Efficacy of ultrasound-guided platelet rich plasma injection for the management of de Quervain's tenosynovitis

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Abstract. De Quervain's tenosynovitis (DQT) is a painful stenosing tenosynovitis of the first dorsal compartment of the wrist, which may be refractory to conservative treatments. The present study aimed to evaluate the efficacy of ultrasound (US)-guided platelet-rich plasma (PRP) injection for the management of DQT. For this purpose, from January, 2020 to February, 2021, 12 patients with DQT who received the US-guided PRP injection were studied prospectively. All patients were evaluated clinically for pain intensity using the visual analog scale and sonographically prior to treatment. The patients were followed-up at 1 and 3 months after the procedure to evaluate the efficacy of the treatment. In total, 12 hands of 12 female patients with DQT were analyzed in the present study. The post-treatment clinical evaluation revealed complete recovery in 4 (33.3%) of the patients, and 6 (50%) of them had recovered and returned to their daily activities. The sonographic evaluation revealed a significant reduction in the mean retinaculum thickness from 1.84 to 1.069 mm, and mean tendon sheath effusion from 2.06 to 1.25 mm, with only 58% of the cases having tendon sheath effusion at 3 months post-treatment. On the whole, the findings of the present study demonstrate that US-guided PRP injection with needle tenotomy can be used as an alternative non-surgical therapy for patients who do not respond to conventional conservative treatments, particularly in cases with sub-compartmentalization. The use of US may play a crucial role in the treatment of DQT, as improved clinical outcomes can be obtained with US-guided injections, particularly in cases with sub-compartmentalization.

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Introduction

De Quervain's tenosynovitis (DQT) is a painful stenosing tenosynovitis of the first dorsal compartment of the wrist that contains tendons of the abductor pollicis longus (APL) and extensor pollicis brevis (EPB). The disease limits wrist movement and is also known as de Quervain's disease, de Quervain's syndrome and de Quervain's tendinopathy (1,2). It is considered one of the most frequent types of wrist tendonitis in athletes, and it is also more prevalent among women between the ages of 30 and 50 years (3). Although the exact cause of DQT remains unclear, overuse or repetitive activity involving the wrist is one of the common causes (4,5).

Non-surgical conservative therapy is considered a first-line treatment for DQT. It includes decreased activity and physiotherapy to reduce pain and inflammation, splinting to reduce tendon friction, the use of non-steroidal anti-inflammatory drugs (NSAIDs), and the injection of corticosteroids (6). The majority of cases (83%) recover following a single corticosteroid injection (7). In the case that conservative therapy fails, which is often due to an inaccurate injection and anatomical variations in the first dorsal compartment, a surgical approach through decompression is considered (8).

Platelet-rich plasma (PRP) therapy is the injection of a patient's own platelet-concentrated plasma that contains growth factors and possesses regenerative characteristics that stimulate tissue healing (9). Ultrasound (US) guidance allows for the accurate injection of PRP (10). Previous studies have demonstrated the efficacy of PRP in the management of other tendinopathies (11). Currently, PRP injection therapy is used as alternative management in patients with DQT who have failed to respond to other conservative treatment strategies (12). However, there are insufficient studies regarding its efficacy, with or without US guidance. The present study aimed to evaluate the efficacy of the use of US-guided PRP injection in the management of DQT.

Patients and methods

Registration. The current study was registered as per the Declaration of Helsinki - 'Every research study involving human subjects must be registered in a publicly accessible database

before recruitment of the first subject' (https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/). The study was recorded at Research Registry, with a registration number of: researchregistry8593.

Setting and study design. The present study was a prospective interventional study that included 12 patients with DQT. It was conducted over a period of 13 months, from January, 2020 until February, 2021 at the Sulaimani Teaching Hospital and Shar Teaching Hospital (Sulaimani, Iraq). Ethics committee approval was obtained from the Ethics Committee of the University of Sulaimani. Verbal and signed written consents were acquired from all the patients for US-guided PRP injection and for the use of their data.

Inclusion and exclusion criteria. The inclusion criteria included patients with DQT who failed to respond to conservative treatments. Patients who were had a history of rheumatoid arthritis, trauma or fractures in the hands or the wrist joints, shoulders or elbow problems, or those who had received previous corticosteroid injection therapy for DQT within the last 6 weeks were excluded from the study.

