Misdiagnosis and Radial Tunnel Syndrome: Considering the Distal Biceps Tendon

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Radial tunnel syndrome (RTS) has long been a difficult therapeutic and diagnostic entity for upper extremity surgeons. The presentation is vague and the diagnosis is typically one of exclusion. Multiple clinical entities are known to mimic RTS, but little attention has been paid to the distal biceps. Experience suggests that insertional biceps tendonitis is a potential confounding diagnosis in suspected RTS and that magnetic resonance imaging (MRI) may be of diagnostic benefit in chronic cases before surgical intervention is undertaken. This study is a 13-patient case series. The included patients presented with proximal forearm pain and positive provocative maneuvers for RTS. All included patients were found to have distal biceps pathology on MRI evaluation. At final follow-up (average 6.9 years), all patients had resolution of symptoms with therapy aimed specifically at addressing the distal biceps tendon. A diagnosis of insertional biceps tendonitis could explain both the typical success with conservative treatment and the poor results from surgical intervention for RTS. (Journal of Surgical Orthopaedic Advances 28(1):35–40, 2019)

Key words: conservative management, distal biceps, misdiagnosis, radial tunnel syndrome, tendonitis, therapy

Radial tunnel syndrome (RTS) is a rare pain syndrome in which it is postulated that intermittent compression of the posterior interosseous nerve (PIN) results in proximal forearm pain without motor or sensory deficits (1–3). RTS remains a clinical diagnosis of exclusion as static electromyography (EMG) and other objective data have not proved particularly useful in confirming the diagnosis (4-9). The physical exam findings described by Roles et al. and subsequently expanded on or clarified by others—lateral elbow pain 5 to 6 cm distal to lateral epicondyle, pain with resisted supination, pain with resisted middle finger extension, pain with palpation over the volar elbow (along the radial tunnel), and resolution of pain with corticosteroid injection (CSI) or local anesthetic injection—still provide the basis of diagnosis (2, 6, 9–13). Given the vague nature of the clinical presentation, RTS has, not surprisingly, long been a difficult diagnostic and therapeutic entity for the upper extremity surgeon (9, 14, 15).

Since the term was first coined by Roles and Maudsley in 1972, RTS has been a topic of much debate in the orthopedic community (2, 3). RTS has been doubted by some primarily because of its vague clinical presentation and the lack of confirmatory electrodiagnostic or radiographic findings (3–5, 14, 16). Compounding this controversy is the fact that the PIN has been historically considered a motor-only nerve and its entrapment resulting in a pain-only syndrome has been a source of confusion. Additionally, surgical outcomes have been lackluster and only a fraction of decompressed PINs in patients diagnosed with RTS have visible morphological changes intraoperatively (17). Given this ambiguity, it is widely accepted that multiple clinical entities can mimic RTS, most notably lateral epicondylitis, and therefore one must approach proximal forearm pain with an open differential diagnosis.

One such, often overlooked, diagnosis is distal biceps tendonitis or tendinosis. Contrary to RTS, distal biceps tendon pathology, with the exception of complete rupture, is an entity that has received relatively little attention in the literature (18–26). While it has been mentioned in passing that biceps pathology can mimic RTS (15, 21), biceps pathology is frequently left out of the differential when discussing proximal forearm pain (12). To the authors' knowledge, no report has specifically addressed the overlap in presentation of RTS with insertional biceps

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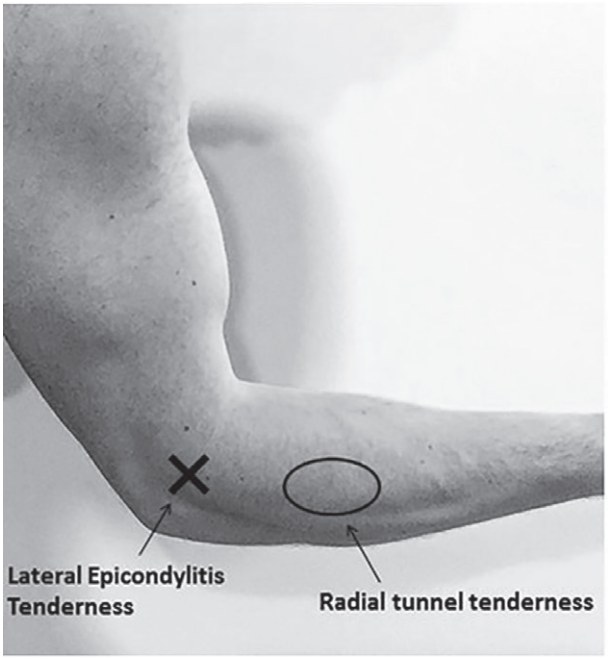

FIGURE 1 The findings of tenderness to palpation for lateral epicondylitis and radial tunnel syndrome are in distinctly different locations. Radial tunnel syndrome tenderness is said to be 5 to 6 cm distal to the lateral epicondyle. This study also found that patients with distal biceps pathology also had pain in this region.

tendonitis. It is the authors' view that the provocative tests said to confirm RTS clinically—proximal forearm tenderness [volar and lateral (23)], pain with resisted supination of the forearm, and improvement with CSI and local anesthetic injection—localize to the distal biceps tendon as well as any other structure. The presence of insertional biceps tendonitis could explain the usual success of conservative management for RTS (13) as well as the oftentimes unsatisfactory surgical outcomes (1–3, 5, 6, 12–14, 17, 27–30).

