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Efficacy of Ultrasound-Guided Hydrodissection for Treating De Quervain's Tenosynovitis

Fabio Vita[1], Flavio Origlio[2], Davide Pederiva[1], Stefano Galletti[3], Federico Pilla[1], Roberto Tedeschi[4,*], Cesare Faldini[1], Donati Danilo[5,6]

[1] *IRCCS Istituto Ortopedico Rizzoli, 1st Orthopaedics and Traumatology clinic, Bologna*
[2] *Physical Therapy and Rehabilitation Unit, IRCCS Istituto Ortopedico Rizzoli, University of Bologna, Bologna, Italy*
[3] *Musculoskeletal Ultrasound School, Italian Society for Ultrasound in Medicine and Biology, Bologna, Italy*
[4] *Department of Biomedical and Neuromotor Sciences, Alma Mater Studiorum, University of Bologna, Bologna, Italy*
[5] *Physical Therapy and Rehabilitation Unit, Policlinico di Modena, Modena, Italy*
[6] *Clinical and Experimental Medicine PhD Program, University of Modena and Reggio Emilia, Modena, Italy*

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ABSTRACT

Objective: This study evaluated the effectiveness of ultrasound-guided hydrodissection treatment for De Quervain's stenosing tenosynovitis, characterized by the narrowing of the first extensor compartment of the wrist. Notably, approximately 2% of cases involve a fibrous septum that divides the compartment.
Subjects and Methods: Ninety-five patients diagnosed with De Quervain's disease using ultrasound underwent hydrodissection treatment. When a septum was present, the needle was redirected into each sub-compartment to distribute the therapeutic solution evenly and facilitate the breaking of the septum.
Results: Ninety patients reported significant improvements in pain and functionality within 2 months of the initial treatment, with a marked decrease in the mean visual analog scale score from 7.65 ± 1.31 to 1.65 ± 2.32. A second infiltration, administered 2 months later, further alleviated pain and enhanced hand function-

* Corresponding author: Roberto Tedeschi, Department of Biomedical and Neuromotor Sciences (DIBINEM), Alma Mater Studiorum University of Bologna, Bologna, Via Zamboni 33, 40126 Bologna, Italy, Phone: +393472988475
E-mail address: roberto.tedeschi2@unibo.it (R. Tedeschi).

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ality. However, 5 patients with septum required surgical intervention after nonconclusive results from the infiltrative treatment.
Conclusions: This study confirms that ultrasound-guided hydrodissection is an effective treatment for approximately 95% of patients with De Quervain's disease, achieving substantial pain relief and improved joint mobility after the first treatment. These findings support the continued use of ultrasound guidance to enhance the precision and efficacy of treatment in complex cases.

Introduction

De Quervain's disease (dQD) is a painful condition of the wrist that causes difficulty in daily activities. It is a stenosing tenosynovitis of the first dorsal compartment of the extensors caused by inflammation of the tendon sheaths of the long abductor pollicis longus (APL) and extensor pollicis brevis (EPB), which leads to abnormal gliding of these tendons at the wrist.[1–3]

Possible risk factors include activities involving the repetitive use of the wrist and hand, especially in manual workers, and in pregnant women due to hormonal alterations.[4]

This pathology was first described by a Swiss doctor Fritz De Quervain in 1895, and is common in active adults aged 30 to 50 years and often affects the dominant hand. It has an incidence of approximately 0.94% to 6.3% per 1000 people[5,6] and is 6 to 10 times more common in women than in men.[7,8]

Currently, the diagnosis is initially made based on the clinical picture, which manifests itself with pain at the level of the first extensor canal, which worsens with thumb abduction, in grip action and ulnar deviation of the wrist.[9] The Finkelstein test, a passive test, is performed by the examiner who passively deviates the patient's wrist to the ulnar side to evaluate pain, which is indicative of De Quervain's disease.

Ultrasound (US), useful as a first-level examination, shows tendon compression within the first extensor channel and possibly magnetic resonance imaging, as a second-level examination, is performed only in case of diagnostic doubts (cysts or neoplasms that compress the wrist and/or the extensor compartment).[10]

Numerous treatment options are available for dQD. In the early stages, conservative treatment is used within 6 months of symptoms appearance.[11–16] Conservative options include application of ice, use of splints during manual activities, local or oral application of nonsteroidal anti-inflammatory drugs, physical therapy using laser or US, and injection of corticosteroids and anesthetic to the first dorsal compartment with or without US assistance.[17] In the early stages of treatment, splinting involves immobilizing during manual activities and also continuously, including the thumb, for a period of 6 weeks.

