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De Quervain Tenosynovitis: Anatomical Variants of the First Dorsal Compartment and Their Role in Ultrasound-Guided Injection and Surgical Management — A Narrative Review

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Purpose: De Quervain tenosynovitis is a common cause of radial wrist pain and is characterized by stenosing tendinopathy of the abductor pollicis longus and extensor pollicis brevis in the first dorsal compartment. Increasing evidence suggests that the anatomical variants within this compartment contribute to disease development and treatment failure. To summarize the current evidence on anatomical variations in the first dorsal wrist compartment, their detection using ultrasound, and their implications for injection-based and surgical management of de Quervain tenosynovitis.
Methods: Studies published between 2015 and 2025 on de Quervain stenosynovitis, first dorsal compartment anatomy, ultrasonography, injection therapy, and surgical outcomes were included.
Results: Inter-tendinous septation and subcompartmentalization of the abductor pollicis longus and extensor pollicis brevis tendons were more prevalent in patients with de Quervain tenosynovitis than in controls and were associated with persistent symptoms after conventional corticosteroid injection or surgical release. Ultrasound demonstrates high sensitivity and specificity for detecting septa, multiple tendon slips, and subcompartments and reliably maps adjacent neurovascular structures. Ultrasound-guided corticosteroid injections, hydrodissection, platelet-rich plasma injection, and percutaneous release techniques have shown improved targeting of pathological compartments and favorable clinical outcomes. In surgical management, failure to recognize and decompress the separate subcompartments is a key cause of residual pain and recurrence.
Conclusions: Anatomical variants of the first dorsal compartment are common and clinically significant in de Quervain stenosynovitis. The routine use of ultrasound to identify anatomical variants can optimize the selection and execution of both nonsurgical and surgical treatments, potentially improving outcomes and reducing recurrence.

Keywords: De Quervain tenosynovitis, first dorsal compartment, anatomical variant, ultrasonography, abductor pollicis longus, extensor pollicis brevis

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De Quervain tenosynovitis, also known as De Quervain's disease, is a common stenosing overuse pathology of the wrist, characterized by mucopolysaccharide accumulation and thickening in the tendon sheath of the extensor pollicis brevis and abductor pollicis longus [1–3]. These tendons pass through the first dorsal compartment, a narrow fibro-osseous tunnel running over the radial styloid and beneath the extensor retinaculum, where they are susceptible to entrapment in repetitive motions and acute trauma [3,4]. Although the term "tenosynovitis" implies inflammation, intrinsic degeneration secondary to overuse is now regarded as the predominant underlying mechanism, supported by ultrasound findings of tendon sheath swelling, peritendinous edema, tendon enlargement, and increased vascularity [2,5,6]. This condition was first described by the Swiss physician Fritz De Quervain in 1895 [1,3].

De Quervain tenosynovitis is more prevalent in women (approximately 1.3%) than in men (0.5%), and recognized risk factors include repetitive or forceful manual work, pregnancy, and increased use of electronic devices [1,7,8]. Clinically, patients present with pain and tenderness over the radial styloid. The diagnosis is supported by the Finkelstein test, which is the most specific clinical diagnostic tool [1,3,9]. Management typically begins with conservative measures including splinting, nonsteroidal anti-inflammatory drugs, and corticesteroid injections, with surgical decompression of the first dorsal compartment reserved for refractory cases [3,10].

However, the outcomes of both non-surgical and surgical treatments are significantly influenced by the presence of anatomical variants within the first dorsal compartment. Three key variants have been identified as clinically relevant: intertendinous septation, subcompartmentalization of the abductor pollicis longus and extensor pollicis brevis tendons, and variations in the number of tendon slips. These variants are present in a substantial proportion of patients with de Quervain tenosynovitis and are associated with treatment failure when they are unrecognized, as injections may fail to reach all affected subcompartments and incomplete surgical decompression may result in persistent symptoms [3,15,18,19]. Ultrasonography has emerged as the key imaging modality that allows the detection of these variants in real time, enabling clinicians to tailor both injection-based and surgical management to the individual anatomical profile of each patient.

Therefore, this narrative review aimed to summarize the current evidence on anatomical variants of the first dorsal compartment, examine their detection by ultrasound, and explore their implications for the injection-based and surgical management of de Quervain tenosynovitis, with the goal of providing up-to-date, clinically relevant insights for clinicians.

