Clinical Observation of Self-made Four-step Tendon Regulating Manipulation in the Treatment of 30 Cases of Thumb Stenotic Tenosynovitis

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Abstract [**Objectives**] To observe the effectiveness of four-step tendon manipulation in the treatment of thumb stenotic tenosynovitis, under the guidance of "tendon first" theory. [**Methods**] 30 patients with stenotic tenosynovitis of thumb were treated with four-step tendon manipulation and traditional manipulation respectively, 3 times a week, a total of two weeks. The clinical efficacy, changes of visual analogue scale (VAS) and the recurrence rate after 15 d of follow-up treatment were observed before and after treatment. The differences were statistically significant ($P<0.05$). [**Results**] After treatment, the VAS and the recurrence rate after 15 d of treatment in the observation group were significantly lower than those in the control group ($P<0.05$). After treatment, the total effective rate was 73.33% in the control group and 93.33% in the observation group ($P<0.05$). [**Conclusions**] The effect of four-step tendon regulating manipulation in the treatment of thumb stenotic tenosynovitis is ideal. The effect is significantly better than that of traditional Chinese medicine in improving thumb pain and function, which is worthy of clinical promotion.

Key words Taking reinforcement first, Four-step tendon regulating manipulation, Stenotic tenosynovitis of thumb

1 Introduction

Stenotic tenosynovitis of thumb, also known as "triggered synovitis and trigger finger", is a common disease that causes hand pain, mobility disorder and even disability due to A1 pulley disease, and the thumb is most vulnerable to it[1-3]. For the early and middle stages of thumb stenotic tenosynovitis, the current treatment is mainly local blocking, small needle knife, and acupuncture and moxibustion, but there are certain risks. Manual treatment of tenosynovitis is safe, effective and easy to be accepted by patients. It is mainly aimed at regulating the tendon injury and bone damage of the focus to restore normal physiological function. The four-step tendon regulating manipulation originates from the academic thought of Shen Fengjun, a famous old Chinese medicine doctor, "tendons first, tendons for bone, tendon diseases harming bone, tendon bone comorbidity, and balance of tendons and bones". Professor Zhang Kaiwei, director of the Department of Orthopaedics and Traumatology of the First Affiliated Hospital of Guizhou University of Traditional Chinese Medicine, summarized many years of clinical experience and innovated, and treated from the perspective of tendons and bones, aiming at regulating tendons and bones. It mainly adjusted the microenvironment inside joints, corrected biomechanical abnormalities, improved the pathological state of "tendon out of groove and bone misalignment", achieved "bone alignment and tendon softness, and bone tendon balance", and restored the physiological function of muscles and bones. Now, four-step tendon regulating manipulation is used to treat the patients with stenotic tenosynovitis of thumb.

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2 Data and methods

2.1 General data A total of 60 patients from the section for outpatients in Department of Orthopedics and Traumatology of the First Affiliated Hospital of Guizhou University of Traditional Chinese Medicine from October 2020 to July 2021 were selected and randomly divided into the control group and the observation group, with 30 patients in each group. Among them, there were 5 males and 25 females in the control group. They aged 21 - 76 years old, with an average age of (42.53 ± 12.04) years old. The course of disease was between 1.5 and 13 months, with an average course of disease of (3.67 ± 3.19) months. There were 7 males and 23 females in the observation group. They aged 20 - 78 years old, with an average age of (42.10 ± 11.52) years old. The course of disease was between 1.0 and 15 months, with an average course of disease of (3.60 ± 3.18) months. There was no statistically significant difference between the two groups in general data such as gender, age, course of disease, affected finger, and disease grading ($P>0.05$), and details referred to Table 1.

