment of femoral neck fractures

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Abstract

Purpose: To determine the effect of Huoxue Busui decoction plus hollow screw internal fixation in adolescent and middle-aged patients with fractures of the femoral neck.

Methods: 56 patients receiving treatment for fracture with hollow screw internal fixation in the emergency rapid diagnosis and treatment channel of Dongying People's Hospital, China from April 2015 to January 2023 were randomly assigned to study and control groups. The two groups received hollow screw internal fixation and conventional drug therapy, but in addition, control group were given Huoxue Busui decoction 2 days after surgery. Visual analogue scale (VAS), hip efficacy score and hip flexor-extension range of motion pre- and post-operation were analyzed.

Results: Preoperative VAS score and postoperative garden alignment index (GAI) of fracture reduction were comparable in the two groups. The VAS scores of control group at 5 days, 7 days, 1 month and 12 months after surgery were significantly lower than study group ($p < 0.05$). Fracture healing time was shorter in study group. At the last follow-up, there was no case of fracture non-union in control group. However, there were 2 cases of nail withdrawal and 1 case of femoral head necrosis. In contrast, study group had 1 instance of non-union, 3 instances of nail removal and 4 instances of femoral head necrosis.

Conclusion: Huoxue Busui decoction combined with hollow screw internal fixation improved femoral neck fracture in young and middle-aged patients and promotes fracture healing after surgery and effectively improves joint function of patients. However, longer follow-up time, and in-depth study of the mechanism of action of this combination will be required.

Keywords: Huoxue Busui decoction, Hollow screw internal fixation, Femoral neck fracture, Emergency rapid diagnosis

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INTRODUCTION

Fracture of femoral neck is a common type of injury seen in clinical practice [1]. Femoral neck fracture often occurs in middle-aged and elderly people. Significantly violent impart is required for

it to occur in younger population, mostly as a result of high-energy injuries such as traffic accidents or falls from great heights. Studies suggest that surgical reduction of the fracture end within 24 h effectively restores blood flow to the femoral head. This has an important impact

on improving fracture healing rate and reducing cases of femoral head necrosis [2].

Closed reduction hollow screw fixation is currently widely used for treating this type of fracture [3]. According to literature reports, while rate of internal fixation failure in fracture of femoral neck in young adults is 18 %, the incidence of bone non-union is 9 %, and the incidence of ischemic pregnancy-associated death of femoral head is 14 % [4]. Failure of internal fixation, non-union of bone and avascular necrosis of femoral head negatively affect the quality of life of patients, thereby imposing great financial stress on patients, apart from wastage of medical resources [5]. Therefore, it is very important to study how to effectively improve the prognosis of middle-aged and young patients with femoral neck fractures, promote fracture healing, and reduce postoperative complications. Dongying Hospital Affiliated to Shandong Provincial Hospital Group have established an emergency fast detection and management setup for treatment of hip fractures, to improve therapeutic efficiency.

Traditional Chinese medicine (TCM) is important in perioperative management of femoral neck breakage in adolescents. Many TCMs promote fracture healing to different degrees, improve hip joint function after surgery, and have a good curative effect. Moreover, TCMs are cheap and have few side effects. *Huoxue Bumedi* Decoction has the effect of promoting blood circulation and removing blood stasis, tonifying the liver and kidney, reducing swelling and relieving pain [6].

This study investigates the effectiveness of combining *Huoxue Busui* decoction with hollow screw internal fixation as therapeutic strategy in adolescents with femoral neck fracture.

METHODS

General data

In this study, 56 young and middle-aged individuals with fractures of the femoral neck and treated with hollow screw internal fixation in the emergency rapid diagnosis and therapy channel of Dongying People's Hospital, China from April 2015 to January 2023, were selected. Using a prospective randomized control method in line with the order of treatment, patients were assigned randomly to study and control groups, each with 28 patients. This study was approved by Dongying People's Hospital, China (approval no. DYYX-2024015) and was conducted following the declarations of Helsinki [7].

Diagnostic criteria

Garden classification of femoral neck fracture is the most widely used, and it is simple and easy to master the classification in clinical practice. It is divided into four types, based on the severity of fracture and displacement: type I: incomplete or impingement fracture; type II: no-displacement complete fracture; type III: partial displacement complete fracture; and type IV: complete displacement *cum* complete fracture [6].

TCM diagnostic criteria

These include (a) main syndrome, i.e., traumatic disease, absence of swelling or local mild swelling, obvious tenderness, percussion pain, flexion of the affected limb, adduction and rotation deformity, severe movement limitation, and inability to walk or stand. (b) tongue and pulse, i.e., red tongue or tongue with petechiae and bruises, with slim and yellowish fur, and slippery pulse string. Postoperative femoral head necrosis was determined in line with standard method [6].