Pre-treatment assessment. A short history and demographic information were collected from the patients, and they were given a 10-point visual analog scale (VAS) score to assess pain intensity and ability to perform daily tasks. All the patients were diagnosed clinically using the Finkelstein test. A US examination was used to confirm the diagnosis of DQT. In addition, the examination of the opposite hand was also performed for comparison. A B-mode US examination with a sufficient amount of gel was performed in both the transverse and sagittal planes to allow for the proper evaluation and visualization of anatomical structures, followed by a color Doppler US mode to detect peri-tendinous hyperemia. The B-mode gain was decreased and the color gain was increased at a threshold just below aliasing to optimize the visualization of low-velocity flow. Complete data on the baseline sonographic findings were collected, including the thickness of the extensor retinaculum, tendon sheath effusion, paratendinous hyperemia and anatomical variation.

Procedure. For the preparation of the PRP, 10 ml of blood were drawn from each patient and placed in a Hightop PRP tube (Lora). The blood was centrifuged at 1,792 x g for 10 min at a temperature of 24˚C. Finally, 2 ml PRP were obtained from each blood sample, which was ready for injection. PRP injections were performed under local anesthesia using an aseptic technique with the patient in a sitting position, with the hand resting on a pillow and slight ulnar deviation of the wrist. Under the US guide, 1 ml of the anesthetic agent (lidocaine) was diffused subcutaneously. After 5-10 min, 2 ml PRP were injected into the affected area under US guidance. The injection was made by inserting a 22-gauge needle at a 45˚ angle to the transducer into the tendon sheath, followed by needle tenotomy of the tendons to induce intra-tendinous micro tear, promoting faster healing.

In the case of sub-compartmentalization, half of the PRP (1 ml) was injected into each compartment. To ensure this, once the first compartment was injected, either the septum between the sheaths was pierced with the needle, or the needle was drawn back and the remaining half was injected around the other tendon. The injection area was then cleaned and a plaster was applied.

Each patient was monitored for 10 min after the injection, then discharged from the department. Patients were recommended to avoid straining and repetitive movements of the treated wrist for at least 7 days and to wear a wrist splint for 2-3 days. They were also advised to use an ice pack or paracetamol as a painkiller when necessary and to avoid the use of other NSAIDs.

Patient follow-up. All patients were followed-up at 1 week after the injection and were examined for any complications at the injection site, including the presence of infection, loss of function and tendon stiffness or rupture. In addition, the patients were scheduled to visit after 1 and 3 months to determine the pain severity level based on the VAS score, and to evaluate the efficacy and durability of the treatment using a US examination. None of the patients received any other treatment for DQT during the follow-up period.

Data collection and analysis. Microsoft excel 2019 was used to register the data. The Statistical Package for the Social Sciences (SPSS) program-version (25) (IBM Corp.) was used to code and conduct data analysis. The outcomes of the procedure were analyzed using one-way ANOVA test with Tukey's post hoc test being performed when significant results were observed (as the periodic groups had the same sample size). The results are presented as the mean ± standard deviation. Qualitative data are presented as frequencies and percentages, and McNemar's test was used to make comparisons (as data for the same variable were obtained from the same individual in different time periods). A P-value <0.05 was considered to indicate a statistically significant difference.

Results

Demographic and baseline characteristics. A total of 12 hands of 12 female patients with DQT were examined in the present study. All the patients were housewives with an average age of 43 years, ranging from 28 to 68 years. Amongst the affected hands, 8 (66.6%) were dominant, and 4 (33.3%) were non-dominant, as presented in Table I.

Clinical assessment. Upon a clinical examination, all the patients presented with tenderness over the radial styloid process, 4 patients had swelling, and the results of the Finkelstein's test were positive for all the cases. The patients had an average VAS score of 8.66 prior to treatment, and post-treatment, the score decreased to 4.5 and 1.91 ($P<0.001$) at the 1- and 3-month follow-up periods, respectively. The VAS scores of the patients before and after treatment are presented in Table II.

