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Percutaneous Release of the First Dorsal Extensor Compartment: A Cadaver Study

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Background: To evaluate the efficiency of the percutaneous 18-G needle technique in releasing the fibro-osseous sheath over the first dorsal extensor compartment of the hand.
Methods: Using anatomic landmarks, percutaneous release was performed with an 18-G needle on 48 wrists of 24 cadavers. The specimens were then dissected and examined for the completeness of the first dorsal extensor compartment release and any tendon or neurovascular injuries. The tunnel length, number of abductor pollicis longus and extensor pollicis brevis tendons, presence of an intertendinous septum, and the effects of these parameters on percutaneous release were evaluated.
Results: Percutaneous release was performed on all of the wrists, and the evaluation of the adequacy of release revealed 25 complete releases, 21 partial releases, and 2 missed releases. There were 19 cases of tendon complications. No neurovascular injuries were noted. The mean tunnel length was 2.66±30 cm, and the mean number of tendons was 2.75±0.86. A septum was present in 33.3% of cases. Tunnel length and tendon number had no statistically significant effect on release, whereas the presence of a septum was significantly associated with inadequate tunnel release and the development of tendon complications.
Conclusions: Percutaneous release of the first dorsal extensor compartment using an 18-G needle was associated with high rates of incomplete release and tendon damage in the presence of an intertendinous septum. Further study is required under ultrasound guidance to determine the usefulness of percutaneous release in the first dorsal extensor compartment.
Clinical Relevance: Release with a percutaneous needle tip in De Quervain's syndrome may provide the advantages of better cosmetic results with less scar formation and an early return to work. *(Plast Reconstr Surg Glob Open 2016;4:e1022; doi: 10.1097/GOX.0000000000001022; Published online 5 October 2016.)*

De Quervain's syndrome is a stenosing tenosynovitis of the abductor pollicis longus (APL) and extensor pollicis brevis (EPB) tendons. Nonsurgical methods, such as nonsteroidal anti-inflammatory medications, are used in the primary treatment of this disease.[1] In patient groups where conservative treatment is not successful, the fibro-osseous sheath over the first dorsal extensor compartment is released using surgical methods for symptomatic relief.

Although the release can be performed with standard open surgery techniques, it has recently been performed with less invasive endoscopic techniques.[2] There has been increasingly widespread use of minimally invasive methods in the surgical treatment of common conditions such as carpal tunnel, cubital tunnel, Dupuytren contracture, and trigger finger. The results of these surgical methods are equivalent to those of open surgery; however, these new methods are more cosmetically acceptable to the patient, causing less scarring, and they have the added advantage of an earlier return to work.[3–8]

Some studies have reported that needle tip percutaneous tenotomy can be performed effectively and safely in Dupuytren disease and trigger finger.[5,8,9] The hypothesis of this study was that percutaneous needle tenotomy can also be applied in De Quervain's disease and can provide

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effective release of the first dorsal compartment. The aim of this study was to understand the effects of release of the fibro-osseous sheath on the first dorsal extensor compartment with percutaneous needle tip tenotomy and to evaluate the potential nerve and tendon complications after tenotomy.

MATERIALS AND METHODS

Approval for the study was granted by the Institutional Review Board of the Ethics Committee of the Istanbul Forensic Science Institution. Through the Forensic Medicine Institute, 48 upper limbs without previous injury to the wrist area were obtained from 24 fresh-frozen cadavers. There were 13 male and 11 female cadavers with a mean age of 45.12 years (range, 17–82 yr) (Table 1). The procedures were performed on the first dorsal extensor compartment of 48 wrists.

Details of the Needle Tenotomy Technique

First, the anatomic landmarks on the first dorsal compartment were identified as previously shown by Hazani et al.[10] The proximal and distal borders of the area where the percutaneous release was to be made were indicated with a marker pen. The distal release location was at the midpoint of the line drawn between Lister's tubercle and the scaphoid tubercle. The proximal site was a 2.5-cm section of the tendon over the APL (Figs. 1A, B).

