

Review Article

A Brief Review of the History of Traditional Chinese Medicine Manual Reduction in the Treatment of Fractures

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Abstract: Chinese orthopedic surgeons have accumulated rich experience in clinical practice for thousands of years and formed a unique theoretical system and treatment methods, which have been passed down from generation to generation. With the introduction of western plastic surgery technology into China in the mid-19th century, orthopedics of traditional Chinese medicine had a great development. At this stage, traditional Chinese orthopedic surgeons accepted modern western surgical techniques and summed up eight new techniques for bone-setting (traditional Chinese medicine manual Reduction). The history of the development of CO (Chinese osteosynthesis) is briefly reviewed in this article. Instead of pursuing open reduction and internal fixation, CO insists on closed reduction to treat long bone fractures of the extremities. CO pursues functional alignment of fractures, relative fixation, and recovery of the function of the affected limb as the primary purpose. This treatment concept has been widely recognized by orthopedic surgeons in China. This article introduces eight kinds of reduction manipulations for treating long bone fractures under the guidance of the concept of CO, including Touching with Hands; Traction; Rotation, Flexion, and Extension; Lift-pressing and Squeezing; Swing and Percussing; Separating the bones; Folding and Rotation; Massage. It is important that manual Reduction should not be used for open fractures. Attention should be paid to avoid injury of blood vessels and nerves during reduction.

Keywords: Chinese Osteosynthesis, Bone-Setting, Fractures

1. Introduction

Non-surgical treatment of fractures has been used for thousands of years in China. Traditional Chinese medicine (TCM) orthopaedics is an important part of TCM, which summarized thousands of years of clinical experience and formed a treatment method mainly based on non-surgical treatment. For most patients with bone and joint injuries in clinical practice, they can recover and achieve the limb function before injury through good closed manual reduction. To avoid adding new trauma to the injured site is the goal pursued by TCM Manual Reduction. Under the impact of Western orthopedics, CO learned human anatomy and physiology and formed its unique treatment methods. The development of Chinese orthopedics and eight kinds of manual reduction is

briefly introduced in this article. The purpose of this article is to review the development of TCM Manual Reduction, absorb innovative ideas and integrate modern science and technology to improve fracture reduction methods and then reduce the pain of patients and their economic burden.

2. History of the Development of Traditional Chinese Medicine (TCM) Bone-Setting Manipulation Before 1840

Despite the use of anesthetics in surgery in the third century, the development of surgery in China was limited by cultural constraints. Reverence for the dead, aversion to bleeding, and other conservative attitudes prevent any [1]. Under this

influence, fractures are usually treated nonoperatively.

In about 122 BC, it was recorded in *Shiji · Bianque Canggong Liezhua* accurate understanding of human anatomy and physiology that the methods of cutting with stone needles and guiding Massage were used to treat diseases [2]. In the 4th century, Ge Hong recorded the dislocation of the mandibular joint in his book *Chouhou Peichi Fang* and used traction and Massage to treat the dislocation [3]. This book recorded the bamboo plate fixation of the fracture, thus opening up the history of small splint external fixation for fracture treatment. In about 841, Taorui Lin recorded four kinds of bone manipulation in the *Xianshou Li Shang Xuduan Secret Prescription*: "relative damage," "pulling out," "pulling into the bone by force," and "Na zheng." [4] He proposed that after fracture reduction, it is necessary to perform Massage and Daotong (exercise) to circulate blood and qi, which is conducive to recovery. In about 1300, Shengji Zonglu recorded that for fractures, the light ones needed to reduce swelling and relax tendons, while the heavy ones needed to connect broken bones and continue to hurt tendons, emphasizing the importance of fracture reduction [5]. In the 15th century, Zhu Di emphasized the importance of the anatomical Reduction of fractures in the book *Puji Fang* [6]. Knowing the anatomical structure of local bones and joints is necessary before bone-setting. The book also introduces fifteen methods of Reduction and fixation of fracture and dislocation. In 1742, Wu Qian summarized the orthopedics experience before the Qing Dynasty in his book *The Essence of Bone-setting* [7]. The bone-setting techniques were summarized as touching, joining, bending, lifting, pressing, rubbing, pushing, and taking, which is the representative work of bone-setting techniques of traditional Chinese medicine.