No procedure-related complications occurred during the injection; however, 2 patients had mild vasovagal signs after the procedure, which may be due to side-effects of lidocaine or pain at the time of the injection. Amongst the patients, complete recovery was observed in 4 patients (33.3%), 6 patients (50%)

Table I. Demographics and history of the patients with DQT in the present study.

Patient no.	Age, years	Duration of symptoms	Affected hand	Previous treatment
1	28	12 months	Dominant	Rest, NSAID, and corticosteroid injection
2	65	2 months	Dominant	Rest, NSAID
3	35	2 months	Non-dominant	Rest, NSAID
4	45	3 months	Dominant	Rest, NSAID
5	30	4 months	Dominant	Rest, NSAID
6	68	4 months	Non-dominant	Rest, NSAID, and corticosteroid injection
7	30	2 months	Dominant	Rest, NSAID
8	53	3 months	Dominant	Rest, NSAID
9	43	4 months	Non-dominant	Rest, NSAID
10	26	2 months	Dominant	Rest, NSAID
11	60	6 months	Dominant	Rest, NSAID, and corticosteroid injection
12	33	2 months	Non-dominant	Rest, NSAID

DQT, de Quervain's tenosynovitis; NSAID, non-steroidal anti-inflammatory drugs.

Table II. VAS scores of patients for pain intensity.

Patient no.	Pre-treatment VAS score	VAS score at 1-month follow-up	VAS score at 3-month follow-up	P-value[a]
1	9	1	0	<0.001
2	9	8	8	
3	9	5	0	
4	9	4	1	
5	9	5	2	
6	8	3	0	
7	9	7	7	
8	7	2	0	
9	9	6	1	
10	8	5	2	
11	9	4	1	
12	9	4	1	
Mean	8.66±0.65	4.5±1.97	1.91±2.71	

[a]The P-value is representative for all patients before and after treatment. VAS, visual analogue scale.

had recovered to a degree where they returned to their daily activities with minimal pain, and no significant improvement was observed in 2 patients (16.6%).

Sonographic evaluation. Baseline sonographic findings (as presented in Table III) revealed a thickened retinaculum (1.89±0.5; ranging from 1.3-3 mm) and tendon sheath effusion (2.07±0.52) in all patients (illustrated in Figs. 1 and 2). As regards anatomical variations, 5 patients (41.7%) had septum between APL and EPB, and 4 patients (33.3%) had accessory tendon slips (example illustrated in Fig. 1). However, post-PRP injection, a US examination at the 1- and 3-month follow-up periods revealed a significant improvement in the patients. The thickness of the extensor retinaculum had progressively decreased, from a mean of 1.89 mm pre-injection to a mean of 1.3 mm and 0.96 mm at the 1- and 3-month follow-up, respectively (P<0.001). The tendon sheath effusion observed in all the patients had a mean thickness of 2.07 mm pre-injection. At the 1-month follow-up, effusion was observed in 11 cases (91%) with a mean thickness of 1.6 mm, and at the 3-month follow-up, only 7 of the cases had effusion (58%) with a mean thickness of 0.73 mm (P<0.001). Peri-tendinous hyperemia

Table III. Ultrasound findings at baseline and at the 1- and 3-month follow-up periods.

			Tendon sheath effusion (mm)				Retinaculum thickness (mm)				Peri-tendinous hyperemia				
Patient no.	Septum between EPB and APL	Multiple tendon slips	Baseline	1-Month follow-up	3-Month follow-up	P-value	Baseline	1-Month follow-up	3-Month follow-up	P-value	Baseline	1-Month follow-up	P-value	3-Month follow-up	P-value
1	Yes	-	1.8	1	0.5	<0.001	1.6	1.4	0.9	<0.001	-	-	0.063	-	<0.001
2	-	-	2	2	1.8		2.4	2.4	2.4		Yes	Yes		-	
3	-	Yes	1.4	1.2	0		1.8	0.9	0.5		-	-		-	
4	Yes	-	2.3	2	1		2.5	1.8	1.2		-	-		-	
5	-	-	2	1.6	0		1.9	1.6	1		Yes	-		-	
6	Yes	-	3	3	2		1.6	1.4	1		Yes	-		-	
7	-	-	2.3	2	1		1.8	1.6	1		Yes	-		-	
8	Yes	Yes	1.5	1.5	1.5		1.9	1	1		Yes	Yes		-	
9	-	Yes	2	1.8	0		1.5	0.9	0.9		-	-		-	
10	-	-	1.5	1	0		1.3	1	0.6		Yes	-		-	
11	Yes	Yes	3	2.1	1		3	1.6	1		Yes	-		-	
12	-	-	2	0	0		1.4	0	0		-	-		-	
Overall	5/12 (41.7%)	4/12 (33.3%)	2.07±0.52	1.6±0.75	0.73±0.76		1.89±0.5	1.3±0.6	0.96±0.56		7/12 (58.3%)	2/12 (16.7%)		0/12 (0%)	

