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Research Progress on Clinical Effects of Different Needle-knife Selection Points for Stenosing Flexor Tenosynovitis

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Abstract: *As a minimally invasive technique, needle-knife therapy has demonstrated remarkable efficacy in the treatment of stenosing flexor tenosynovitis. The accuracy of selection points directly influences the success rate of needle-knife therapy, with palpation serving as a traditional and crucial method for determining treatment points. Hard nodules and tender points, as the primary bases for point selection, assist physicians in identifying the pathological area. With the advancement of medical technology, modern imaging techniques such as ultrasound guidance have been introduced into needle-knife therapy, enhancing the accuracy of point selection and the safety of treatment. This review explores improved approaches to point selection in needle-knife therapy, emphasizing the integration of modern imaging techniques and anatomical basic research to achieve more precise lesion localization. Meanwhile, it proposes identifying areas devoid of nerves and blood vessels during point selection to adhere to the principle of minimal injury and reduce the impact on surrounding normal tissues. By adopting this method, more personalized and precise treatment plans can be provided to patients, thereby improving treatment outcomes and reducing postoperative complications.*

Keywords: *Needle-Knife; Different Selection Points; Stenosing Flexor Tenosynovitis*

1. Introduction

Stenosing flexor tenosynovitis, also known as trigger finger (TF), is associated with excessive finger activity or trauma. The main clinical symptoms include difficulty in flexing and extending the affected finger, with a visible snapping motion resembling the trigger of a gun when attempting to forcibly extend the finger. With the accelerated pace of social life in recent years, TF has gradually become a common clinical condition. Currently, the primary treatment methods for TF in clinical practice include needle-knife therapy [1], external application of traditional Chinese medicine [2], acupuncture and physiotherapy [3], surgery [4], shockwave therapy [5], and other rehabilitation treatments. Recent clinical studies have found that needle-knife therapy for TF is characterized by a low number of treatment sessions and remarkable efficacy. The purpose of this article is to provide better options for treating TF by summarizing commonly used needle-knife selection points in clinical practice. After extensive research by numerous medical practitioners, there is a tendency to prefer needle-knife therapy as the first-line treatment for TF [6]. Although TF is a common condition, there is currently no unified standard for its clinical grading. According to the classification method in "Green's Operative Hand Surgery," TF is divided into four different levels of severity, with the first two levels typically being suitable for conservative treatment [7]. Therefore, when formulating a treatment plan, physicians should accurately assess the patient's condition based on this grading standard and select appropriate needle-knife selection points accordingly to achieve optimal therapeutic outcomes.

2. Understanding of TF in Traditional Chinese and Western Medicine

2.1 Understanding of TF in Traditional Chinese Medicine

In traditional Chinese medicine (TCM), TF is classified under the category of "Jin Bi" (tendon arthralgia). Its pathogenesis is often attributed to strain-induced damage to the tendons, or invasion of cold and dampness into the meridians, leading to obstruction of meridians, impaired circulation of qi and blood, and qi stagnation with blood stasis. TCM offers a variety of treatment methods for TF, including acupuncture, moxibustion, and acupoint injection [8-10]. In recent years, modern approaches such as

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microwave irradiation at acupoints have also been applied in the treatment of this condition, continuously improving its efficacy. When treating TF, TCM emphasizes harmonizing qi and blood and dredging the meridians to achieve the goals of reducing swelling, relieving pain, and restoring finger function. Treatment methods are selected based on the severity of the condition; for mild cases, herbal fumigation and washing may be used, while for severe cases, techniques such as needle-knife therapy at selected acupoint for puncturing and cutting may be employed. TCM also emphasizes prevention and care, such as avoiding overexertion, keeping warm, preventing invasion of cold and dampness, and engaging in appropriate hand exercises to prevent the onset of the disease [11].

2.2 Understanding of TF in Modern Medicine

The pathogenesis of TF may be related to factors such as excessive hand activity, reduced synovial fluid secretion within the tendon sheath, external compression on the tendon sheath, and long-term friction [12]. These factors lead to thickening of the tendon sheath and tendon, narrowing of the intrasheath passage, further exacerbating friction, and causing inflammation. Patients with TF often experience clicking and popping sounds during finger flexion and extension, accompanied by pain, impaired flexion and extension, swelling, and limited function of the affected finger. Additionally, imaging examinations such as ultrasonography can help physicians observe the condition of the tendon sheath and tendon, which is of great significance for diagnosis and treatment. Modern medical treatment methods for TF include non-surgical and surgical treatments. Non-surgical treatments encompass various approaches, such as topical application of Voltaren emulgel and intra-sheath injection of corticosteroids [13,14]. Surgical treatment is usually considered when non-surgical treatments are ineffective [15]. Preventive measures include avoiding prolonged repetitive hand movements, taking appropriate rest and engaging in hand exercises, and using protective gear when necessary to reduce friction and compression on the tendons [16].