2.2 Diagnostic criteria All patients meet the diagnostic criteria in the *Diagnostic Efficacy Standards for Traditional Chinese Medicine Syndrome*[4] and Quinnell[5] gradation. Diagnostic criteria: (i) with a history of recurrent hand strain, common among women and manual workers; (ii) finger pain, limited mobility, obvious symptoms after waking up in the morning or fatigue; (iii) there is a bouncing sound in the metacarpophalangeal joint, which can touch the nodules. Quinnell gradation: level 0 indicates mild local tenderness pain, with normal finger flexion and extension ac-

Table 1 Two sets of basic information

Group	Number of cases	Sex		Age//years old	Course of disease	Affected finger		Quinnell gradation		
		Male	Female		months	Left	Right	I	II	III
Control	30	5	25	42.53 ± 12.04	3.67 ± 3.19	11	19	6	20	4
Observation	30	7	23	42.10 ± 11.52	3.60 ± 3.18	9	21	6	19	5

tivity; level I refers to no sound, mild tenderness pain, and mild limitation of flexion and extension activities; level II is marked by a bouncing sound, active correction of the hinge lock, and limited flexion and extension activities; level III indicates a bouncing sound, and the hinge cannot be actively corrected and can be corrected passively, and the flexion and extension activities are limited; level IV refers to complete finger interlocking and cannot perform flexion and extension activities.

2.3 Inclusion and exclusion criteria Inclusion criteria: (i) patient meets diagnostic criteria, and Quinnell grading is I – III; (ii) there is no fractures or dislocations of fingers, and no skin ulcers or wounds; (iii) patient is 20 – 85 years old; (iv) patient did not receive local closure treatment within 3 months. Exclusion criteria: (i) patient does not meet diagnostic criteria, and Quinnell grading is I – III; (ii) local skin has damage, infection, sinus tract, *etc.*; (iii) patient is currently in pregnancy; (iv) patient merges diseases such as tumors and tuberculosis; (v) patients with severe osteoporosis and rheumatoid diseases.

2.4 Therapeutic methods

2.4.1 Control group. Traditional techniques[6] are used for treatment. (i) The surgeon should face the patient, align the tip of the thumb with the thickening of tendon sheath, and press for about 3 min. At the moment of applying force, the direction of force should be perpendicular to the affected area. (ii) The distal end of the thumb tightly clamps the distal end of the circular ligament, and it instructs the patient to actively extend the metacarpophalangeal and interphalangeal joints with force. At the maximum angle of active extension, the surgeon passively overextends the metacarpophalangeal and interphalangeal joints of the affected finger with their fingers. The surgeon then tightly clamps the proximal end of the circular ligament with the distal end of the thumb, and instructs the patient to actively bend the metacarpophalangeal and interphalangeal joints with force. At the maximum angle of active flexion, the surgeon passively flexes the metacarpophalangeal, and interphalangeal joints of affected finger with their fingers, with the tip of the thumb facing the swollen proximal segment of the thumb. At the moment of final application of force, the direction of force should be perpendicular to the affected area. (iii) The surgeon uses the thumb to perform 3 – 5 thrusts from the distal end to the proximal end of the affected area.

2.4.2 Observation group. Using the self-made four-step tendon regulating manipulation, with the patient in a sitting position and the surgeon facing the patient, the specific steps are as follows. (i) Loose tendon: with the palm upward, fix the affected limb with the left hand, apply the point, press, knead, and push methods to the affected part and its surroundings, and relax the flexor hallucis tendon, thenar eminence, and the adhesion of the loose tendon nodes, about 3 min. (ii) Stretch tendon: fix the affected limb, perform vertical passive traction, reverse stretching, and rotational stretching of the metacarpophalangeal and interphalangeal joints to achieve full flexion, abduction, and adduction of the metacarpophalangeal and interphalangeal joints to the maximum angle, maintaining for 5 – 10 s each time, and repeating 5 times for about 3 min. (iii) Adjust tendon: fix the affected limb, press the thumb on the lesion, perform resistance to abduction and adduction, and flexion of the affected metacarpophalangeal and interphalangeal joints, maintaining for 5 – 10 s each time, and repeating 5 times for about 3 min. (iv) Bone setting: fix the affected limb with one hand, hold the affected thumb with the other hand, and passively move the affected finger. During the movement, use force perpendicular to the thumb to instantly pull the affected finger, repeat the operation 5 times, then pinch the affected finger with both hands, pull, shake, and sway the affected finger 20 – 30 times, for about 2 – 3 min.