Surgical treatment involves decompression of the first dorsal compartment of the wrist, open or endoscopic, and is usually reserved for those cases where conservative measures failed or symptoms persisted for more than 6 months.[18]

Percutaneous interventional procedures play an important role in the diagnosis and treatment of a wide variety of wrist and hand conditions. The wrist and hand are prone to injuries and inflammatory conditions that can benefit from therapeutic injections. There is little consensus among physicians on the various aspects of injection procedures, such as the injection site, use and type of steroids, and frequency and injection technique.[19,20] Interventional procedures are often performed without US guidance, based on careful use of anatomical landmarks. However, it has been widely shown that without imaging guidance, injection accuracy is reduced.[21] The superficial nature of wrist and hand

Table 1
Outcome Measures Pretreatment and at the 2-Month and 6-Month Follow-ups.

Outcome Measure	Pretreatment (Mean ± SD)	2 Months Posttreatment (Mean ± SD)	6 Months Posttreatment (Mean ± SD)	Student's *t*-Test (p-value)
PRWH-E	55.1 ± 2.54	22.65 ± 4.52	7.45 ± 1.34	<0.0005
VAS	7.65 ± 1.31	1.65 ± 1.42	0.45 ± 1.23	<0.001
DASH	45.55 ± 2.46	16.34 ± 2.42	6.32 ± 2.37	<0.0005

Table 1 provides a detailed overview of changes in patient-rated wrist/hand evaluation (PRWH-E), visual analog scale (VAS), and Disabilities of the Arm, Shoulder and Hand (DASH) scores, recorded pretreatment and at 2-month and 6-month posttreatment follow-ups. The data demonstrate statistically significant improvements in all metrics, as evidenced by the p-values from the students *t*-test.

structures lends itself well to US evaluation and procedures,[19] especially in conditions such as De Quervain's disease.

The infiltrative procedure aims to avoid surgery for the patient and to reduce healthcare expenditure.[21–23] Corticosteroid injection has shown a high success rate, ranging from 62% to 100%, depending on whether the procedure is performed under US guidance.[24]

In fact, recent studies have shown that US-guided injections have a success rate between 93% and 98%, compared to techniques performed without US guidance, ranging from 50% to 70%.[25] The APL and EPB tendons are usually located in the same compartment, but in some patients, there are subcompartments within the first extensor compartment, separating the two tendon components, present with a variability of 30% to 70%, often present even in patients with asymptomatic wrists.[26–29] These anatomical variations play a role in the etiology of De Quervain. This results in under-compartmentalization of the first extensor compartment and makes it difficult for the drug to reach the internal sheath of each tendon effectively; therefore, the failure and reduction of the success rate of non-US-guided injection treatment can be attributed to imprecise injection techniques.[7,8]

Finally, recent literature has shown that endoscopic and US-guided infiltrative treatments are comparable to open surgical treatment.[30]

The aim of the study was to evaluate the feasibility and effectiveness[31] of US-guided hydrodissection treatment in patients with De Quervain's disease.

Methods

This study is as a prospective cohort study involving 95 patients with clinical and US-based diagnosis of De Quervain's disease, who underwent infiltrative treatment of US-guided hydrodissection of the first extensor compartment, from January 2024 to April 2024. Among the patients enrolled in the study, 60 were women and 35 were men. The mean age of the patients was 42 ± 6.53 years.

Thirty-seven patients had De Quervain's disease on the left wrist and 58 on the right wrist, and 54 patients were manual laborers and 41 were office workers (Table 1).

The patients were evaluated clinically and with US by an orthopedic surgeon specializing in upper extremity surgery. Those who met the inclusion criteria were asked to provide their consent by signing an informed consent form.

The exclusion criteria were as follows: Patients who were unable to understand and give consent, pregnant women, patients who had previous infiltration treatment in the last 6 months, and patients with polypharmacological allergies such as anesthetics, cortisone allergies.

Patients were re-evaluated at 2 and 6 months using the visual analog scale (VAS) for pain assessment, Disabilities of the Arm, Shoulder and Hand (DASH),[32] and patient-rated wrist/hand evaluation (PRWH-E).[32–34] The second infiltration was carried out 2 months after the first.

Ethical Issues

This interventional study was approved by the local ethics committee (701/2023/Sper/IOR).

The research protocol received approval from the Ethics Committee AVEC (Comitato Etico Area Vasta Emilia Centro) under protocol code CE AVEC: /Sper/IOR806/2022. Written informed consent was obtained from all participants.

Inclusion Criteria

Diagnosis Confirmation: Patients must have a clinically and US-confirmed diagnosis of De Quervain's tenosynovitis.