To investigate this hypothesis, a study was done on a case series of 13 patients who either carried a diagnosis of RTS or had a clinical picture consistent with RTS who were subsequently found to have distal biceps pathology on magnetic resonance imaging (MRI). In all cases, this led to clinical improvement once treatment strategies were appropriately altered. This series identifies insertional biceps pathology as a potential confounding diagnosis in suspected RTS. It is hypothesized that many patients with a clinical presentation consistent with RTS may have distal biceps tendonitis and MRI may be of diagnostic benefit.

Materials and Methods

This study was an institutional review board–approved retrospective chart review of 13 patients who were selected by the senior author for inclusion on the basis of specific criteria. To be included in the study, patients must have presented with a primary complaint of proximal forearm pain with positive provocative maneuvers for radial tunnel syndrome. Patients <18 years old and those who had not failed conservative management were excluded from this study. All patients were seen in a single surgeon's clinic and all physical exams were performed by the senior author. Exam findings considered consistent with a clinical diagnosis of RTS included pain on the lateral forearm that was 5 to 6 cm distal to the lateral epicondyle (3 to 5 cm distal to the radial head; Fig. 1), pain with resisted supination, and pain with palpation over the volar elbow. CSI at the radial tunnel or volar elbow was not routinely used in the diagnostic and therapeutic algorithm so as to minimize risk of rupture at the distal biceps tendon given its close anatomic proximity. All included patients underwent and failed conservative management for a minimum of 6 weeks. At that point, MRI was obtained for each patient to further elucidate the diagnosis given the recalcitrant nature of the patients' symptoms. MRIs were interpreted by the senior author, as well as a fellowship-trained musculoskeletal radiologist.

Patients included in the study initially presented to clinic between July 2008 and March 2011. Chart review was conducted on the selected patients and information was compiled and stored in an encrypted Microsoft Excel (Microsoft, Redmond, Washington) document. Specific data points collected included age, sex, affected extremity, hand dominance, onset of symptoms (insidious vs. acute), chronicity of symptoms, nature of symptoms (worsening, unchanged, or improving), prior interventions for symptoms, worker's compensation status, occupation, physical exam, and MRI date and impression.

Results

Demographics

Thirteen patients were selected for inclusion in this case series. The mean patient age was 50.1 years old (range, 34–66 years). Of the included patients, there were seven females and six males. Ten patients (77%) had right-sided proximal forearm pain, and all patients who endorsed a dominant hand were right-hand dominant; documentation of hand dominance for one patient was not available (Table 1).

Previous Treatment

Before initial presentation to the hand surgery clinic, 10 of the 13 patients had previously undergone the conservative measures. The number of patients undergoing each conservative measure is as follows: nine had physical therapy, three had counterforce bracing, six had nonsteroidal

TABLE 1 Patient demographics

Patient	Age	Sex	Extremity Affected	Hand Dominance
1	61	Female	Right	Right
2	52	Female	Right	Right
3	66	Male	Right	Right
4	63	Male	Right	Right
5	44	Female	Right	Right
6	45	Female	Left	Right
7	40	Female	Right	Right
8	34	Female	Right	Right
9	47	Male	Right	Right
10	38	Male	Right	Right
11	61	Male	Right	Not available
12	49	Male	Left	Right
13	52	Female	Left	Right
Mean	50.1			

anti-inflammatory drugs (NSAIDs), six had corticosteroid injection (in all cases at the common extensor origin for concomitant lateral epicondylitis), three had activity modification, and one had an ergonomic evaluation of his work space. Two patients had received prior surgical intervention by another surgeon. One patient (patient 9) had received debridement of the medial epicondyle as well as a proximal median nerve decompression, neither of which provided relief. The other patient (patient 12) had had a Nirschl procedure performed previously with some improvement of his lateral epicondylitis, but with persistence of his proximal forearm pain. Additionally, one patient (patient 8) had previously been diagnosed with RTS by another surgeon and presented to this clinic for a second surgical opinion. None of the patients had previously been diagnosed with insertional biceps pathology.