In each column, the P-values presented are representative for all patients before and after treatment. EPB, extensor pollicis brevis; APL, abductor pollicis longus.

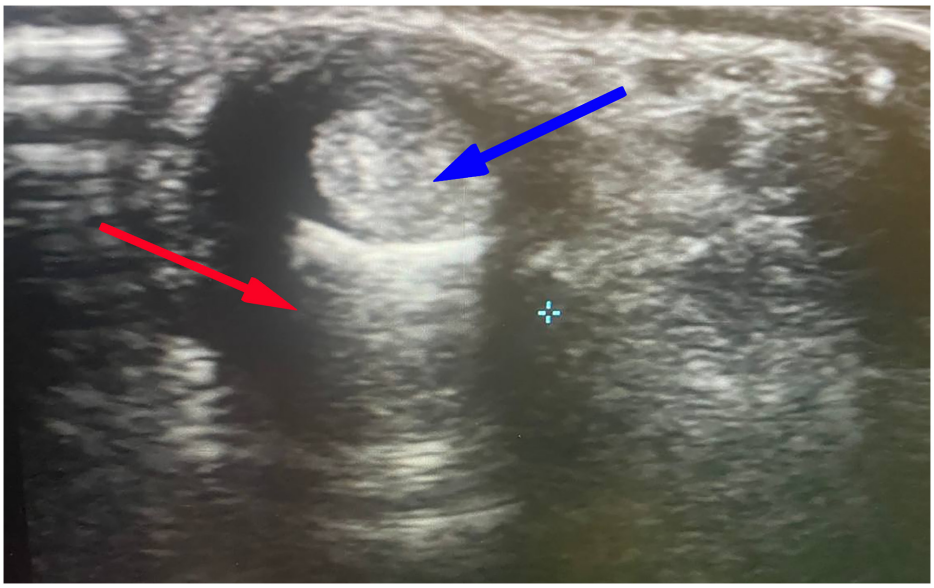

Figure 1. Transverse scan of the first dorsal compartment showing thickened retinaculum (red arrow), with tendon sheath effusion (blue arrow).