Next, an 18-G needle tip was advanced into the compartment from the distal portion of the dorsoulnar aspect of the indicated line; the localization of the needle over the tendon was confirmed with wrist movement (Figs. 1C, D). Pulling the needle back over the tendon, small oscillations were made at 5-mm intervals over the sheath, directly parallel to the tendon from the proximal to distal direction, thereby releasing the tunnel (Fig. 1E).

In the third stage of the study, the wrists were dissected, with specific attention paid to the adequacy of the first dorsal extensor compartment release and any injury to other structures (tendons or nerves). A longitudinal incision was made from the proximal and distal creases in line with the respective rays, and the dissection carefully proceeded down to the tendon under 3.5× loupe magnification. Measurements were obtained using rulers. First, the status of the tunnel release was assessed (Figs. 1F–G). The release was considered complete if the entire length of the first dorsal compartment was released (Fig. 2). It was deemed partial if part of the first dorsal compartment was intact (Fig. 3), and a missed release was declared if the needle had not released the tunnel at all. Wrists remaining intact at both ends were also considered a missed release (Fig. 4). For the partial releases, the length and site of the remaining tunnel were noted. The actual length of the first dorsal compartment was also measured with calipers. Together with the evaluation of the tunnel release, the tunnel length and the presence of a septum between the APL and the EPB were also assessed.

The APL and EPB tendons were then inspected for any injuries. Tendon injuries were classified as no injury,

Table 1. Characteristics of the Cadavers

Parameters	Total	Descriptive Data
Age (yr)	24	45.12±18.21 (17.0–82.0)
Gender (female/male)	11/13	45.8%/54.2%
Tunnel length (cm)	48	2.66±0.30 (1.90–3.10)
Septum (present/absent)	16/32	33.3%/66.7%
Tendon number	48	2.75±0.86 (2.0–5.0)
Release (complete/partial/missed)	25/21/2	52.1%/43.7%/4.2%
Tendon damage (none/longitudinal scoring/partial laceration/complete laceration 1 tendon/complete laceration 2 tendons)	29/7/2/8/2	60.4%/14.6%/4.2%/16.7%/4.2%

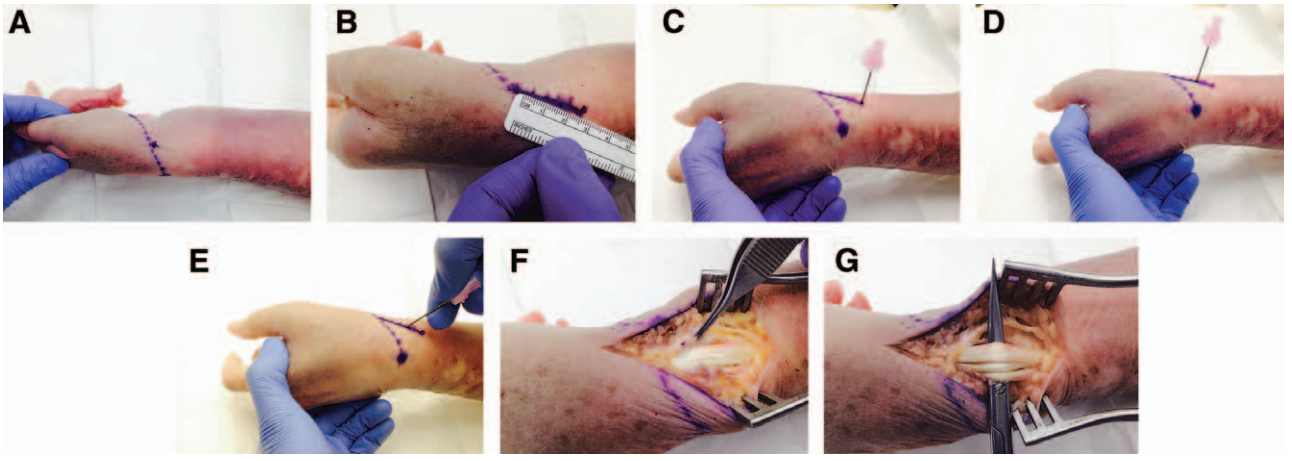

Fig. 1. A, B, Marking the landmarks. C, D, Needle over the tendon was confirmed with wrist movement. E, Pulling the needle back over the tendon, small oscillations were made at 5-mm intervals. F–G, The status of the tunnel release was assessed.