3. The Development History of Traditional Chinese Medicine (TCM) Bone-Setting Manipulation After 1840

With the introduction of western plastic surgery technology into China in the mid-19th century, orthopedics of traditional Chinese medicine had a great impact. The invention of X-ray has created favorable conditions for the diagnosis and treatment of fractures. Influenced by this, some Chinese orthopedic surgeons began to seek anatomical Reduction, emphasize rigid fixation, and often adopt open Reduction, internal fixation, and extensive plaster external fixation for fractures. [8] In the 1960s, the Association for the study of internal fixation (AO) proposed four principles for the treatment of fractures [9]:

- 1) Anatomical Reduction of the broken end of the fracture
- 2) Strong fixation to meet the local biomechanics
- 3) Protection of the blood supply of the fracture end and soft tissue
- 4) Functional exercise

The key idea is to achieve primary fracture healing by compression and rigid fixation between fracture fragments without callus formation. In clinical practice, AO scholars have found that some fractures are still difficult to achieve

early functional exercise of the injured limb [10]. Even in clinical practice, there are reports of diaphyseal fractures fixed with compression plates and refractures after the removal of the plate after healing [11, 12]. AO scholars have found that due to the destruction of the blood supply of the periosteum and cortex of bone in open Reduction, the compression plate and screw produce a stress shielding effect, which leads to the occurrence of complications such as delayed union, nonunion, and refracture after removal of fixation.

Based on the principles of AO fracture treatment, the concept of Biological osteosynthesis (BO) emerged. There are five principles of the BO concept [13, 14]:

- 1) Reduction should be performed away from the fracture site to protect the attachment of local soft tissue;
- 2) The anatomical Reduction of comminuted fracture fragments should not be forced at the expense of the blood supply of the fracture;
- 3) The use of low elastic modulus and good biocompatibility of internal fixation devices;
- 4) Reduce the contact surface between the internal fixator and bone (intramedullary and extracortical);
- 5) Reduce the surgical exposure time as much as possible.

The core idea is not to pursue absolute stability after fracture fixation but biomechanical stability.

Based on the BO concept, CO (Chinese osteosynthesis) emerged. CO, also known as osteosynthesis of Integrated Traditional Chinese and Western medicine, is represented by Professor Fang Xianzhi and Professor Shang Tianyu. CO scholars pursue non-surgical treatment of fracture reduction and fixation without affecting joint activities and daily life. When necessary, limited surgery is used to achieve closed fracture reduction without open Reduction. Open Reduction is necessary, and small incision effective fixation must be adhered to. The concept of CO consists [15]:

- 1) The combination of static and dynamic (the local fixation of the fracture end is as important as the functional movement of the joint);
- 2) Equal importance of muscle and bone (fracture reduction and local soft tissue protection are equally important);
- 3) Internal and external treatment (not only treat the local fracture but also regulate the function of the five zang-fu organs, enhance the ability of physical recovery);
- 4) Doctor-Patient cooperation (doctors follow up patients and guide functional exercise).

Under the guidance of the CO concept, CO scholars summarized and improved the traditional Chinese bone-setting techniques and formed eight new methods of bone-setting, including Touching with Hands; Traction; Rotation, Flexion, and Extension; Lift-pressing and Squeezing; Swing and Percussing; Separating the bones; Folding and Rotation; Massage.

4. A Brief Introduction to the Eight Modern Bone-Setting Methods

- 1) Touching with Hands: it was developed from the first

method of the eight methods of bone-setting in the Zhenggu Xin-fa Yaozhi, which is similar to modern palpation. The specific step is for the doctor to touch the fracture site with his hand, from light to heavy, from shallow to deep, from far to near, and understand the direction of fracture displacement. Even with the auxiliary diagnosis of X-ray and CT nowadays, "Touching with Hands" is still the basic skill of every orthopedic surgeon.