Age: Patients aged between 18 and 65 years, to target a population capable of providing informed consent and to exclude pediatric and complex geriatric cases.

Symptom Duration: Patients who experienced symptoms for at least 1 month but not more than 6 months to exclude very acute or chronic long-term cases that might respond differently to treatment.

Functionality: Patients must be capable of performing daily activities independently, ensuring that they can follow posttreatment care instructions.

Consent: Patients must be willing and able to provide informed consent.

Exclusion Criteria

Cognitive Impairment: Patients unable to understand the study or provide informed consent.

Pregnancy: Pregnant women, due to potential risks or alterations in treatment responses.

Previous Treatment: Patients who received infiltrative treatments in the affected wrist within the last 6 months, to ensure the absence of residual effects from prior treatments.

Polypharmacological Allergies: Patients with known allergies to anesthetics or corticosteroids, which are likely to be used in the treatment process.

Statistical Analysis

All continuous variables are expressed in terms of mean ± standard deviation (SD) and range. Categorical variables are summarized in terms of absolute frequency and percentage. Correlations between means of outcome measures pretreatment and posttreatment were analyzed using the *t*-test; $p < 0.05$ was considered significant. The statistical analysis was performed using the statistical package for social sciences (SPSS), software version 15.0 (SPSS Inc., 199 Chicago, Illinois, USA) by a statistical consultant.

Outcome Measures

VAS for pain, DASH, and patient-rated PRWH-E questionnaires were used for clinical assessment.

Ultrasound assessment

A clinical diagnosis of De Quervain was made by an orthopedic surgeon based on direct tenderness on the radial side of the wrist and a positive Finkelstein test. The diagnosis was confirmed using US performed by a musculoskeletal sonographer. The ultrasound scan was performed using a high-frequency linear transducer from 5 to 17 MHz on 2 axes, transversal (Figure 1) and longitudinal (Figure 2). US findings that indicate De Quervain's disease include thickening of first extensor compartment retinaculum associated with tenosynovitis of APL and EBP. The scan look for any inflammation and difficulty in tendon sliding, as well as to determine if there is a septum between the APL and EPB. For comprehensive evaluation and to rule out other potential conditions, the US findings were compared with the unaffected limb.

Figure 1. Ultrasound-Guided Technique for De Quervain's Tenosynovitis Treatment. The image illustrates the procedure of ultrasound-guided injection being administered to a patient's wrist. On the left is a schematic representation showing the positioning of the ultrasound probe for the injection. The two images on the right display the ultrasound cross-sectional view of the wrist's first extensor compartment before and after the hydrodissection treatment, highlighting the anatomical changes posttreatment.

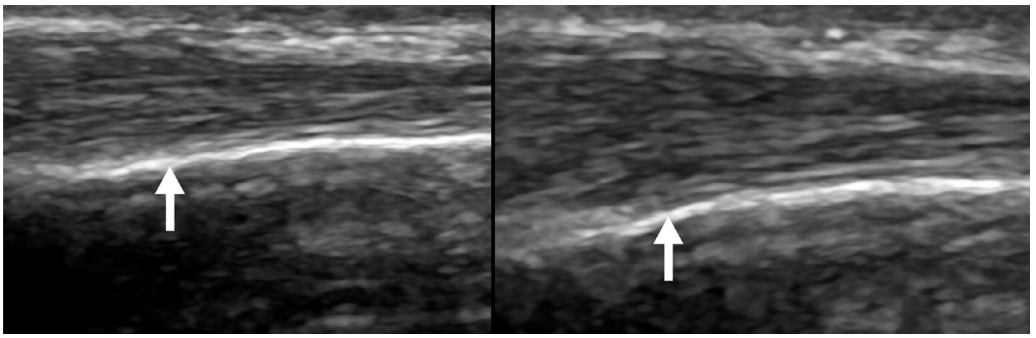

Figure 2. Pre- and Posttreatment Ultrasound Images of De Quervain's Tenosynovitis. Displayed are the sequential ultrasound images demonstrating the first extensor compartment of the wrist affected by De Quervain's tenosynovitis. The left image reveals the pretreatment condition, characterized by thickened retinaculum and swollen sheath indicative of inflammation. The right image shows the compartment posthydrodissection treatment, highlighting the reduced inflammation and decompressed tendons, signifying a successful therapeutic response.

Ultrasound-guided hydrodissection infiltrative treatment

The procedure was carried out by an expert hand surgeon, assisted by a musculoskeletal sonographer.[10] Hydrodissection of the first extensor compartment was achieved using a linear US probe set for musculotendon evaluation (7-16 MHz). The environment and equipment were kept sterile, with the US transducer covered by a sterile disposable device, and the patient's skin disinfected with either povidone-iodine or chlorhexidine, depending on individual allergies or intolerances.