3. Selection of Needle-Knife Points

3.1 Areas with Indurations Detected by Palpation as Conventional Selection Points for Needle-Knife Therapy in Clinical Practice

As a minimally invasive technique, needle-knife therapy has gained widespread recognition for its effectiveness in clinical settings. When treating conditions such as tenosynovitis, the selection of needle-knife points directly influences the treatment's efficacy and safety. Choosing areas with indurations as insertion points is based on a profound understanding of pathological changes and a summary of practical experiences. The formation of indurations is typically associated with local inflammation, tissue fibrosis, or pathological thickening at the tendon pulley sites. Thickening at the A1 pulley site may result from long-term tendon friction or cumulative minor injuries, leading to increased local pressure and impairing the normal gliding function of the tendon.

In clinical practice, precise localization of induration areas through meticulous palpation provides accurate navigation for needle-knife therapy. Liu Qiqi's research demonstrated that selecting induration sites as insertion points effectively alleviates restricted movement of the affected finger and improves patients' quality of life. This treatment method yields remarkable results, offering rapid pain relief and functional recovery for patients [17]. Zhang Hongzhen's study further confirmed the effectiveness of using induration sites as insertion points, with a cure rate of 97.32%. This indicates the high application value of needle-knife therapy in treating conditions such as TF. This cure rate statistic not only provides clinicians with a solid basis for treatment but also instills confidence in patients [18]. Although Jiao Yusheng's clinical observation reported a 100% cure rate, which may be subject to limitations in sample size and observation duration, it still showcases the potential efficacy of needle-knife therapy under specific conditions. This result suggests that needle-knife therapy may achieve complete pathological reversal in certain cases [19]. Xu Ying selected bead-like nodules on the body surface as insertion points and found an effectiveness rate of 90.70% [20]. Therefore, selecting areas with indurations detected by palpation as needle-knife points is effective to a certain extent. However, due to limitations in sample size, further clinical observations are required to validate the clinical effects of this point selection method.

3.2 Areas with Tender Points Detected by Palpation as Conventional Selection Points for Needle-Knife Therapy in Clinical Practice

Under the influence of long-term chronic strain, continuous friction between the flexor tendons of the

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affected finger and their fibrous sheath walls may lead to local chronic aseptic inflammation. This inflammatory response causes tissue edema, subsequently increasing intraluminal pressure. During clinical examination, patients often exhibit significant tenderness upon local palpation of the affected area, which is a direct response of the inflammatory region to palpation [21].

Yan Pengpeng proposed a similar viewpoint in his treatment practice, emphasizing the precise selection of high-tension or tender points at the affected site as insertion points for needle-knife therapy. He further pointed out that the etiology of TF is not only related to long-term chronic strain but also that acute injuries play a crucial role in its development. Therefore, considering both etiology and pathological changes, adhering to the principle of "addressing both the root cause and symptoms," is of great significance for improving treatment outcomes [22]. Xie Zhongling selected tender points as insertion points for the needle-knife and found that this approach effectively alleviated patient pain [23]. This method of selecting needle-knife points based on tender points has become a common practice in treating stenosing flexor tenosynovitis.

From the perspective of traditional Chinese medicine, Wang Lie believed that the formation of tender points is related to the obstruction of qi flow in the meridians. When qi in the meridians is stagnated and obstructed, the cumulative effect over time leads to local swelling and tenderness. Needle-knife therapy relieves symptoms by dredging the meridians in these areas [24]. This concept not only enriches the theoretical foundation of needle-knife therapy but also provides a new perspective for clinical treatment.

In summary, whether based on the pathophysiological mechanisms of Western medicine or the meridian theory of traditional Chinese medicine, needle-knife therapy emphasizes the identification and utilization of tender points at the affected site when selecting points. This precise treatment strategy not only helps alleviate patients' immediate symptoms but also offers the potential for promoting long-term recovery and functional improvement of the affected area. As clinical practice continues to evolve, the point selection methods for needle-knife therapy will become more refined to achieve optimal treatment outcomes.

4. Application of Ideas for Improved Needle-Knife Point Selection

As needle-knife therapy becomes increasingly widely used in the treatment of TF, clinicians have gradually come to realize that while traditional needle-knife point selection methods are effective, there is still room for further optimization. The ideas for improved needle-knife point selection mainly focus on the following aspects:1. Combining Modern Imaging Techniques to Enhance Point Selection Accuracy

With the development of medical imaging technologies, such as ultrasound and MRI, doctors can observe pathological changes in the tendon sheath and tendons more clearly. By integrating these imaging findings, doctors can more accurately determine the lesion site and thus select more precise needle-knife treatment points, improving treatment outcomes.

5. Integrating Modern Anatomical Basic Research

During the process of needle-knife point selection, basic anatomical research, such as modern medical anatomy and pathophysiology, can be incorporated. By adopting an integrated traditional Chinese and Western medicine approach, a more comprehensive understanding of the pathological mechanism can be achieved, enabling the selection of more appropriate treatment points.