Methodology

A meticulous search of literature was performed through databases, namely PubMed and Google Scholar with the use of keywords such as “de Quervain tenosynovitis,” “de Quervain syndrome,” “de Quervain disease,” “first dorsal compartment,” “extensor compartment,” “abductor pollicis longus,” “extensor pollicis brevis,” “ultrasound,” “sonography,” “anatomical varia*”, “corticosteroid injection,” “injection,” “surgical treatment,” “surgery,” “operative management,” and “treatment outcome.” These terms were connected using Boolean operators to conduct the literature search. A literature search was also performed via the literature search function using AI-powered platforms, such as Elicit, Consensus, and SciSpace, via verbal prompts, including the keywords mentioned above. Articles were screened using the following inclusion and exclusion criteria:

Inclusion Criteria:

Articles were included in this review if they are

- Studies published from 2015 to 2025 were limited to those published in the past 10 years because of their relevance in current practice.
- Focused on de Quervain tenosynovitis and its related anatomical variants, diagnosis, and treatment
- Systematic reviews, meta-analyses, narrative reviews, randomized controlled trials, cohort studies, cross-sectional studies, case-

controlled studies, and cadaver studies (levels of *evidence I to V)*

Exclusion Criteria:

Articles were excluded from this review if they are

- Unrelated to de Quervain tenosynovitis or the first dorsal compartment
- Not published in English
- Full text not accessible
- Case reports involving fewer than 3 patients
- Non-peer-reviewed sources (such as editorials, letters, and conference abstracts)
- Duplicate publications or secondary use of the same dataset
- Published before 2015

Study Selection

The initial literature search identified 623 articles from the databases, of which 83 were identified via the search on AI-powered platforms. Titles and abstracts were screened, and full-text availability was assessed. 33 articles with full-text were reviewed for eligibility.

Data Extraction and Synthesis

Essential information from the selected studies was gathered and summarized. This information encompassed the study design, population characteristics, intervention types, outcome measures, and key results.

RESULTS

Table 1 Summary of Selected Studies and Findings.

Authors	Year	Design	Focused Area	Key Findings
Rowland et al	2015	Systematic review and meta-analysis (Level I evidence)	Effectiveness of corticosteroid injection for de Quervain stenosing tenosynovitis	Corticosteroid injection leads to a higher rate of resolution of symptoms and statistically significant improvement in function.
Danda et al	2016	Prospective observational study (Level III evidence)	Effectiveness of ultrasound use for needle positioning for steroid injection for de Quervain tenosynovitis. Functional outcomes of steroid injection. Prevalence of anatomical variations in the form of multiple tendons and subcompartments. Effectiveness of single versus multiple injections in the presence of subcompartments.	35% of patients were found to have a separate subcompartment for abductor pollicis longus and extensor pollicis brevis. Ultrasound guidance improves the accuracy of corticosteroid injection. For patients with subcompartments, two separate injections (one for each subcompartment) led to better clinical outcomes than a single injection.
Güleç et al	2016	Cadaveric study (Level IV evidence)	Evaluating the effectiveness of percutaneous 18-guage needle technique for releasing the fibro-osseous sheath in the first dorsal extensor compartment. Assessing anatomical factors such as tunnel length, number of tendons, presence of a septum influencing release success and complications. Investigating tendon and neurovascular injuries post-procedure. Exploring the potential of minimally invasive techniques in treating de Quervain's tenosynovitis.	Tendon complications occurred in 39.6% of cases, including scoring, partial, and complete lacerations. The septum presence significantly correlated with incomplete release and tendon damage. Tunnel length and tendon number had no statistically significant impact on release success. No neurovascular injuries were observed. Ultrasound guidance is recommended to improve safety and efficacy, especially in cases with septation in the first dorsal compartment.