The US probe was positioned transversally over the first extensor compartment of the wrist. Hydrodissection involved injecting a mixture of 2 mL cortisone (betamethasone 4 mg), 2 mL 2% lidocaine hydrochloride, and 2 mL saline using an in-plane technique. A 22-gauge, 30 mm needle was employed to deliver a total of 6 mL of the solution, divided equally between the upper and lower portions of the compartment.

In instances where a septum was present within the tendon sheath, effectively creating subcompartments, the needle was adjusted to ensure that the solution adequately reached both areas (Figure 3). This procedure aimed to gently expand the compartment and septum—not to rupture them—thereby alleviating the constriction of the tendons and reducing symptoms.

Results

This study enrolled a total of 95 patients diagnosed with De Quervain's stenosing tenosynovitis, all of whom successfully completed the prescribed follow-up period without any dropouts, thus ensuring a comprehensive evaluation of the treatment's efficacy.

The primary outcome measure was pain, assessed using VAS. Initially, the collective baseline VAS score for the group was 7.65 ± 1.31, indicating a moderate to severe pain level prior to any treatment. Following the first round of US-guided hydrodissection infiltrative treatment, a substantial reduction in pain was observed, with the mean VAS score decreasing considerably to 1.65 ± 1.42 at the 2-month follow-up. This significant reduction in pain highlights the immediate effectiveness of the treatment in alleviating symptomatic discomfort.

Further improvements were noted during the subsequent follow-up at 6 months, particularly after the second round of infiltration was administered at the 4-month mark. The mean VAS score at this stage was 0.45 ± 1.23, suggesting a sustained and profound alleviation of pain that can be attributed to the cumulative effects of the dual infiltrative procedures.

In addition to pain reduction, functional outcomes were also rigorously assessed using the DASH scale and patient-rated PRWH-E. Both tools showed significant enhancements in wrist and hand func-

Figure 3. Ultrasound Visualization During Hydrodissection Procedure for De Quervain's Tenosynovitis. From left to right, the sequence of images depicts the ultrasound-guided hydrodissection technique. The first image shows the needle in place, delivering therapeutic solution to the first extensor compartment. The middle image captures the moment of hydrodissection where the injectate is distributed within the tendon sheath. The final image on the right illustrates the compartment postprocedure, with reduced swelling and expanded space around the tendons, indicative of successful hydrodissection.

tionality, corroborating the VAS findings. Statistical analysis of these measures showed a marked improvement with a p-value of <0.0005, indicating a high level of statistical significance.

Despite the overall success of the treatment, there were specific instances where the infiltrative procedure did not result in the desired therapeutic outcomes. In 5 patients, representing approximately 5.3% of the study cohort, US imaging revealed a fibrous septum effectively dividing the first extensor compartment into 2 distinct sub-compartments. In these cases, despite the strategic redirection of the needle into each sub-compartment during the hydrodissection process, the intended therapeutic effect was not achieved, leading to the necessity for surgical intervention. These instances underscore the variability in anatomical structures that can influence the outcome of conservative treatments and highlight the importance of individualized patient assessments and tailored treatment approaches.

No complications were immediately reported following the injections (Table 1). The absence of adverse effects underscores the safety of the US-guided hydrodissection infiltrative procedure when conducted under controlled conditions by skilled practitioners. The analysis revealed that the increased space around the tendon observed in posttreatment US images is primarily attributable to a reduction in the size of the inflamed tendon, rather than to an expansion of the compartment. This reduction indicates a significant decrease in inflammation and swelling of the tendon, confirming the effectiveness of the US-guided hydrodissection treatment.

Discussion

Ultrasound-guided hydrodissection infiltrative treatment is regarded as one of the most efficacious modalities for managing De Quervain's disease. Nonetheless, the therapeutic success of this approach can vary due to the anatomical complexities of the first extensor compartment. Notably, variabilities such as septations within this compartment can cause treatment failures in approximately 15% to 20% of cases.[6,24,35,36] The presence of septations impedes the effective distribution of the corticosteroid within the tendon sheath, which is often cited as the primary reason for the ineffectiveness of the treatment.[36,37]

The use of ultrasonography has been pivotal to mitigate these challenges. Real-time imaging provided by US ensures the precise visualization of the target area, facilitating accurate needle placement and thereby enhancing the overall effectiveness of the injection procedure.[18,36] This technique allows clinicians to navigate the anatomical intricacies of the wrist more successfully, ensuring that the medication reaches its intended target.