Inclusion criteria

Patients in the following categories were included: those aged 18 - 65 years; patients who got treatment \leq 24 h after fracture; patients who did not receive hormone or other drug treatment affecting bone metabolism 6 months before surgery and who were in good general condition; those with no obvious degeneration of the hip joint, and patients whose follow-up period exceeded 1 year, with complete compliance and documentation.

Exclusion criteria

The excluded patients were those with pathological fractures; patients with femoral head necrosis or hip dysfunction before injury; patients with other related diseases that interfere with bone metabolism or who had a history of taking hormones or other drugs that affect bone metabolism, within 6 months before surgery; patients who had aggravated heart, liver and renal insufficiency; and those with poor compliance who follow treatment according to regulations.

Fast channel diagnosis and treatment flow path

Improved preoperative examination in emergencies such as comprehensive blood screening, D-dimer, anterolateral x-ray of hip joint, CT of hip joint, cardiac ultrasound, and

lower limb arteriovenous color ultrasound were done. Patients provided information on their medical condition. Then, details of surgery and post-surgery rehab were worked out, and the patient provided informed consent for the relevant surgery after contraindications were excluded. The surgeons performed the surgery within 24 h of admission into the hospital.

Procedures

Surgical approach

Both groups received hollow screw internal fixation treatment. Anatomical screening of the fracture site was done using intraoperative traction fluoroscopy and three hollow screws were screwed in an inverted "pin" shape. Garden IV fractures that were difficult to reduce were subjected to open reduction and internal fixation.

Treatments

The two groups of patients were given subcutaneous injections of low molecular weight heparin calcium to prevent thrombosis after surgery. The drugs were changed to oral rivaroxaban after discharge for 6 weeks of anticoagulation therapy.

Postoperative oral celecoxib analgesia and other conventional treatment

Approximately 24 h after the operation, patients were asked to exercise sitting up and sitting sideways and to avoid straight leg elevation exercise. During bed rest, quadriceps isometric contraction exercises, passive flexion and extension adduction, and abduction and internal and external rotation exercises were performed. Hip joint radiographs were reviewed 2 days after surgery, and radiographs were reviewed 1, 3, 6, and 12 months after surgery to assess callus growth and formation. The patients were instructed to gradually bear weight on the affected limb until complete weight-bearing period. Patients in study group received *Huoxue Busui* decoction on the second day after surgery. The *Huoxue Busui* decoction had the following formula: *danshen* (30 g), *Angelica* (30 g), *Frankincense* (5 g), *myrrh* (5 g), *Astragalus* (30 g), *leech* (6 g), *scorpion* (10 g), *deer antler* (2 g), *xianling spleen* (10 g), *xianmao* (6 g), *guchibubu* (15 g), *achyranthes* (15 g), *cinnamon* (6 g), *Paeoniae* (12 g), *baizhu* (9 g), *poria* (9 g), and *licorice* (6 g). Non-decoction granules were given (145 mL at a time) in the morning and evening, for 1 course which was for 1 month. Each patient took 3 consecutive courses.

Evaluation of parameters/indices

Visual analogue scale (VAS)

Perioperative and postoperative follow-up data were recorded for both groups. Visual analogue scale (VAS) was used to rate walking-induced pain [8]. The scale ranged from 0 to 10, with 0 indicating no pain, while 10 indicated the most unbearable pain.

Harris score

Harris score was used to assess pain, limb function, deformity, and range of motion (ROM).

Garden alignment index

Garden alignment index was used to evaluate the reduction quality of image fractures [9]. X-ray of normal hip was 160° between the inner margin of femoral shaft and the femoral head of bone trabecula, and 180° between the femoral head axis and axis of the femoral neck. Definition A: Aft 155° - 165°, lateral 180°; B: anteroposterior 150° - 155°, lateral 180°; C: forward < 150° or lateral > 180°.

Healing time

Healing time of fracture was evaluated via regular imaging review and indicators such as hollowed-nail retreat, loosening and displacement and avascular necrosis of femoral head were evaluated.

Statistical analyses

Statistical Package for Social Sciences (SPSS 26.0) software was used to analyze data. Measured results are presented in form of mean ± standard deviation (SD). A two-group comparison of data with normal distribution was done with an independent sample *t*-test. Within-group comparison of time points was done with 1-way ANOVA or paired *t*-test. Results presented as non-normal distribution were compared with rank sum test, and enumeration data were compared using χ^2 or Fisher exact test. Two-group comparison of grade data was done with Mann-Whitney U test. Values of $p < 0.05$ were considered statistically significant.