Authors	Year	Design	Focused Area	Key Findings
Garçon et al	2018	Retrospective study (Level III evidence)	Long-term outcomes of surgical treatment for de Quervain's tenosynovitis. Evaluation of Le Viet's surgical technique involving subcutaneous fixation of the retinaculum flap. Assessment of anatomical variants and their impact on surgical results.	A supernumerary septum was found in 50 cases and multiple slips of the abductor pollicis longus tendon were found in 35 cases. No recurrence of tendon dislocation, neuroma formation, or symptom recurrence was seen in this study. Le Viet's technique has been proven to be reliable and effective over long-term follow-up.
Croutzet et al	2019	Descriptive feasibility study combining cadaver study and prospective clinical case series (Level III evidence)	Identification of subcompartmentalization in the first extensor compartment using Hiranuma's classification (Type I: no septum, Type II: full septum, Type III: distal septum). Localization of the superficial radial nerve branches to avoid nerve injury. Use of continuous ultrasound guidance for retrograde sectioning of the tendon sheath. Application of a specialized blade designed for percutaneous release. Assessment of pain and function using QuickDASH and VAS scores. Monitoring for complications and surgical efficiency	Complete release was achieved in 52.1% of wrists; 43.7% had partial release; 4.2% missed release. Ultrasound successfully identified compartment types in 13 of 14 cadaveric wrists. One misidentification led to incomplete release. No nerve injuries were observed in cadavers or patients. Minor tendon abrasions occurred in cadavers but not in clinical cases. All 22 patients showed significant improvement in QuickDASH scores (from 59 pre-op to 9 post-op). No morbidity was reported; most returned to work within 3 months. The average surgery time was 8 minutes, performed in an office setting. The procedure was cost-effective and minimally invasive.
Jung et al	2022	Randomized controlled trial (Level II evidence)	Evaluated the effectiveness of ultrasound-guided steroid injections for de Quervain disease. Injection into both the abductor pollicis longus (APL) and extensor pollicis brevis (EPB) subcompartments versus into the EPB subcompartment alone. Assessed pain reduction and complication rates post-injection. Targeted patients with complete intracompartmental septation between APL and EPB.	No significant difference was observed between the two groups in terms of pain scores at 6 and 12 weeks post-injection. Skin hypopigmentation occurred less frequently in the extensor pollicis brevis-only group (33%) than in the both-subcompartment group (67%). No serious adverse events reported in both groups. Extensor pollicis brevis-only injections are equally effective and may reduce steroid-related complications.
Shen et al	2022	Cadaveric study (Level IV evidence)	Evaluating the safety and efficacy of percutaneous release of the first extensor compartment using acupotomy. Comparing outcomes between ultrasound-guided and blind techniques. Assessing anatomical structures, potential neurovascular and tendon injury, and release success rates in cadaveric wrists.	The ultrasound-guided technique has a success rate of 87% compared with the blind technique at 75%. No neurovascular and significant tendon injury in either group. Surface scratches occurred in 13.04% of ultrasound-guided cases and 22.22% of blind-technique cases. The presence of fibrous septum and bony protrusion in the first dorsal compartment may affect the success rate of treatment. Both techniques are viable for percutaneous release.

Authors	Year	Design	Focused Area	Key Findings
				Ultrasound guidance can improve precision and reduce procedure-related injury.
Bosman et al	2022	Systematic Review and Meta-Analysis (Level I evidence)	Evaluated the effectiveness and complication rates of surgical release of the extensor retinaculum as the treatment for de Quervain tenosynovitis. Also investigated the superiority of incision type.	21 studies with 939 patients included. 5% of these patients did not show complete remission of pain at follow-up. The mean reduction in visual analog scale scores was 5.7 on 0–10 scale. No difference in outcomes between different types of surgery or incisions was seen. The pooled complication rate was 11%.
Asaad et al	2023	Prospective interventional study (Level III evidence)	Evaluated the effectiveness of ultrasound-guided platelet-rich plasma (PRP) injection for treating de Quervain's tenosynovitis. Targeted patients who were unresponsive to conservative treatments like NSAIDs, splinting, and corticosteroid injections. Assessed both clinical outcomes (pain reduction, recovery) and sonographic changes (retinaculum thickness, tendon sheath effusion).	33.3% of patients achieved complete recovery while 50% returned to daily activities with minimal pain. Mean pain scores (VAS) dropped from 8.66 to 1.91 over 3 months. Sonographic improvements such as reduction of retinaculum thickness, decreased tendon sheath effusion and resolution of peritendinous hyperemia at 3 months have been observed. No major complications were reported; only mild vasovagal symptoms noted in two patients. Ultrasound-guided PRP injection with needle tenotomy is a promising non-surgical alternative for refractory de Quervain tenosynovitis, especially in cases with anatomical variations like subcompartmentalization.
Challoumas et al	2023	Systematic review and meta-analysis (Level I evidence)	Comparative effectiveness of treatments for de Quervain tenosynovitis including corticosteroid injections, ultrasound-guided corticosteroid injections, thumb spica immobilization, surgical techniques, incision types, and alternative treatments such as acupuncture, shockwave therapy and neural therapy.	Corticosteroid injection combined with thumb spica immobilization for 3–4 weeks showed statistically significant improvements in pain and function (though not always clinically significant). Ultrasonography-guided corticosteroid injections were more effective for pain relief than conventional corticosteroid injections. Immobilization alone (splint or cast) was among the least effective interventions. Surgical release is highly effective (up to 95% symptom resolution) but should be reserved for cases where non-surgical treatments fail. A separate extensor pollicis brevis subcompartment was found in up to 90% of patients and 70% of asymptomatic individuals. Ultrasound-guided corticosteroid injections into the extensor pollicis brevis alone ranked among the most