In our study, the efficacy of US-guided hydrodissection treatment was evaluated in the context of enhancing precision and treatment outcomes for patients with De Quervain's tenosynovitis. To ascertain the benefits of US guidance, we compared the results of our US-assisted hydrodissection treatments with historical data on traditional corticosteroid injections performed without US assistance and commonly referred to as blind injections. This comparison aims to highlight the improvement in precision and efficacy obtained using real-time US imaging, which helps in accurate drug delivery and potential reduction in the need for subsequent interventions.

In our comprehensive study involving 95 patients, all individuals were accurately diagnosed with De Quervain's disease, and no adverse events or complications were recorded during the evaluations. The demographics of our patient cohort aligned with those reported in existing literature, providing a robust basis for evaluating the efficacy of hydrodissection treatment. Although most of our patients benefited significantly from this treatment, 5 individuals continued to experience limited range of motion, rigidity, and persistent pain, which was reflected in a mean VAS score of 6.35 ± 1.22.

The literature reports variable cure rates for corticosteroid injections in treating De Quervain's disease, generally ranging from 58% to 84% after the first injection and improvements between 79% and 91% after the second injection.[38–41] By using a weighted mean calculation, these studies collectively indicate an average cure rate of approximately 73% after the initial injection and 83% after the subsequent one. Remarkably, our findings demonstrate a superior initial cure rate of approximately 82%, escalating to 95% after the second round of hydrodissection, thus underscoring the superior efficacy of our treatment protocol.

Although this study was not a randomized controlled trial, it provides compelling evidence that US-guided hydrodissection can significantly improve pain, disability, and mobility in patients with De Quervain's disease in a primary care setting. The observed enhancements were statistically significant and also clinically meaningful. The mean VAS score plummeted from 7.65 ±1.31 pretreatment to 1.65 ±1.42 at the 2-month follow-up—a reduction of 78.4%. This downward trend in pain continued up to the 6-month mark, with a further reduction to 0.45 ±1.23, representing an impressive overall pain reduction of 94.1%.

Our analysis also revealed that the incidence of the anatomical septum within the first extensor compartment was approximately 5%, which is considerably lower than the previously reported rates.[26–28] The presence of this septum is a known complicating factor that can lead to the failure of corticosteroid injections. Supporting literature suggests a high incidence of septum presence among patients who did not respond to corticosteroid injections and required surgical intervention.[42–44] Furthermore, the high sensitivity of US examination (100%) and specificity (96%) for detecting these septations[8] proved crucial in ensuring precise delivery of the treatment to all the affected sub-compartments. Our study used a total of 6 mL of the therapeutic solution, including corticosteroids, under US guidance, achieving substantial symptom relief and functional improvement. This prompts an interesting consideration for future research—whether different volumes might yield similar benefits, particularly in the presence or absence of US guidance.

Comparing our approach with a nonguided method using the same volume could elucidate the role of US in enhancing treatment accuracy versus the sheer effect of the medication volume. Additionally, investigating smaller volumes under US guidance could help determine the minimal effective dose that maintains efficacy while potentially minimizing any side effects associated with larger volumes.

Such investigations would further refine our understanding of the optimal strategies for managing De Quervain's tenosynovitis, balancing efficacy, patient safety, and resource utilization. These points underscore the necessity for continued research, focusing on tailored approaches that leverage advanced imaging techniques to optimize therapeutic outcomes. Implementing US-guided hydrodissection for De Quervain's tenosynovitis involves higher initial costs owing to the need for specialized equipment and training. However, this method may prove more cost-effective over time. The precision of US guidance can enhance treatment accuracy, potentially reducing the need for repeat procedures and decreasing the likelihood of surgical interventions. These benefits might offset the higher initial investment by reducing the overall healthcare costs associated with treatment failures and complications. A thorough cost-benefit analysis comparing both approaches would help clarify the long-term economic impact and support informed decisions in clinical practice.

Conclusion

This study demonstrated the effectiveness of US-guided hydrodissection treatment for De Quervain's disease, with a notable 95% of patients achieving significant improvement over the 6-month follow-up period after 2 injections, significantly surpassing reported cure rates from other studies. The presence of intra-compartmental septa, which can complicate treatment, underscores the importance of US as a therapeutic tool and also as an essential diagnostic method. We advocate the incorporation of ultrasonography into standard protocols for diagnosing and treating De Quervain's disease to enhance treatment precision and outcomes, thereby reducing the need for surgical interventions.

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Ethical Committee: CE AVEC: /Sper/IOR806/2022

Declaration of competing interest

The authors declare that there are no conflicts of interest.

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