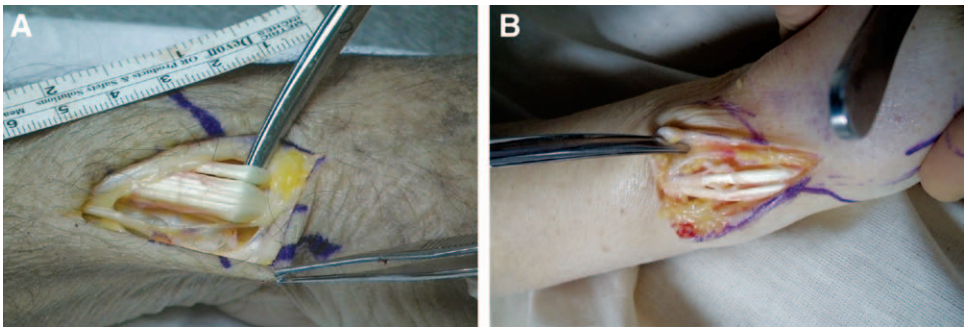

Fig. 2. A, Complete release of first dorsal extensor compartment without septum and tendon injuries. B, Complete release of first dorsal extensor compartment with septum.

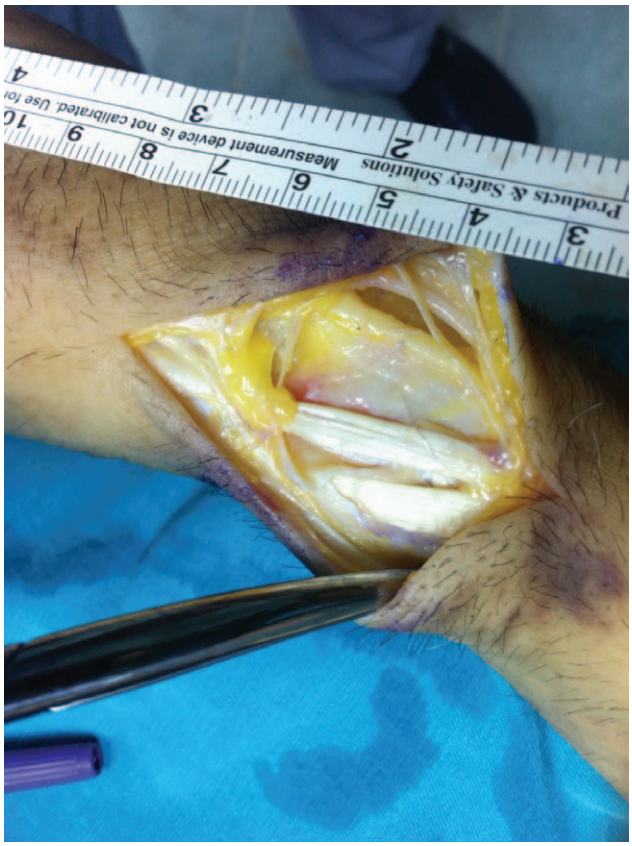

Fig. 3. Septum with the partial release of compartment (proximal part of the compartment).

longitudinal tendon scoring (indentation into the tendon tissue), partial laceration (interruption of 1 edge of the tendon with the tendon continuity maintained), or complete laceration (tendon continuity interrupted). The number of tendons in the tunnel and the occurrence of any injury related to the sensory branches of the radial nerve were assessed.

Statistical Analysis

The statistical analyses of the study data were performed using SPSS for Windows software (version 21.00; SPSS, Chicago, Ill.). As normal distribution was not achieved for any parameter, the nonparametric Mann-Whitney U test was used for between-group comparisons of the existing parameters. For comparisons of categorical parameters, analyses were performed with the Pearson chi-square test and Fisher's exact test. In addition, the descriptive properties in the study were evaluated with descriptive statistical tests. A value of $P < 0.05$ was accepted as statistically significant.