Authors	Year	Design	Focused Area	Key Findings
				effective interventions for short-term pain relief. Surgical decompression of only the extensor pollicis brevis subcompartment has shown comparable effectiveness to full compartment release.
Fakoya et al	2023	Narrative review (Level V evidence)	Review on etiology, diagnosis, and treatment for de Quervain's tenosynovitis.	De Quervain tenosynovitis is caused by thickening of the extensor retinaculum causing tendon entrapment, with repetitive wrist and thumb movements serving as contributing factors. Anatomical variants such as septation in the first dorsal compartment may predispose one to this condition. Finkelstein's test remains the most widely used clinical diagnostic tool. Ultrasound imaging is effective for visualizing tendon thickening and compartmental changes. MRI can be used for complex or atypical cases but is not routinely necessary. Conservative treatments include rest, splinting, NSAIDs, and corticosteroid injections. Corticosteroid injections are highly effective, especially when guided by ultrasound. Surgical release is reserved for refractory cases and involves decompression of the first dorsal compartment. Acupotomy and ultrasound-guided percutaneous release show promise in cadaveric and early clinical studies and may reduce complications and recovery time. Early intervention improves outcomes and may prevent progression to chronic pain. Anatomical knowledge is crucial for successful treatment, especially during surgical approaches.
Kotzias et al	2023	Systematic review (Level I evidence)	Anatomical variants of the first extensor wrist compartment such as the presence of inter-tendinous septum, number and insertion of tendinous slips of the abductor pollicis longus and extensor pollicis brevis, and morphology of the extensor groove on the radial styloid process. Comparative analysis between cadaveric wrists without known disease and patients with de Quervain's tenosynovitis.	An inter-tendinous septum found in 47% of de Quervain patients versus 39.3% of cadavers. Complete inter-tendinous septum is more common in patients (76.8%) than in cadavers (63.8%). Multiple abductor pollicis longus tendon slips were observed in 74.5% of patients versus 92.5% of cadavers, and they are most commonly inserted at the first metacarpal base or shaft, trapezium and abductor pollicis brevis tendon.

Authors	Year	Design	Focused Area	Key Findings
			Review of implications for diagnosis, treatment planning, and surgical outcomes.	A single extensor pollicis brevis tendon slip was seen in 93% of patients versus 87% of cadavers. Extensor pollicis brevis is absent in 3% of patients versus 2% of cadavers. The extensor pollicis brevis tendon slips have varied insertions at proximal phalanx base, distal phalanx, and extensor hood. A bony ridge in extensor groove was present in 17.8% of patients versus 58.9% of cadavers. Inter-tendinous septum and extensor groove variants may contribute to tendon entrapment and treatment failure. Awareness of these variants is critical for the effectiveness of corticosteroid injection and surgery.
Liu et al	2024	Retrospective comparative study (Level III evidence)	Investigated anatomical variations of the extensor pollicis brevis and abductor pollicis longus tendons. Compared patients with de Quervain tenosynovitis to those with thumb carpometacarpal arthritis. Aimed to identify structural differences in the first dorsal compartment of the wrist.	Patients with de Quervain tenosynovitis were generally younger (average age 51 vs 63). The had a higher proportion of women (86.1% vs 77.1%). The included more individuals of African American (15.7%) and Asian (5.2%) descent. Tendon subcompartments were more prevalent (79.1% vs 64.2%) in the de Quervain group. Fewer abductor pollicis longus tendon slips were observed (38.3% had two or fewer slips vs 20.7% in controls). The presence of tendon subcompartments, not the number of tendon slips, is associated with de Quervain tenosynovitis.
Vita et al	2024	Prospective cohort study (Level III evidence)	Investigated the effect of ultrasound-guided hydrodissection for de Quervain tenosynovitis on pain levels (VAS score), functional ability (DASH and PRWE-H scores), and the need for surgical intervention at 2 months and 6 months post-treatment.	A significant decrease was observed in VAS scores at both 2 and 6 months. Notable improvements were observed in DASH and PRWE-H scores over time. Only 4.2% of patients required surgery after treatment. No major complications were reported, indicating the procedure is safe and well-tolerated. Most patients with a septum responded well to treatment but five patients with a septum did not improve and eventually required surgical intervention.
Lee et al	2025	Retrospective diagnostic accuracy study (Level III evidence)	Studied the anatomical variations in patients with de Quervain tenosynovitis.	Ultrasound use in septum detection has a sensitivity of 90.9% and specificity of 91.7%.