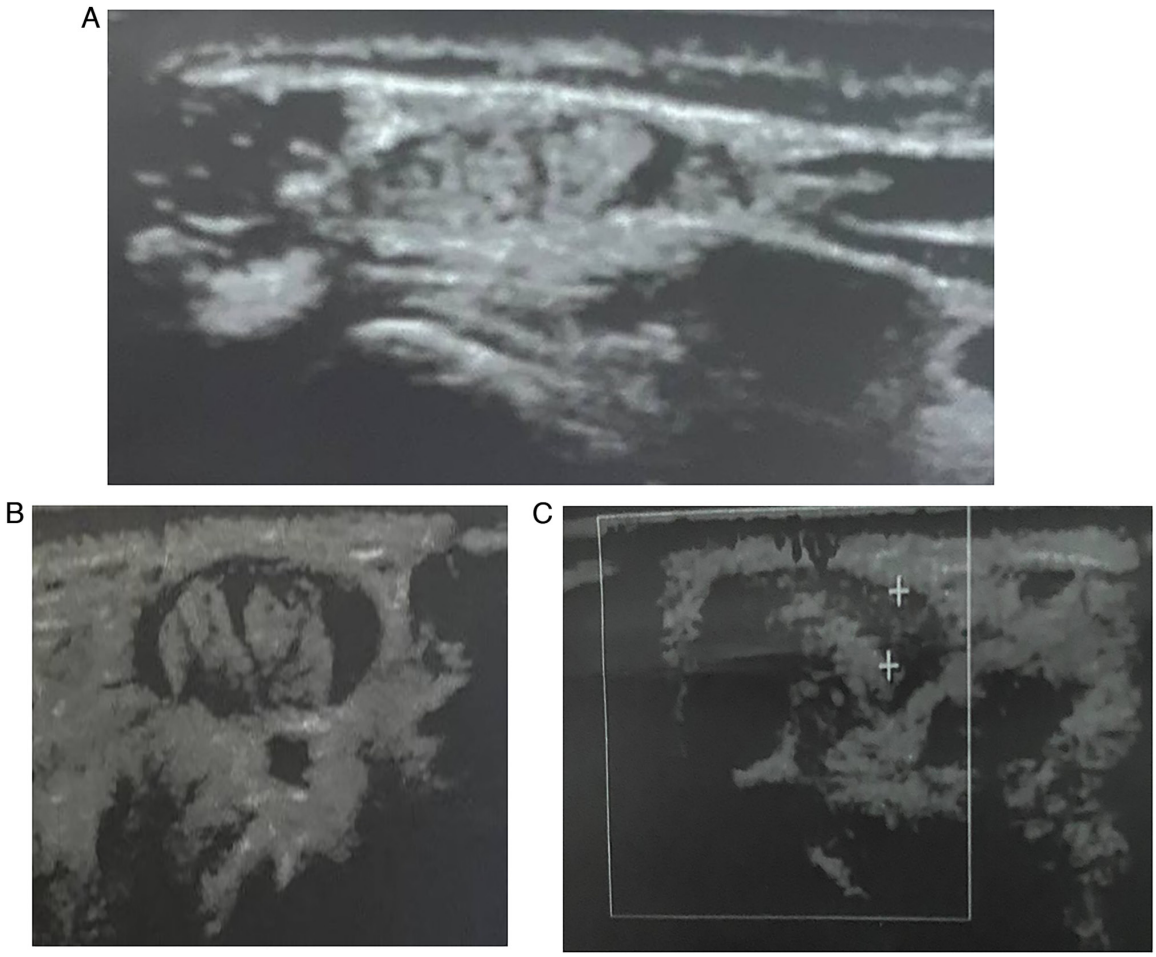

Figure 2. Transverse scan of the first extensor compartment: (A) Normal hand compared to (B) symptomatic hand with tendon sheath effusion and (C) a hand with a thickened retinaculum.

was initially observed in 7 patients (58.33%), and after the PRP injection this was only observed in 2 patients (16.7%) at the 1-month follow-up (P<0.063) and in no patients (0%) (P<0.001) at the 3-month follow-up (Table III; examples illustrated in Fig. 3). Sonographic improvements observed in two different patients are illustrated in Figs. 4 and 5.