RESULTS

Perioperative basic conditions

Control group comprised 16 men and 12 women of age range 22 - 63 years (average age = 46.2 ± 23.9 years). Fracture Garden classification

showed 16 cases of type II, 7 cases of type III, and 5 cases of type IV. Eighteen (18) patients had fractures on the left-hand side, while 10 patients had it on the right-hand side. Injury causes were falls in 18 cases, traffic accidents in 6 cases, and 4 cases of falls from a height. The average time from injury to operation was 17.9 ± 13.6 h. Three patients had essential hypertension and two had glycosuria. In the study group, there were 15 males and 13 females with ages ranging from 24 to 64 years (mean age = 45.3 ± 24.5 years). The Garden types of bone fracture were type II (18 cases), type III (6 cases) and type IV (4 cases). Seventeen (17) patients had fractures on the left-hand side, while 11 patients had it on the right-hand side. Fractures were mainly due to fall in 15 cases, accidents from road crossing in 5 cases, and injuries due to falling from a height in 8 cases. The average duration from fracture to surgery was 18.2 ± 12.6 h (14 – 26 h). Two patients had primary hyperemia in combination with fracture, while one had glycosuria. The 2 groups were comparable concerning sex, age, fracture site, reason for fracture, duration from fracture to surgery, fracture type, chronic disease in combination with internal medicine, and quality of fracture reduction (Table 1).

VAS pain score

The VAS scores were similar in the study and control groups before operation ($p > 0.05$). However, VAS scores of the control group were better than those of the study group on day 5, day 7, 1 month and 12 months after operation ($p < 0.05$; Table 2).

Hip function scoring criteria (Harris) score

The hip Harris scores in control group at 1 and 6 months post-operation were better when compared with study group score 12 months post-surgery ($p < 0.05$; Table 3).

Range of motion (ROM)

At 1 month and 6 months post-surgery, the ROM was markedly better in control group than in study group (Table 4).

Fracture healing time and complications

The healing time of fracture in control group was markedly shorter than that in study group ($p < 0.05$). As at the last follow-up, there were no fracture non-union cases in the study group, but 2 cases of nail removal and 1 case of femoral head necrosis were seen. One patient had non-union, 3 patients had nail removal, and 4 patients

had femoral head necrosis, in study group, and the difference between groups was significant ($p < 0.05$).

DISCUSSION

Femoral neck fracture tends to occur in the elderly, and with the development of transportation industry, the number of cases is gradually increasing in younger population [10]. In adolescents, fractures of the femoral neck are often unstable in which the hip joint is mechanically subjected to greater axial stress on an external stand [11]. In addition, complications of femoral neck fracture are more likely to occur in young adults than in older adults. Studies have revealed that the incidence of femoral head necrosis in the younger population will not be affected by surgery done more than 48 h after injury [12].

However, it has also been reported that early operation within 24 h after femoral neck fracture in young adults reduces the incidence of femoral head necrosis [13]. Based on actual situations, a clinical model of rapid diagnosis and treatment channel with emergency surgery as the main objective, under multidisciplinary cooperation has been established. This entails emergency reception, completion of various examinations, "zero passage time" for completion of necessary medical consultation for patients without obvious contraindications, arrangement of surgical treatment as soon as possible, early Chinese medicine intervention, and other links to achieve seamless connection.

For the fracture of femoral neck, although the option of internal fixation has always been a focus of debate, the most popular choice in young adults involves three parallel hollow nails. Its advantage is that the compression screw technology relieves the compression between bone blocks at the broken end of fracture and forms a three-dimensional framework with bone tissue, improves the rotational stress and shear force against the fracture end, enhances healing, and decreases the incidence of femoral head necrosis [14].

Huoxue Busui Decoction enhances blood flow and nourishes the blood, thereby removing blood stasis and regulating collagens, enhancing essence and generating *pulp*. *Salvia miltiorrhiza* and its active components promote the proliferation, differentiation and mineralization of osteoblasts, improve the organizational structure of bone trabeculae, and promote bone formation [15].

Table 1: Perioperative conditions of patients (n = 28)

| Group | Gender | | Age (years) | Fracture classification (number) | | | Cause of injury (number) | | Cause of injury (example) | | | Concomitant medical disease % | The time between injury and operation (h) Time of operation | Reduction outcome | |
|---------|--------------------|--------|------------------------|----------------------------------|-----|----|--------------------------|-------|---------------------------|---|---|-------------------------------|--|--------------------|------|
| | Male | Female | | II | III | IV | left | right | A | B | C | | | Excellent | Good |
| Control | 16 | 12 | 46.2±23.9 | 16 | 7 | 5 | 18 | 10 | 18 | 6 | 4 | 5 | 17.9±13.6 | 26 | 2 |
| Study | 15 | 13 | 45.3±24.5 | 18 | 6 | 4 | 17 | 11 | 15 | 5 | 8 | 3 | 18.2±12.6 | 25 | 3 |
| P-value | 0.863 [#] | | 0.746 ^{&} | 0.531 ^{&} | | | 0.642 [#] | | 0.982 ^{&} | | | 0.682 [#] | 0.934 [*] | 0.834 [#] | |