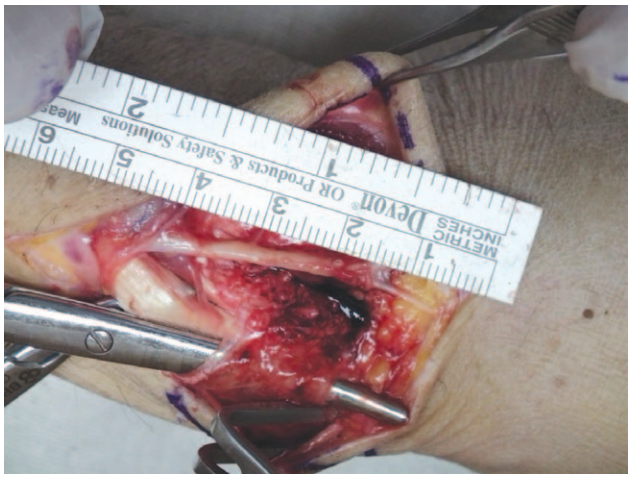

Fig. 4. İntact compartment after percutaneous release.

RESULTS

Percutaneous release was applied to all wrists and yielded the following results: 25 (52.1%) complete releases, 21 (43.7%) partial releases, and 2 (4.2%) missed releases. The results for each wrist are shown in Table 2. Of the 21 partial releases, the proximal edge of the first extensor compartment was intact in 8 wrists, and the distal portion was intact in 13 wrists. Both edges were intact in 2 wrists. Despite the high rate of partial releases, the remaining unreleased portion of the tunnel in the partial release cases had mean lengths of 17.69% of the distal edge and 15% of the proximal edge.

There were 19 (39.6%) cases of tendon complications. Of these cases, 8 had a complete laceration of a single tendon, 2 had a complete laceration of 2 tendons, 7 had a longitudinal indentation (scoring) of the tendon tissue without any tendon length interruption (Fig. 5), and 2 had

Table 2. Comparison of the Release Groups

Parameters	Total	Release (Full)	Release (Incomplete)	*P*
Total wrists	48	25 (52.1%)	23 (47.9%)	–
Number of tendons (mean; range)	25/23	2.68±0.90 (2.0–5.0)	2.82±0.83 (2.0–5.0)	0.992
Septum (present/absent)	16/32	20% (5)/80% (20)	47.8% (11)/52.2% (12)	0.041*

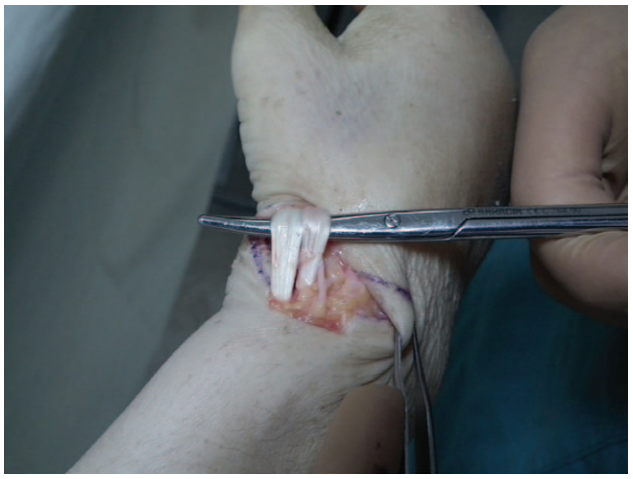

Fig. 5. EPB tendon longitudinal scoring with complete release.