Authors	Year	Design	Focused Area	Key Findings
			Compared ultrasound findings with surgical observations to assess diagnostic accuracy. Evaluated intraobserver and interobserver reliability of ultrasound imaging.	Detection of multiple abductor pollicis longus slips has a sensitivity of 95.5% and specificity of 91.7%. Detection of selective extensor pollicis brevis has a sensitivity of 100% and specificity of 97.2%. The intraobserver agreement was k = 0.89 and interobserver agreement was k = 0.83 for reliability.
Marth et al	2025	Narrative review (Level V evidence)	A detailed overview of dorsal and volar compartment anatomy. Emphasis was placed on common and rare tendon configurations.	Anatomical variations are frequent and can impact diagnosis and treatment. Ultrasound is highly effective for dynamic assessment of tendon disorders. MRI provides superior soft tissue contrast for complex cases. Awareness of tendon variants helps avoid misdiagnosis and guides surgical planning.

Historical Perspective

Anatomical variations of the wrist were investigated in studies that predated the studies included in this review. In 1986, Jackson et al. found that 75% of 300 cadaveric wrists had a number of tendons that differed from what was considered standard anatomy [15]. They found partial or complete septation of the wrist in 40% of their specimens and division of the first compartment by septa in one-third of the wrists, consistent with the findings reported by the studies included in this review [15]. Bahm et al. also found division of the first dorsal compartment by septa in operative settings in 1995 and noted that the presence of a septum and crowded compartment was responsible for failure of steroid injection [17]. De Quervain tenosynovitis is managed via nonoperative measures, such as steroid injections. Surgical management can be performed in patients who do not respond to these modalities. This included a modified technique performed by Le Viet et al. from 1983–1990 with a less conspicuous transverse scar [11].

Anatomical Variants of the First Dorsal Compartment

Tendon Slip Variations and Bony Anatomy of the Extensor Groove

The abductor pollicis longus and extensor pollicis brevis control thumb abduction and extension, respectively, at the carpometacarpal joint [12–14]. In the standard anatomical arrangement, the abductor pollicis longus inserts into the base of the first metacarpal and lies more radially, whereas the extensor pollicis brevis inserts into the proximal phalanx [3,12]. However, several anatomical variants are commonly found in this compartment, including intertendinous septation, which occurs in up to 40% of cases, subcompartmentalization, and variations in the number of tendon slips [3,13,15]. These variants are clinically significant, as they increase the likelihood of developing de Quervain tenosynovitis, contribute to treatment failure, and are associated with pain recurrence following both injection and surgical management [3,15,18,19]. The following subsections describe these variants in detail.

Septation/Subcompartmentalization

The intertendinous septum is a fibrous structure that divides the first extensor compartment of the wrist into two subcompartments. In a systematic review conducted by Kotzias et al., the presence of an intertendinous septum was found to be significantly more frequent in patients with de Quervain tenosynovitis, with a prevalence of 47%

in these patients compared with 39.3% in cadaveric wrists with no history of de Quervain tenosynovitis [14]. The presence and extent of septation can be classified using the Hiranuma classification, in which type I means no septum, type II means a full-length septum, and type III means only a distal septum [21]. In studies that classified the septum as complete or incomplete, a complete septum was more common in patients with de Quervain tenosynovitis (76.8% vs 63.8%) [14]. The incidence of subcompartmentalization was significantly higher in patients with de Quervain tenosynovitis (79.1%) than in controls (64.2%) in a retrospective comparative study by Liu et al. involving 351 patients [12]. This suggests that the presence of subcompartments is significantly associated with de Quervain stenosynovitis. In addition, this finding suggests the need to consider the presence of subcompartments when providing treatment, such as corticosteroid injections, as injections should be delivered to all subcompartments for optimal outcomes. In a prospective observational study by Danda et al. involving 51 wrists, those who received separate corticosteroid injections in both subcompartments had complete resolution of symptoms, whereas incomplete resolution was observed in three out of eight patients who received injections in only one of the subcompartments [22]. This finding suggests that this anatomical variant should be considered for the treatment of this condition.