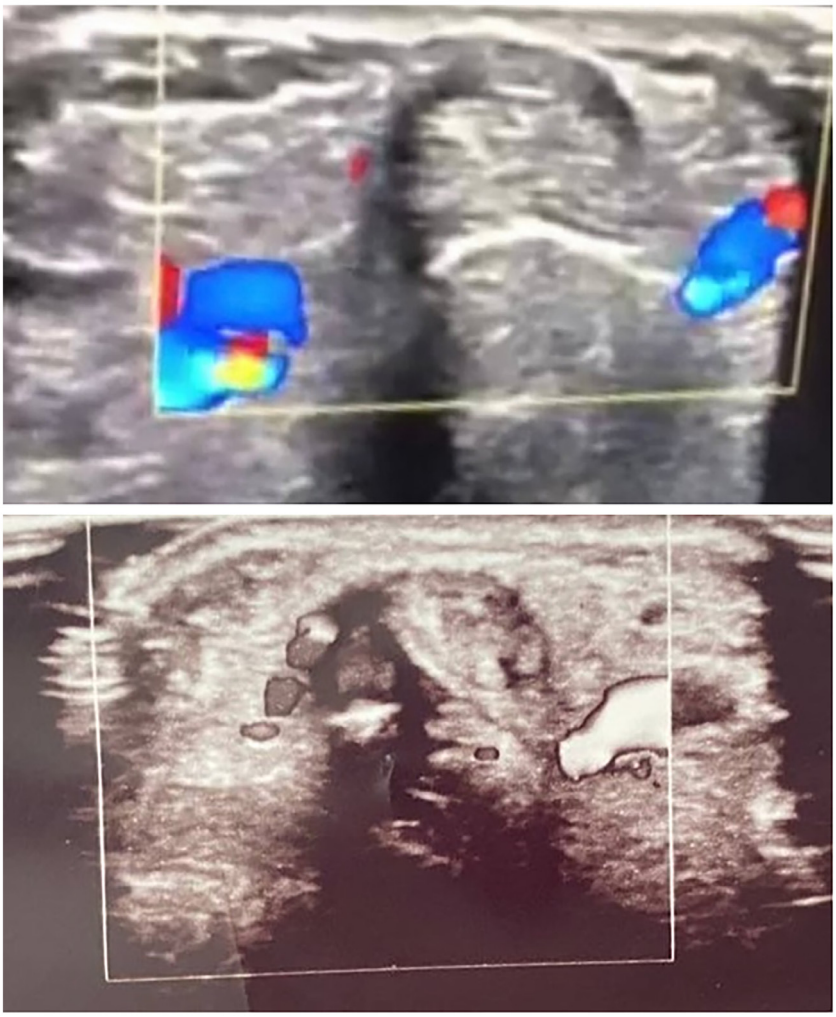

Figure 3. Transverse scan of the first extensor compartment of two different patients (top and bottom panels), illustrating peri-tendinous hyperemia, a thickened retinaculum and tendon sheath effusion.

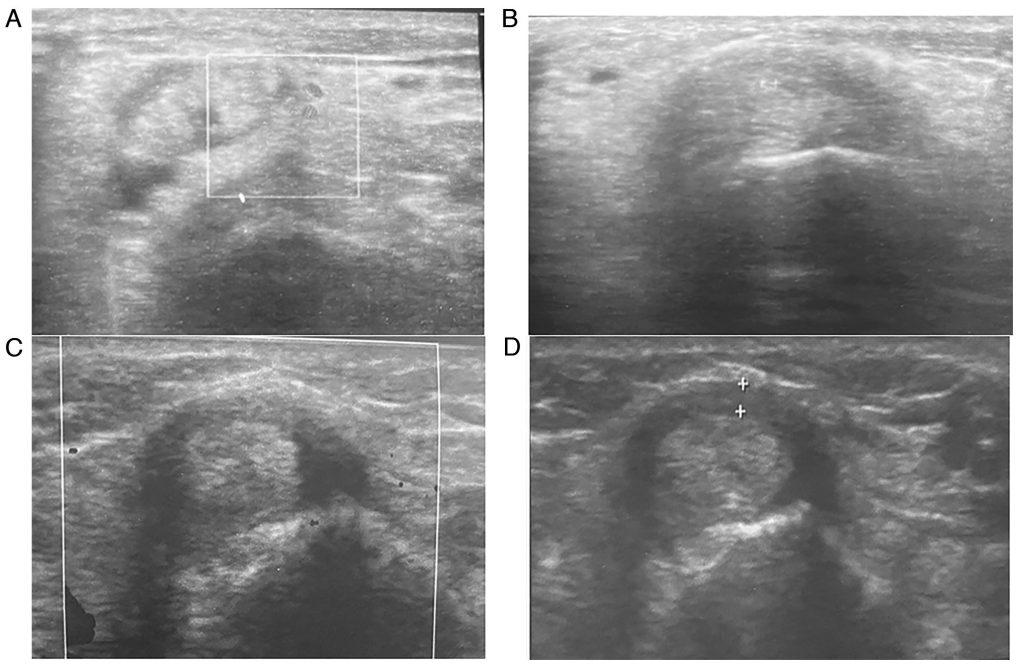

Figure 4. Ultrasound examination of the left wrist of a 60-year-old female patient. (A) Evidence of hyperemia) and (B) evidence of retinaculum thickness before treatment; (C and D) at 3 months after the platelet-rich plasma injection, indicating no evidence of (C) hyperemia and (D) a prominent decrease in retinaculum thickness.