2.5 Observation indicators (i) Using visual analogue scare[7] (VAS), and a straight line of 0 – 10 cm. The higher the value, the more intense the pain will be. (ii) Total effective rate: (Number of cured cases + Number of improvement cases)/Total number of cases × 100%. (iii) Follow up recurrence rate 15 d after treatment.

2.6 Efficacy evaluation It refers to the efficacy standards in the *Efficacy Standards for Syndrome Diagnosis by Traditional Chinese Medicine*[4]. Apparent effect: no obvious tenderness, bouncing sound, or strangulation in the local area; effective: the pain is significantly relieved, with occasional popping and no strangulation; invalid: pain, no relief from strangulation.

2.7 Statistical methods SPSS 23.0 was used for relevant data analysis. Counting data was represented by rate and percentage (%), and measurement was represented by mean plus or minus standard deviation ($\bar{x} \pm s$). Chi square value was represented by χ^2, and $P < 0.05$ indicated statistical significance.

3 Results and analysis

3.1 Comparison of VAS scores between two groups before and after treatment There was no statistically significant difference in VAS scores between the two groups before treatment ($P > 0.05$). After treatment, the VAS score of thumb pain decreased compared to before treatment, but the VAS score reduction in the observation group was significantly better than that in the control group, and the results were statistically significant ($P < 0.05$). Details were shown in Table 2.

3.2 Comparison of recurrence rates between two groups after 15 d of treatment finish The recurrence rates of two groups after 15 d of treatment finish were followed up, and the results were statistically significant ($P = 0.034$), $\chi^2 = 4.474$ (Table 3).

Table 2 VAS scores before and after treatment in both groups ($\bar{x} \pm s$, $n = 30$)

Group	Before treatment	After 2 treatments	After 6 treatments
Control	6.62 ± 0.21	3.96 ± 0.36 *	2.25 ± 0.54 *
Observation	6.92 ± 0.24	3.42 ± 0.19 *#	1.13 ± 0.15 *#

Note: Compared with the same group before treatment, * showed $P < 0.05$; compared with the control group after treatment, # showed $P < 0.05$.

Table 3 Comparison of recurrence rates between two groups after 15 d of treatment finish

Group	Number of cases	Number of follow-up visits	Recurrence count	Recurrence rate//%
Control	30	22	10	45.45
Observation	30	28	3	10.71 *

Note: Compared with the control group, * showed $P < 0.05$.

3.3 Comparison of treatment effects between two groups In the control group, 16 cases were cured, and 6 cases were improved, and 8 cases were ineffective, with a total effective rate of 73.33%. In the observation group, 25 cases were cured, and 3 cases were improved, and 2 cases were ineffective, with a total effective rate of 93.33%. The difference in total effective rate between the two groups was statistically significant ($P = 0.037$), $\chi^2 = 6.576$ (Table 4).

Table 4 Total effective rate after treatment in both groups

Group	Number of cases	Cure	Improvement	Unhealed	Total effective rate//%
Control	30	16	6	8	22 (73.33)
Observation	30	25	3	2	28 (93.33) *

Note: Compared with the control group, * showed $P < 0.05$.

4 Discussion

Stenotic tenosynovitis of the thumb is a disease characterized by aseptic inflammation, hyperplasia and nodular shape at the intersection of the tendon and its pulley. As the disease continues to develop, it will eventually form a hand lock[8]. A1 pulley is the most common lesion of tenosynovitis[1-2]. The pathogeny is caused by chronic strain. In the early stage of tenosynovitis, local congestion and edema are the main reactions[9]. In the middle and late stage, connective tissue hyperplasia, hypertrophy, adhesion and nodule formation are the main manifestations[10]. With the increase of electronic products in modern society and other factors, the incidence rate of tenosynovitis continues to rise, seriously disturbing the daily life of patients.