5.1 Identifying Abnormal Echo Regions under Ultrasound as Improved Point Selection

In the treatment of TF, the improved needle-knife point selection technique combined with ultrasound guidance has become a precise and safe clinical practice. Yu Chuan employed a series of innovative steps to combine traditional palpation with modern ultrasound technology, enhancing the precision and safety of the treatment. First, reactive points on the patient were identified through palpation, followed by precise localization of these points using ultrasound guidance. On ultrasound images, these points typically appeared as hypoechoic regions, similar to the Ashi points in traditional Chinese medicine theory, possibly due to muscle nodule contraction. Yu Chuan further marked these regions on the skin surface with iodophor to ensure that the needle-knife could accurately penetrate between the annular ligament and the compressed tendon, achieving effective release. This method not only improved the accuracy of the treatment but also reduced damage to surrounding tissues, accelerated postoperative

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recovery, and alleviated patient discomfort. Needle-knife therapy guided by ultrasound improved efficacy by eliminating local reactive points, altering biomechanical states, reducing myofascial pressure, and enhancing local blood supply [25].

Tax Yunhua's research further confirmed the effectiveness of ultrasound-guided needle-knife therapy, indicating that this method not only increased the cure rate but also accurately located the affected finger while effectively avoiding damage to blood vessels, nerves, and tendons. It significantly reduced the postoperative recurrence rate and shortened the patient's recovery time [26]. Wang Baojian's study also demonstrated the point selection method combining ultrasound and needle-knife, which further enhanced treatment safety and effectiveness by first locating blood vessels and nerves before performing needle-knife procedures [27]. Chen Hongjian identified the thickest part of the tendon under ultrasound guidance during TF treatment, marked it, and then performed needle-knife release at this site, resulting in good postoperative recovery for patients [28]. Jiang Xiwen conducted fixed-point localization under musculoskeletal ultrasound guidance and found that patients experienced significant pain relief after needle-knife surgery, with a low postoperative recurrence rate [29]. Zhang Wenbing performed fixed-point insertion under ultrasound assistance, achieving an effective cure rate of 100% and favorable long-term prognosis [30].

Although the point selection treatment combining ultrasound and needle-knife represents a clinical trend, its widespread adoption is hindered by equipment limitations in some regions. Therefore, doctors need to reasonably select the most suitable treatment method based on their clinical conditions. With the development of medical technology and increased equipment availability, we anticipate that this innovative treatment approach will provide a safer and more effective therapeutic experience for more patients.

5.2 Identifying Nerve- and Vessel-Free Areas at the TF Site as Improved Point Selection

During the process of selecting and localizing points for needle-knife therapy, it is essential to conduct an in-depth and detailed analysis of the patient's local anatomical structures. This involves a comprehensive assessment of the distribution of muscles, tendons, ligaments, as well as adjacent nerves and blood vessels. Based on this, combined with the patient's specific conditions, including the area of pain, the degree of restricted movement, and previous treatment history, a thorough consideration should be given to determine the optimal needle-knife treatment points.

When selecting improved points, the principle of minimal damage should be followed, avoiding major nerves and blood vessels as much as possible while ensuring that the needle-knife can precisely target the pathological tissue to exert its functions of releasing adhesions and promoting local blood circulation. After studying cadaver specimens, Ouyang Jie pointed out that if the operator's technique is too rough during needle insertion, it may cause damage to the flexor tendon or the proper palmar digital nerve. Therefore, during the release procedure, complete release of the A1 tendon sheath is sufficient to achieve the expected therapeutic effect, avoiding unnecessary damage [31,32]. When performing needle-knife therapy, individual differences and treatment responses among patients must also be considered. Each patient's constitution, pain threshold, and sensitivity to treatment vary, so doctors should make personalized adjustments to point selection and localization based on the patient's specific conditions. Additionally, meticulous observation during treatment and patient feedback are equally important, as they can help doctors adjust the treatment plan in a timely manner to ensure treatment safety and effectiveness. In practice, doctors should adopt gentle and accurate techniques to avoid unnecessary damage to surrounding normal tissues. Meanwhile, thorough preoperative communication and appropriate postoperative guidance are also crucial for improving treatment outcomes and reducing complications. By comprehensively applying their professional knowledge and clinical experience and considering the patient's specific conditions, doctors can provide patients with more precise and personalized needle-knife treatment plans [33].

6. Summary and Prospects

Needle-knife therapy for TF, as an efficient minimally invasive surgical technique, is gradually standing out among conservative treatment methods and demonstrating its unique advantages. Benefiting from the integration of treatment philosophies and methods from both traditional Chinese and Western medicine, along with the strong support of modern imaging technologies, the precision and safety of needle-knife point selection have been significantly enhanced. This improved point selection strategy not only optimizes treatment outcomes but also effectively alleviates patients' pain during the treatment

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process and reduces the risk of postoperative recurrence.

We anticipate that more in-depth research findings will emerge in the future, further exploring and refining the point selection methods for needle-knife therapy in treating TF. This will pave the way for providing patients with safer and more effective treatment plans, thereby driving continuous progress and development in this field.

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