- 2) Traction: the specific steps are that the doctor and the assistant are located at the far and near ends of the fracture, traction along the longitudinal axis of the limb, overcome muscle resistance, correct shortening displacement, and restore the length of the limb.
- 3) Rotation, Flexion, and Extension: This maneuver is mainly used to correct the rotation and angulation deformity of the fracture end, especially for the fracture near the joint. This technique makes up for the deficiency of simple traction. Rotation manipulation (Figure 1): it is suitable for rotation deformity. The doctor holds the distal end and rotates to the left or right around the longitudinal axis of the limb under the traction to restore the normal physiological axis. Flexion and Extension method (Figure 2): It is suitable for the angular deformity of the limb. The doctor fixes the proximal segment of the joint with one hand and swings the limb along the crown axis of the joint by holding the distal segment with the other hand.
- 4) Lift-pressing and Squeezing: This maneuver is mainly used to correct the lateral displacement of the fracture. Lateral displacement can be divided into anterior-posterior (superior-inferior or palmar dorsal) and mediolateral (left and right) displacement. Lift-pressing method (Figure 3): It is suitable for the anterior and posterior displacement of the fracture. The doctor presses the thumb of both hands on the convex end of the fracture downward and the other end of the depressed fracture upward with the rest of the fingers so that the two ends of the fracture are aligned. Squeezing method (Figure 4): It is suitable for the medial and lateral displacement of the fracture. The physician fixes the proximal end of the fracture in one hand and the distal end of the fracture in the other hand, pressing the outward projecting fracture end inward with reverse force using the fourth finger and thumb.
- 5) Swing and Percussing: This maneuver is mainly suitable for transverse and serrated fractures. After the above manipulations, the fracture can be reduced. However, gaps between the broken ends of transverse and serrated fractures may still exist to make the fracture ends in close contact and increase stability. Swing method (Figure 5): The doctor can fix the fracture with both hands. The assistant can gently sway the distal part of the fracture in the left and right or front and rear direction under steady traction until the bone fricatives between the broken ends gradually become smaller or disappear. Percussing method (Figure 6) is generally used when the transverse

fracture occurs in the metaphyseal. After fracture reduction and splint fixation of the affected limb, the doctor can fix the splint of the fracture with one hand and gently tap the distal end of the fracture with the other hand to make the fracture end closely embedded and increase the stability.

- 6) Separating the bones (Figure 7): This maneuver is suitable for correcting the lateral displacement of the juxtaposition fracture of the two bones. The interosseous membrane or interosseous muscle is attached between the tibiofibular, ulna, and radius, metacarpal diaphysis, or metatarsal diaphysis. After the fracture, the fracture segments are drawn to each other by the interosseous membrane or interosseous muscle, resulting in lateral displacement. The surgeon squeezes the gap between the two bones from the palmar and dorsal sides of the fracture with the thumb and the rest of the fingers, respectively. Keep the distal and proximal fracture segments relatively stable. Repair a double fracture as a single fracture.
- 7) Folding and Rotation: This maneuver is suitable for limb fracture with obvious shortening or angulation deformity. In muscular patients with transverse or serrated fractures, traction alone often cannot completely correct the overlapping displacement. Folding method (Figure 8): Under the resistance traction, by increasing the Angle between the broken ends, the cortical bone of the broken end is aligned with each other and then rapidly reversed so that the fracture is reduced. The rotation method is suitable for correcting oblique and spiral fractures with dorsal displacement or fractures with soft tissue embedding. When using the rotatory maneuver, the key is to judge the way of dorsal displacement according to the mechanical principle of the injury and to perform the operation in the opposite direction of the fracture displacement. In the case of transverse fracture with embedded soft tissue, it is necessary to strengthen the traction and turn the fracture in the opposite direction so that the broken ends are opposite. The complete release of the embedded soft tissue can be judged from the fricative sound of the broken end. During the operation, the doctor must be very cautious and rely on both hands to hold the two fracture segments so that the cortical bone of the two fracture segments is close to each other, not to increase the soft tissue damage. If resistance to rotation is felt, the direction should be changed to reduce the fracture. In addition, when performing this maneuver, the surgeon often warns the assistant that the traction should be properly relaxed after the soft tissue embedded in the fracture end is released.
- 8) Massage: This manipulation regulates the soft tissue around the fracture and can make the tortuous muscles and tendons with the fracture reduction and stretch, which is particularly important for the fracture near the joint. The manipulation should be gentle, and the tendon should be stroked along the bone from top to bottom according to the direction of the muscle to relieve it.