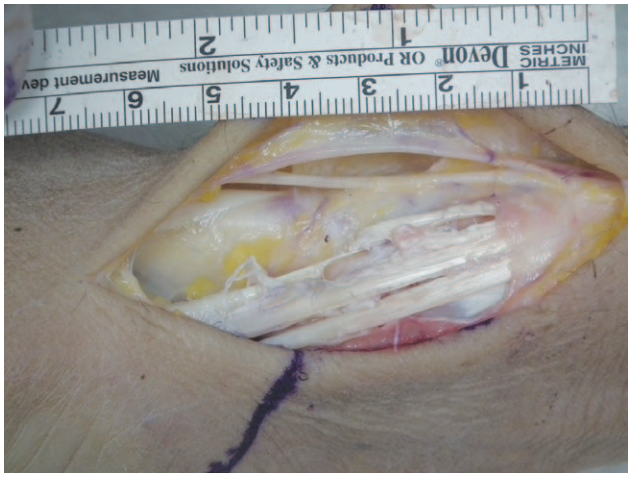

Fig. 6. EPB partial lacerations with incomplete proximal compartment release.

partial lacerations with oblique involvement interrupting only 1 edge of the tendon (Fig. 6). The EPB was involved in 6 complete lacerations of a single tendon, 3 scorings, and 2 partial lacerations, whereas the APL was involved in 2 complete lacerations of a single tendon, 2 complete lacerations of 2 tendons, and 4 scorings (Table 3).

A septum was located inside the fibro-osseous sheath of 33.3% of the hands in the study, and no septum was found in 26 (89.7%) of the 29 hands with no tendon damage. Of the 19 hands with tendon damage, a septum was found in 13 (68.4%). A statistically significant relationship was found between the presence of an intraosseous septum and the development of tendon damage after needle tenotomy in the hands included in the study ($P < 0.05$) (Table 4).

The mean tunnel length was 2.66±0.30 cm, and the mean number of tendons was 2.75±0.86. In addition, no septum was found in 66.7% of the hands (Table 2).

Regarding the degree of release, the mean number of tendons was 2.68±0.90 in the complete release group and 2.82±0.83 in the incomplete release group. No statistically significant difference was found between the groups with respect to tendon number ($P > 0.05$) (Table 2).

A septum was found in 20% of the complete release hands and in 47.8% of the hands in which an incomplete release was observed. A statistically significant relationship was found between the release groups and the presence of a septum ($P < 0.05$) (Table 2).

Although the mean tunnel length was found to be 2.65±0.33 cm in the complete release group, the mean tunnel length was 2.67±0.29 in the incomplete release group. No statistically significant effect of tunnel length on release was found ($P > 0.05$) (Table 2).

There were no injuries to the nerves or vessels.

DISCUSSION

Minimally invasive approaches, which are being increasingly employed in current orthopedic interventions, are also applicable to hand surgery. In this study, the efficacy of percutaneous needle release was evaluated as an alternative surgical treatment for De Quervain's disease. Percutaneous release was performed on 48 cadaver wrists, with complete release achieved in 25 wrists and incomplete release achieved in 23 wrists. Various degrees of tendon damage developed after release in 19 cases. The presence of a septum was confirmed in 20% of the complete release hands and in 52% of the incomplete release hands. A statistically significant difference was observed between release and the presence of a septum.

In hand surgery, there is increasing application of percutaneous release. The efficacy of percutaneous techniques in the release of the A1 pulley in trigger finger surgery has been shown in both cadaver and clinical applications, and successful clinical results of percutaneous needle tenotomies have also been reported.[6–9] In a cadaver study by Rowe et al,[4] successful percutaneous release of the carpal tunnel involving 9 tendons and 1 nerve was reported. Because of the advantages of minimally invasive techniques, the hypothesis of this study was that percutaneous release could be an alternative method in the surgical treatment of frequently seen clinical conditions such as De Quervain's disease.