Note: A: fall injury, B: traffic injury, and C: injury due to a fall from a height. [#]Chi-square test, [&]Mann-Whitney U test, ^{*}t-test

Table 2: Comparison of VAS scores between the two groups (n = 28)

| Group | Pre-operation | 5 th day after surgery | 7 th day after surgery | 1 month after surgery | 12 months after surgery |
|---------|---------------|-----------------------------------|-----------------------------------|-----------------------|-------------------------|
| Control | 7.25±1.88 | 4.22±1.02 | 3.68±0.94 | 2.08±1.14 | 1.01±0.66 |
| Study | 7.34±1.36 | 5.46±1.08 | 4.76±1.24 | 3.42±1.28 | 1.98±0.84 |
| P-value | 0.424 | 0.017 | 0.012 | 0.000 | 0.000 |

Table 3: Hip Harris efficacy scores of both groups (n = 28)

| Group | 1 month after surgery | 6 months after surgery | 12 months after surgery |
|---------------|-----------------------|------------------------|-------------------------|
| Control group | 56.02±8.26 | 86.28±15.47 | 93.68±13.62 |
| Study group | 47.27±6.08 | 76.42±16.24 | 89.38±12.46 |
| P-value | 0.038 | 0.042 | 0.047 |

Table 4: Hip flexus-extension motion between the two groups (n = 28)

| Group | 1 month after surgery | 6 months after surgery | 12 months after surgery |
|---------|-----------------------|------------------------|-------------------------|
| Control | 102.88±3.72 | 120.42±10.66 | 138.74±8.48 |
| Study | 90.34±5.26 | 109.36±9.86 | 130.92±9.38 |
| P-value | 0.024 | 0.022 | 0.037 |

Table 5: Fracture healing time and complications in both groups (n=28)

| Group | Fracture healing time (months) | Complication rate (% , number of cases) | | |
|---------|--------------------------------|---|--------------------|---------------------------------------|
| | | Bone non-union | Nail removal | Ischemic necrosis of the femoral head |
| Control | 4.26±1.24 | (0/28) | (2/28) | (1/28) |
| Study | 5.04±1.38 | (1/28) | (4/28) | (3/28) |
| P-value | 0.002 ^{&} | 0.253 [#] | 0.364 [#] | 0.537 [#] |

[&]Mann-Whitney U test; [#]Chi-square test

Antler increases the levels of growth indices in callus tissue and improves the quality of healing of fractures. Short-horned epimedium and Xianling spleen alleviate bone loss and promote bone formation [16,17]. Bone crushing supplement exerts anti-vascular endothelial injury effects. It acts by promoting blood circulation and decompression, improving the hemorheology of damaged parts and promoting bone metabolism [18].

Data from this study showed that patients in control group had better VAS ratings than those in study group at the various post-surgery times. Moreover, at these time points, the hip Harris score and hip flexion-extension range were better in control group. Fracture healing time was shorter, and non-union, aseptic femoral head necrosis, nail withdrawal and other complications were also much less in control group. These data suggest that *Huoxue Bumedi* decoction promoted blood circulation and removed blood stasis, which made the meridians smooth, improved tissue blood supply and capillary microcirculation, improved microcirculation of the fracture end, and increased the activity of osteoblasts and bone density. *Huoxue Busui* decoction increased bone mass, accelerated fracture healing, relieved post-surgery pain, promoted hip functional recovery, reduced postoperative complications, and improved the quality of life of patients.

Study limitations

Due to limited time, small study population, short duration of follow-up in this study, and lack of in-depth analysis of the effective components and molecular mechanisms involved in the use of *Huoxue Busui* decoction for promoting fracture healing, the determination of clinical efficacy may have certain limitations. It is necessary to include a larger sample size in future studies, and further determine the clinical efficacy, and mechanism of postoperative fracture healing by *Huoxue Busui* Decoction when combined with hollow screw internal fixation.

CONCLUSION

Huoxue Busui decoction combined with hollow screw internal fixation produces definite effect during the treatment of adolescent and middle-aged patients with fractures of femor neck. It promotes healing after surgery and effectively improves joint function of patients. However, longer follow-up time, and in-depth study of its molecular mechanism are necessary.

DECLARATIONS

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Ethical approval

None provided.

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

We 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 the authors. Fengtao Zhou and Dianyuan Wang contributed equally to this work. Fengtao Zhou, Dianyuan Wang and Bo Ning conceived and designed the study, and drafted the manuscript. Fengtao Zhou, Dianyuan Wang, Lifang Han, Liang Li and Bo Ning collected, analyzed and interpreted the study data. Dianyuan Wang and Bo Ning revised the

manuscript for important intellectual content. All authors read and approved the final draft of manuscript for publication.

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