Tendon Slip Variations and Bony Anatomy of the Extensor Groove

Tendon slip configurations vary considrably between patients with de Quervain stenosynovitis and those with normal cadaveric specimens. The abductor pollicis longus has been found to have between 1 and 6 slips in operative settings, although paradoxically, patients with de Quervain tenosynovitis tend to have fewer slips, with multiple slips present in only 74.5% of patients compared with 92.5% of cadavers [14]. In contrast, the extensor pollicis brevis typically presents as a single slip in the majority of cases, with complete absence documented in approximately 2–3% of individuals [3,14]. Importantly, Liu et al. demonstrated that the presence of tendon subcompartments, rather than the number of tendon slips per se, was more significantly associated with the pathogenesis of de Quervain tenosynovitis [12]. Regarding the bony anatomy, variations in the extensor groove of the radius have also been documented, with bony ridges found more frequently in cadaveric samples (58.9%) than in symptomatic samples (17.8%) [14]. The presence of such bony ridges is associated with intertendinous septation. However, whether they contribute to disease pathogenesis or represent incidental anatomical findings remains unclear.

Clinical Examination Limitations in the Context of Anatomical Variants

The diagnosis of de Quervain tenosynovitis is traditionally dependent on clinical examination findings, such as the Finkelstein and Eichoff tests, which are both effective diagnostic tools for this condition, with the Finkelstein test being a more specific clinical test [3]. Despite their effectiveness, there are arguments against the use of these tests due to the fact that there are passive tests that have disadvantages of stressing different structures that are not directly involved in the pathology of De Quervain tenosynovitis [3]. In addition, the understanding of the anatomical variations in the first dorsal compartment has transformed the diagnostic approach for this condition, necessitating the use of imaging studies to achieve accurate anatomical mapping and guide treatment decisions.

Marth et al. pointed out that anatomical differences are common and can influence both diagnosis and treatment, stressing that recognizing tendon variants helps prevent misdiagnosis and assists in surgical planning. They noted that intersection syndromes and other tendon conditions are frequently underdiagnosed because their symptoms overlap with those of de Quervain tenosynovitis and that ultrasound is very effective for the dynamic evaluation of tendon disorders [12]. This indicates that imaging should be used not only for planning treatment, but also for ruling out other differential diagnoses that could resemble De Quervain tenosynovitis.

Ultrasound Use for Variant Detection

Ultrasound has emerged as the primary imaging modality for identifying anatomical variants in the first dorsal compartment owing to its accessibility, cost-effectiveness, real-time dynamic assessment capability, and absence of radiation exposure. Unlike static imaging modalities such as MRI, ultrasonography enables clinicians to dynamically visualize tendon movement, detect septation, map subcompartment morphology, and localize adjacent neurovascular structures in real time, all of which are directly relevant to guiding both injection-based and surgical management. This capability is particularly important given that anatomical variants such as inter-tendinous septation and subcompartmentalization are present in a substantial proportion of patients with de Quervain tenosynovitis and are a recognized cause of treatment failure when left undetected.

Lee et al. demonstrated a remarkable diagnostic performance in a retrospective diagnostic accuracy study that compared ultrasound findings with surgical observations [23]. The sensitivity and specificity for septum detection were 90.9% and 91.7%, respectively, whereas the detection of multiple abductor pollicis longus slips achieved a sensitivity of 95.5% and specificity of 91.7% [23]. The detection of selective extensor pollicis brevis compartmentalization demonstrated the highest accuracy, with a sensitivity of 100% and specificity of 97.2% [23]. Furthermore, the reliability metrics were robust, with intraobserver agreement of κ = 0.89 and interobserver agreement of κ = 0.83, indicating that ultrasound assessment of anatomical variants is both accurate and reproducible across different operators [23]. These figures are clinically significant, as accurate preprocedural identification of septation and subcompartments allows clinicians to determine whether a single injection is sufficient or whether separate injections into individual subcompartments are required for adequate treatment.