Stenotic tenosynovitis of the thumb belongs to the category of "tendon injury" and "tendon arthralgia" in traditional Chinese medicine. The essence of its onset is closely related to the muscles and bones. Although the initial stage is dominated by local inflammatory changes, the fundamental reason is that "tendons do not bind and bones do not stretch" caused by "bone malposition and tendon weakness". The tendons and bones are not soft, and bone damage injures tendons. Inflammation is just an appearance of "tendons and bones are out of balance, tendons and bones are damaged"[11]. The book *Miraculous Pivot · Meridians* states that "bones are the backbone and tendons are rigid". The book *Plain Questions · Generation of the Five Organs* also states that "all tendons and bones belong to the joints" and "tendons are bound to bones and benefits joints", indicating that tendons and bones are interrelated and inseparable. Under physiological conditions, tendons and bones are in dynamic equilibrium[11].

Conservative management, such as acupuncture and moxibustion, blocking and small needle knife, is recommended for the treatment of stenotic tenosynovitis of the thumb in stage I to II, but all of them have different degrees of trauma. Especially for small needle knives, improper operation can damage local tissues and blood vessels, requiring proficiency in anatomy and strict training[11]. Manipulation treatment of thumb tenosynovitis is safe, effective and has sufficient theoretical basis. Manipulation can directly act on the focal tendons and bones, and restore the normal physiological function of the tendons and bones, making the function of "tendons binding bones, and bones expanding tendons" normal, maintaining its dynamic equilibrium, and playing a normal role[12]. Under the theory of "bone dislocation and tendon out of groove", Tan Yifei[13] used massage manipulation to treat thumb stenotic tenosynovitis, and analyzed the disease from the perspective of local biomechanics, providing a theoretical basis for manipulation treatment. The four-step tendon regulating manipulation is based on the academic idea of Shen Fengjun, a renowned traditional Chinese medicine practitioner, that "tendons are the first and used for the bones, and tendon diseases harm bone, and there is co-disease and balance of tendon and bone". Traditional Chinese medicine techniques are combined with exercise rehabilitation to release tissue adhesion, reduce inflammation, and stimulate soft tissue activity[6, 14-15]. In the initial stage of tenosynovitis, tendon imbalance is the main feature, and then bone imbalance develops. In treatment, tendon management and bone setting techniques should be combined to achieve bone alignment and tendon flexibility. The traditional manipulation treatment of thumb tenosynovitis is mainly to promote blood circulation, remove blood stasis, dredge the meridians, regulate tendons, and disperse knots, *etc*[6]. It deals with the "tendon" at the lesion, while neglects the importance of "bone". In principle, there is a certain discrepancy with the theory of "tendon bone balance". Although the patient's symptoms have been somewhat alleviated, the root cause of the disease has not been fully cured, resulting in a high recurrence rate.

From ancient times to the present, manipulation therapy should attach importance to the ideas of "integration of tendons and bones" and "equal emphasis on tendons and bones", correct the pathological state of "bone dislocation and tendon out of groove", and reconstruct the physiological state of "bone expanding tendon and tendon binding bone". Professor Shi Qi's "balancing method" (balancing tendons and bones, and restoring balance) provides a theoretical basis for the prevention and treatment of "chronic musculoskeletal diseases"[16]. Lin Zhigang *et al.*[17] also proposed that the importance of "balance of tendons and bones" and the theory of "tendons first" should be paid attention

to in manipulation treatment. Wang Guojun[18] pointed out that the concept of "emphasizing both tendons and bones" has a very long history, and attention should be paid to the concept of "emphasizing both tendons and bones" in the diagnosis and treatment of common bone injury diseases. Throughout history, medical practitioners have emphasized the importance of tendons and bones, advocating for the principle of "treating both tendons and bones equally, emphasizing both tendons and bones, and balancing them". Especially for manipulation treatment, it should pay full attention to the roles of "tendons and bones". The mechanical imbalance of tendons and bones is the key to the pathogenesis of thumb stenotic tenosynovitis. The treatment results showed that the total effective rate, VAS score, and recurrence rate of the observation group were significantly better than those of the control group, indicating that the functional recovery of the observation group was more significant.

In summary, as an innovation in traditional Chinese medicine techniques, the four-step tendon regulating manipulation has significantly better therapeutic effects than traditional techniques, and has greater advantages in improving pain and function. It is worth promoting in clinical practice. However, there are few cases of observed patients this time, and the treatment and observation cycles are relatively short. Further research is needed to determine their long-term efficacy.

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