In a study of 32 cadaver wrists, Hazani et al reported that in proximal and distal dissection, the mean extensor retinaculum length was 2.2 cm; septation was present in 35% of wrists. The APL tendon demonstrated great variability, with 1, 2, 3, and 4 slips present in 9%, 30%, 43%,

Table 3. Incidence of Tendon Complications

Tendon (n)	None	Longitudinal Scoring	Partial Laceration	Complete Laceration 1 Tendon	Complete Laceration 2 Tendons
APL	13 (27.1%)	4 (8.3%)	0	2 (4.2%)	2 (4.2%)
EPB	16 (33.3%)	3 (6.2%)	2 (4.2%)	6 (12.5%)	0
Total	29 (60.4%)	7 (14.5%)	2 (4.2%)	8 (16.7%)	2 (4.2%)

Table 4. Incidence of Tendon Complications

Total Wrists	No Tendon Complication	Tendon Complication	*P*
No. tendons	29	19	–
Septum (present/absent)	3/26	13/6	0.041
Mean tunnel length (cm)	2.7 ± 0.33 (1.90–3.10)	2.67 ± 0.29 (2.20–3.10)	0.386

and 26% of the specimens, respectively.[10] Nayak et al[11] encountered septation between the EPB and APL at a rate of 34.6% in dissections performed on 156 cadavers of Indian origin. In this study, the mean tunnel length was found to be 2.66 cm; a septum was present in 33.3% of cases; and the mean number of tendons was 2.75 (range, 2.0–5.0). These results are consistent with those reported in the literature.

In this study, septation was found at a rate of 33.3%, and a statistically significant relationship was shown between incomplete release and septation in the wrists to which percutaneous release was applied. The presence of a septum makes treatment more difficult. Zingas et al[12] recommended that if septation is encountered during an injection, injection to both compartments should be administered under ultrasound guidance (USG) to increase treatment efficacy. Similarly, Mirzanli et al reported that in dissection after the first dorsal compartment injection in 75 cadavers, EPB was in a separate compartment in 28% of cases, and the injection was determined not to have been applied to that compartment. There was evidence that injections to both tendon sheaths would be effective.[13]

In studies of the reliability of ultrasound in anatomic variations of the first dorsal extensor compartment, Rousset et al[14] reported that ultrasound was an effective method in the determination of the presence of a septum, number of tendons, and presence of an osseous ridge. To reduce the incidence of incomplete release and tendon damage in the percutaneous needle release technique, preoperative USG evaluation is recommended to assess whether a septum is present; USG is also beneficial during the release. In contrast to needle tip tenotomies performed using anatomic landmarks, as in trigger finger or Dupuytren contracture, the results of percutaneous needle tip tenotomies of the first dorsal extensor compartment revealed that efficacy was low and tendon complication rates were high.

In a case report by Peck and Ely,[15] treatment of De Quervain's tenosynovitis was performed with percutaneous needle tenotomy and platelet-rich–plasma injection under USG. Initially, 4 ml of 1% lidocaine was administered by infiltrating an 18-G needle between the APL and the EPB under USG before the tenotomy. Then, after opening 30 to 35 fenestrations, a 3-ml platelet-rich–plasma injection was administered. Successful results were reported, suggesting that this method could be offered to patients who do not accept surgical treatment or who are unresponsive to conservative treatment for De Quervain's tenosynovitis.[9] This study differed from that of Peck and Ely in that instead of fenestration; a complete release of the first dorsal extensor compartment was performed. To the best of our knowledge, this is the first literature report on this subject. In clinical applications, this method may achieve effective release in selected patients (without a septum) under USG guidance without leading to nerve and tendon complications.

There were some major limitations to this study. The releases were performed using only anatomic landmarks. The high rates of tendon damage and low rates of complete tunnel release could be attributed to the lack of ultrasound use. In addition, there were technical differences from previous studies, the most important of which was the learning curve. There may also have been alterations in landmarks in the cadavers and tissue turgor because of soft-tissue shrinkage or fluid shifts postmortem.

In conclusion, full release was achieved at a rate of 52% using anatomic landmarks in De Quervain's tenosynovitis. The presence of a septum was found to have an effect on incomplete release and tendon damage. Practice in a cadaver laboratory may be warranted because of the learning curve that was noted in this study. Further studies performed under USG guidance are required to determine the usefulness of percutaneous release in the first dorsal extensor compartment.

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