The use of ultrasound extends beyond the simple detection of anatomical variants. Croutzet et al. successfully used ultrasound to identify compartment types based on Hiranuma's classification in 13 of 14 cadaveric wrists, achieving a success rate of 92.9% [21]. However, they noted that one misidentification led to incomplete surgical release, underscoring that, while ultrasound is highly effective, operator expertise and careful interpretation are essential [21]. This study also demonstrated that ultrasound could successfully localize the superficial radial nerve branches, thereby reducing the risk of iatrogenic nerve injury during both injection and surgical procedures [21]. This finding highlights that the value of ultrasound in de Quervain tenosynovitis is not limited to anatomical mapping alone but extends to improving procedural safety. Overall, the evidence strongly supports the routine incorporation of ultrasonography into the preprocedural assessment of de Quervain tenosynovitis, as its ability to characterize the specific anatomical profile of each patient enables a more precise, individualized, and safer treatment delivery than a blind, landmark-based approach.

Ultrasound-Guided Corticosteroid Injection

The role of ultrasound extends beyond the scope of anatomical mapping in the management of de Quervain stenosynovitis. Its ability to visualize septation, tendon slip configurations, and compartment morphology in real-time allows clinicians to tailor treatment strategies with better precision, thereby improving outcomes. Nonsurgical modalities are the first-line treatment for this condition and include rest, ice, therapeutic exercise, splitting, and nonsteroidal anti-inflammatory drugs [1,22,24]. When these methods fail, corticosteroid injection, which is performed directly proximal to the radial styloid process, with a cure rate ranging from 62% to 100% at the initial injection, is the mainstay treatment for this condition [3,25,26]. The injection of corticosteroids is a safe and cost-effective treatment, especially in the early stages of disease, which is supported by a systematic review and meta-analysis by Rowland et al. that demonstrated its effect in improving both pain and function [1,22]. However, this method may fail because of inaccuracy in the technique and the presence of anatomical variations in the first dorsal compartment, such as septations and multiple tendons, as the injection does not enter the compartment or all subcompart-

ments [22]. This problem can be addressed using ultrasound to guide needle placement and injections in all subcompartments. Danda et al. conducted a prospective observational study involving 51 wrists and found that 35% of patients exhibited a separate subcompartment for the abductor pollicis longus and extensor pollicis brevis [22]. Patients who received separate injections into both subcompartments achieved complete resolution of symptoms, whereas incomplete resolution was seen in three out of eight patients who received corticosteroid injections into only one subcompartment [22]. This finding underscores the clinical importance of ultrasound guidance in detecting and accessing all affected compartments, particularly in patients with septation.

Jung et al. conducted a randomized controlled trial comparing ultrasound-guided steroid injections into both the abductor longus and extensor pollicis brevis subcompartments with injections into the extensor pollicis brevis subcompartment alone in patients with complete intracompartmental septation, which further supports the role of targeted injections [27]. The results demonstrated no significant difference in pain reduction at 6 and 12 weeks post-injection between the two groups, suggesting that selective injection into the extensor pollicis brevis subcompartment may be equally effective and that such a precise injection will require the use of ultrasound [27]. Notably, skin hypopigmentation, a common steroid-related complication, occurred significantly less frequently in the extensor pollicis brevis-only group (33%) than in both subcompartment groups (67%) [27]. These findings suggest that US-guided selective corticosteroid injection not only maintains therapeutic efficacy but also reduces the incidence of adverse effects, offering a more refined approach to corticosteroid therapy in anatomically complex cases.