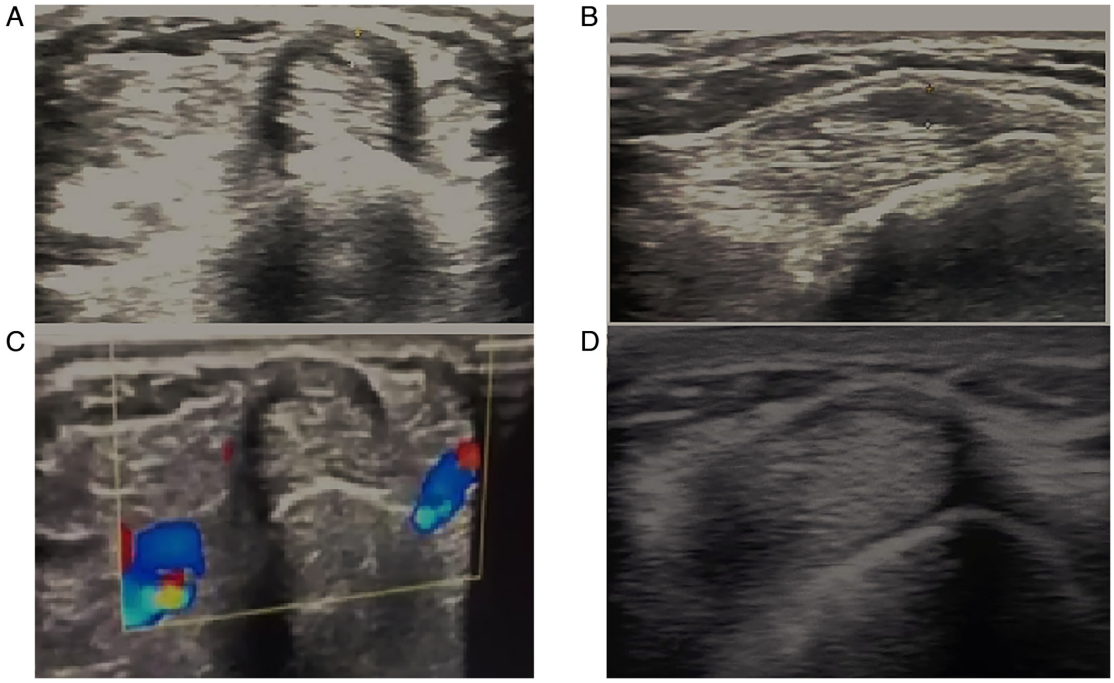

Figure 5. Ultrasound of the first dorsal compartment. (A) Transverse scan; (B) longitudinal scan, illustrating a thickened retinaculum; (C) peri-tendinous hyperemia in a 30-year-old female patient; (D) a prominent decrease in retinaculum thickness observed at 1 month after the platelet-rich plasma injection, which was maintained at the 3-month follow-up scan.

Discussion

DQT is a common disorder that was first mentioned in Gray's Anatomy in 1893 as washerwoman's sprain. The condition was named after the Swiss surgeon, Fritz de Quervain, after he reported 5 cases of first compartment tenosynovitis in 1895 (13). It occurs in 1.3 and 0.5% of working women and men, respectively (14). DQT affects the APL and EPB tendons in the first dorsal compartment of the wrist, which become inflamed and injured as a result of repetitive wrist movements, resulting in pain and reduction in the wrist's range of motion. Its symptoms can be elicited by Finkelstein's test (15,16). DQT may also occur as a consequence of certain wrist fractures, dislocations of the wrist, or in the setting of systemic diseases such as rheumatoid arthritis (17,18).

Although DQT mainly affects the dominant hand, the involvement of the non-dominant hand has been stated in previous research (19). In their study, Lutsky *et al* (20) reported an equal involvement of dominant and non-dominant hands in DQT cases. In the present study, the dominant hand was involved more frequently (66.6%).