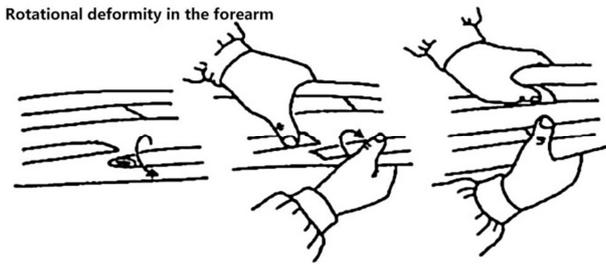


Figure 1. Using Rotation method to correct distal rotational deformity of fractures under continuous traction.

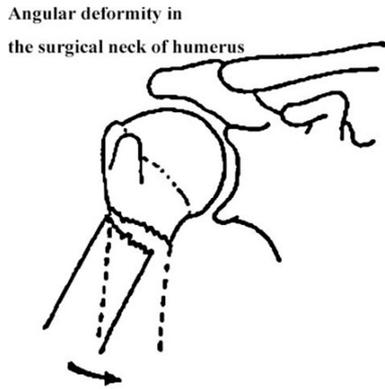


Figure 2. Abduction humeral surgical neck fracture: First abduction traction, and then gradually adduction to correct coronal displacement. Slow forward flexion corrects the forward angular displacement of the sagittal plane.

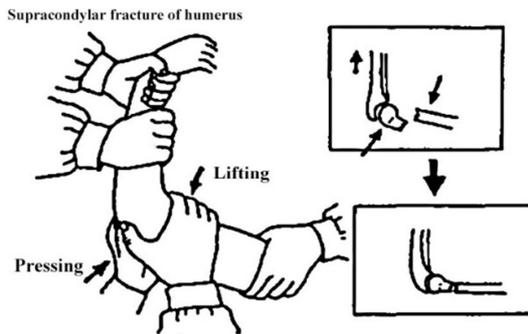


Figure 3. Using Lift-pressing method to correct supracondylar fractures of the humerus.

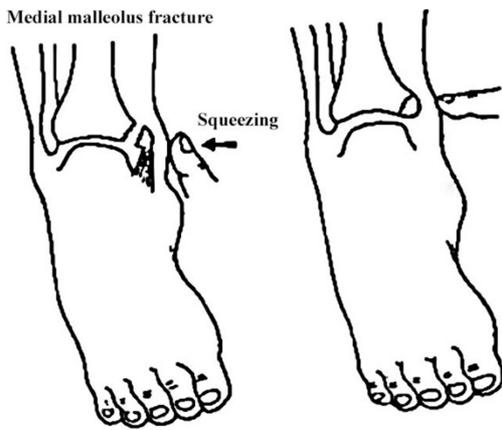


Figure 4. Using Squeezing method to correct supracondylar medial malleolus fracture. Using the thumb to push the distal end of the fracture, and the other four fingers to hold the proximal end of the fracture with reverse force, pressing the protruding fracture block flat.