Emerging Ultrasound-Guided Non-Surgical Therapies

Beyond corticosteroid injections, several emerging ultrasound-guided nonsurgical therapies have shown promise for the management of de Quervain tenosynovitis. Ultrasound-guided hydrodissection, as described by Vita et al., involves the injection of a mixture of cortisone, lidocaine, and saline, with the solution divided equally between subcompartments when septation is detected, to facilitate septum rupture [25]. In a prospective cohort of 48 patients, this technique demonstrated significant reductions in the VAS, DASH, and PRWE-H scores at both 2 and 6 months post-treatment, with only 4.2% of patients requiring subsequent surgical intervention [25]. Ultrasound-guided platelet-rich plasma (PRP) injection combined with needle tenotomy is another alternative, particularly in patients unresponsive to conventional conservative management. In a prospective interventional study of 30 patients by Asaad et al., mean VAS scores decreased from 8.66 at baseline to 1.91 at 3 months, with concurrent sonographic improvements in retinacular thickness and tendon sheath effusion, suggesting structural and symptomatic benefits [28]. Regarding percutaneous release, Shen et al. demonstrated in a cadaveric study of 69 wrists that ultrasound-guided acupotomy achieved a higher success rate than the blind technique (87% vs 75%), with fewer tendon surface injuries (13.04% vs 22.22%), particularly in wrists with fibrous septation and bony protrusions [29]. Collectively, these findings highlight the value of preprocedural ultrasound mapping for guiding these techniques. However, it must be acknowledged that these therapies are supported by limited, predominantly low-level evidence from small, uncontrol studies, and should be regarded as investigational pending larger, well-designed clinical trials.

Indications for Surgical Management

The first-line treatment for de Quervain tenosynovitis consists of conservative approaches such as conventional corticosteroid injection and thumb spica immobilization for 3–4 weeks. In the treatment algorithm proposed by Challoumas et al., conventional corticosteroid injections and thumb spica for 3–4 weeks should be performed following the clinical diagnosis of de Quervain tenosynovitis [2]. If the symptoms persist for another 3–4 months, ultrasound should be performed for a definitive diagnosis [2]. When de Quervain tenosynovitis is

diagnosed sonographically, ultrasound-guided corticosteroid injection and thumb spica casting should be administered for 3–4 weeks [2]. Surgical management should only be considered if symptoms persist for three to 4 months later [2]. Surgical management of de Quervain tenosynovitis typically involves the surgical release of the first extensor compartment [3,31].

Anatomical Variations effects on Surgical Management

There are various surgical techniques that have been described, including open release, endoscopic release, extensor retinaculum elongation, and partial resection of the extensor retinaculum [31]. A systematic review and meta-analysis conducted by Bosman et al. on surgical treatment outcomes of de Quervain tenosynovitis showed no difference in the outcome between different types of surgery or incisions, with a mean reduction in visual analog scale scores of 5.7 on a 0 to 10 scale [31]. Despite the high success rates observed in surgical management, approximately 5% of patients still experience residual pain, which can result from incomplete release [31]. The surgeon should carefully decompress the first compartment and actively search for a subcompartment that separates the extensor pollicis brevis and abductor pollicis longus, as identification and treatment of this compartment is decisive for surgical success [31]. This also suggests the importance of identifying these variants via ultrasonography as part of preoperative planning to improve surgical outcomes.

In cases of supernumerary septa and multiple tendon slips, surgical release of the first compartment may lead to complications such as tendon subluxation [10]. A retrospective study conducted by Garçon et al. involving 80 wrists found a high rate of anatomical variation in the first dorsal compartment including supernumerary septa and multiple tendon slips [10]. In this study, patients underwent surgery using the Le Viet technique, which utilizes a horizontal approach to reduce scar-related complications and subcutaneous fixation of the retinaculum flap to reduce secondary tendon instability [10]. Despite the high rate of anatomical variations, the patients reported significant improvement in the VAS (mean VAS, 0.76), no recurrence, and no tendon dislocation or neuroma after a mean follow-up of 9.5 years after surgery, suggesting the effectiveness of this surgical approach for patients with anatomical variations [10].

CONCLUSIONS

De Quervain tenosynovitis is strongly influenced by anatomical variations within the first dorsal compartment, particularly the presence of septation and separate subcompartments. This narrative review highlights that these variants are common rather than exceptional, and have direct implications for the diagnosis and treatment of this condition.

Ultrasound offers reliable, real-time visualization of the abductor pollicis longus and extensor pollicis brevis tendons, associated septa, and adjacent soft tissue structures. Its use improves diagnostic accuracy and facilitates conservative treatment such as corticosteroid injection and preoperative planning. When such variants are recognized and appropriately addressed, whether through ultrasound-guided injection or surgical decompression, clinical outcomes appear more predictable, and recurrence rates are lower.

Based on the current evidence, routine incorporation of ultrasound into the assessment and management algorithm for de Quervain tenosynovitis is justified. Future studies should aim to standardize scanning protocols and further define how ultrasound-guided anatomy-based strategies compare with traditional approaches in terms of efficacy, complications, and cost-effectiveness.

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