Usually, the APL and EPB tendons are in a single compartment; however, certain anatomic variations may be risk factors for the disease, such as the presence of a fibrous septum and multiple tendon slips (21). These anatomic variations may play a role in the development of DQT by resulting in overcrowding and increased tendon friction (22). In addition, early motherhood, pregnancy and the post-menopausal status are considered predisposing factors in women (14). Chiavaras *et al* (23) reported the presence of an inter-compartment septum in the first extensor compartment in 47% of cadaveric wrists; moreover, this prevalence is greater (59%) in the wrists of patients with DQT. In the present study, out of the 12 patients examined, 5 patients (41.7%) had septum between APL and EPB, and 4 patients (33.3%) had accessory tendon slips; this is slightly lower than what has been previously mentioned by Chiavaras *et al* (23).

Generally, the inflammation and pain caused by DQT can be reduced using a wrist splint to limit wrist movement, and oral analgesics, such as NSAIDs. The injection of steroids into the first dorsal compartment of the wrist is considered as the next line of treatment prior to surgery (24). Furthermore, US-guided PRP injection has emerged as a new non-operative treatment alternative for DQT (10).

The visualization of compartmental anatomy and needle placement with US-guided injection enhances the injection accuracy and clinical outcomes (12). US-guided PRP injection prevents intra-tendinous injection, diminishes the risk of subsequent tear, precisely introduces the injectate into the affected region in cases of sub-compartmentalization, and prevents injection-related complications, such as superficial radial nerve injury (25,26). Peck and Ely (12) used US-guided percutaneous tenotomy and PRP injection in their study to successfully treat a case of DQT, with no reported complications. Moreover, Güleç *et al* (27) used anatomical landmarks for the percutaneous release of the first dorsal compartment and reported several complications, including a 39.6% laceration rate. In the present study, the majority of the cases (83.3%) experienced symptomatic improvement, and no procedure-related complications occurred; however, 2 patients had mild vasovagal signs after the procedure.

Previously, a cohort study by Deb *et al* (28) revealed a good clinical outcome of PRP injection in the treatment of DQT without US guidance; however, they were only able to decrease the VAS scores of patients from 8.98±0.57 to 4.91±1.01 and 3.96±1.94 at the 1- and 6-month follow-up periods,

respectively. In addition, Deb *et al* (28) used a blind approach with a 4-ml PRP injection. In the present study, an improved clinical outcome was achieved with the use of US guidance and half the amount of PRP (2 ml); the mean VAS scores of the patients decreased from 8.66 to 4.5 and 1.91 at 1 and 3 months post-treatment. Another study by Sobhia *et al* (29) attempted to determine the efficacy of PRP injection in comparison to steroid injection and revealed a significant improvement in the pathological manifestations of DQT, such as peri-tendinous hyperemia, thickening of the retinaculum, and tendon sheath effusion. These improvements were also achieved in the present study.

Despite the advantages of the present study, it still has multiple limitations, including a small sample size and the lack of long-term follow-up. In addition, the levels of inflammatory markers were not determined, and the lack of a control group without US guidance is also a limitation. Thus, further studies are required in the future to validate the current findings.

In conclusion, US plays a critical role in the treatment of DQT, as improved clinical outcomes can be obtained with US-guided injections, particularly in cases with sub-compartmentalization. Hence, a US-guided PRP injection with needle tenotomy can be used as an alternative non-surgical therapy for patients who do not respond to conventional conservative treatments. In order to better understand the efficacy of this technique in refractory DQT, further more dedicated and controlled research trials are required.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

AMS was a major contributor to the conception of the study. KKM, KMS and SKA were involved in the literature review, the design of the study, in the revision of the manuscript and in the processing of the figures. KAM and SOA are the radiologists who performed the assessments of the patients. FHK and BAA were involved in the literature review, in the writing of the manuscript, and in data analysis and interpretation. SHM and RQS were involved in designing the study. SHM and RQS confirm the authenticity of all the raw data. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the University of Sulaimani (Sulaimani, Iraq; no. 2019:33). Written informed consent was obtained from all the patients and/or the families of the patients.

Patient consent for publication

Patient consent was obtained regarding the publication of their data and any related images.

Competing interests

The authors declare that they have no competing interests.

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