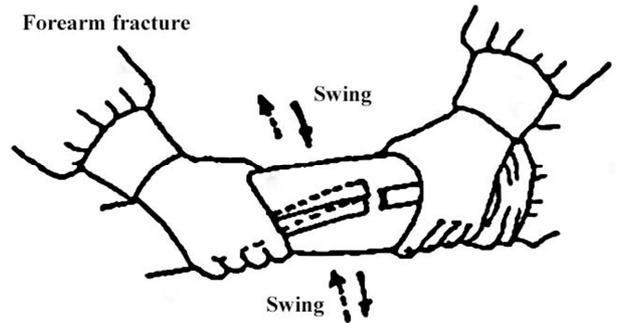


Figure 5. Under continuous traction, hold the distal end of the fracture and gently swing it up, down, left, and right. If the broken end of the fracture no longer slides and the bone friction disappears, it can be stopped.

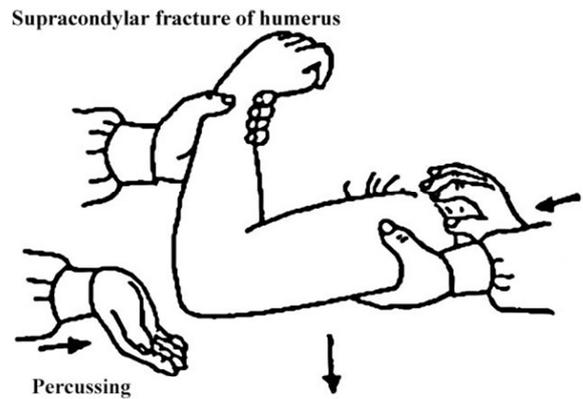


Figure 6. After other manipulations to reduce the fracture, gently tap the distal end of the fracture with the palm root along the longitudinal axis of the shaft.

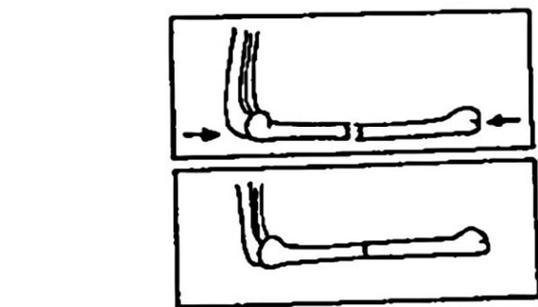


Figure 7. Using Separating the bones method to correct Fracture of the forearm.

Fracture of forearm

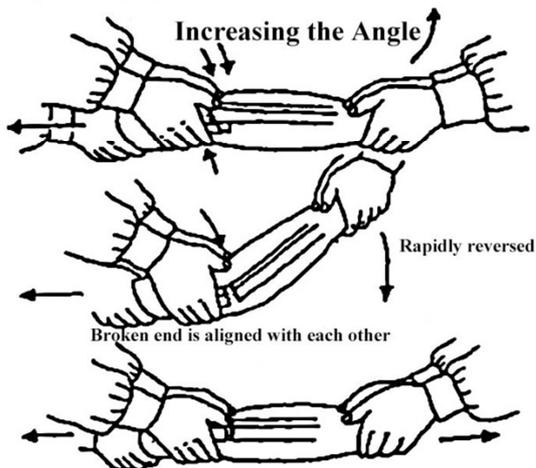


Figure 8. Using Folding method to correct Fracture of the forearm with overlap of the fracture ends.

5. Conclusion

As technology has advanced, the severity and frequency of trauma has increased. At the same time, people have higher requirements for the quality of life, which put forward higher requirements for orthopedic surgeons. Traditional Chinese medicine should be combined with modern technology. Non-surgical treatment of fracture should reduce intervention and damage to the self-repair ability of bone tissue. Fix the fracture and allow the patient to regain limb function immediately. It should be noted that the follow-up and the check is very important! After the swelling of the fractured limb, it is necessary to check in time and adjust the plaster external fixation to avoid plaster loosening, reduction loss, deformity and other conditions. This requires doctors to urge patients to check in time and guide functional exercise.

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