Presenting Symptoms and Exam

The onset of pain was insidious in 10 of the patients (77%), and only one patient (7.7%) had an identifiable traumatic event. The primary complaint in all 13 patients was proximal forearm pain and four patients (33%) endorsed nonspecific pain with lifting and grip. On physical exam, the primary finding in all 13 patients was pain to palpation at 5 to 6 cm distal to the lateral epicondyle on the lateral forearm (Fig. 1). Twelve (92.3%) were also tender, albeit to a lesser extent, anteriorly over the radial tunnel. Only six patients (46%) were also tender to palpation over the common extensor origin, despite a higher percentage (62%) having MRI evidence of lateral epicondylitis (Table 2).

MRI Results and Management

MRI results in all cases demonstrated distal biceps pathology, and in one case (patient 13) it demonstrated biceps and brachialis muscle strains (Table 3). A distal biceps tendon rupture with 3-cm retraction was demonstrated on the MRI of one patient (patient 3); however, his case was unique in that the patient had chronic symptoms with an acute change (tearing sensation) 3 days before his previously scheduled MRI. This patient was the only patient in the series who underwent surgery by the senior author and did well postoperatively with resolution of symptoms after distal biceps tendon repair. The other 12 patients were sent for insertional bicep- specific physical therapy (therapists were counseled to place emphasis on stretching of the distal biceps).

TABLE 2 Presentation and physical exam at initial presentation

Patient	Duration of Symptoms (months)	Onset	Nature of Symptoms[a]	TTP			Pain with Resisted:	
				RT	3–5 cm[b]	CEO	Supination	Flexion
1	2 1/2	Insidious	Worsening	+	++	+	+	+
2	72	Insidious	Worsening (6)	+	++	+	+	-
3	6	Insidious	Worsening (3)	+	++	-	+	+
4	4	Insidious	Worsening	+	++	-	+	+
5	4	Insidious	Unchanged	+	++	+	+	-
6	1	Acute - no trauma	Unchanged	+	++	-	+	+
7	8	Insidious	Unchanged	+	++	-	+	+
8	24	Insidious	Unchanged	+	++	-	+	-
9	8	Insidious	Worsening	+	++	-	+	-
10	2	Acute - no trauma	Improving	-	++	-	+	+
11	6	Insidious	Worsening	+	++	+	+	+
12	10	Insidious	Unchanged	+	++	+	+	+
13	2	Acute - traumatic	Unchanged	+	++	+	-	-

TTP, tenderness to palpation; RT, radial tunnel; CEO, common extensor origin; ++, primary point of tenderness; +, tender.
[a]Number in parentheses represents number of months worsening, if explicitly stated by patient.
[b]3–5 cm distal to radial head on lateral forearm.

TABLE 3 MRI findings

Patient	Delay from Exam to MRI	Increased Signal/Findings				
		CEO	Distal Biceps	Brachialis	Bicipital Tuberosity of Radius	Other
1	9 months 14 days	Marked; +	Mild; +	-	-	
2	12 months 7 days	+	Mild; +	Mild; +	-	Subchondral coronoid cyst
3	5 months 10 days	-	+	-	-	Distal biceps rupture, 3-cm retraction[a]
4	20 days	Mild; +	Mild; +	-	-	
5	2 months 28 days	+	+	-	+	
6	12 months 8 days	-	+	+	-	
7	2 months 14 days	-	-	-	+	
8	Unknown	-	+	-	-	
9	8 days	+	+	-	+	
10	19 days	-	+	-	-	Medial epicondylitis
11	2 months 7 days	+	+	-	-	Partial undersurface tear of common extensor
12	3 months 18 days	+	+	-	-	Partial undersurface tear of common extensor
13	1 month 30 days	+	+	-	-	Supinator muscle strain
Total		8 of 13	13 of 13	2 of 13	3 of 13	

[a]Patient had acute, tearing sensation 3 days before MRI, after it was already scheduled.

Follow-up Results

Full follow-up is available for 12 of 13 patients (92%). At an average follow-up of 6.9 years (range, 5.75–8.5 years), all 12 patients report that they no longer have any upper extremity symptoms. All but one patient (patient 3) improved with only conservative management. Patient 3, as mentioned, underwent distal biceps repair by the senior author and had an uncomplicated and complete recovery. Patient 8 had proximal forearm pain that improved with conservative management; however, she had had prior medial epicondylar debridement and went on to develop medial instability, which was treated by another surgeon with ulnar collateral ligament reconstruction over a year after being seen in this clinic. Follow-up for one patient was unavailable (Table 4).

TABLE 4 Interventions after evaluation and outcomes

Patient	Follow-up (years)	Interventions	Pain Relief	
			Acute[a]	Chronic[b]
1	8.5	PT	Yes	Yes
2	7.67	PT	Yes	Yes
3	7.75	PT, surgery[c]	Yes	Yes
4	7.083	PT	Yes	Yes
5	7.91	PT	Yes	Yes
6	7.91	PT	Yes	Yes
7	NA	PT	NA	NA
8	6.083	PT, surgery[d]	Yes	Yes
9	6.17	PT	Yes	Yes
10	6	PT	Yes	Yes
11	6.25	PT	Yes	Yes
12	5.83	PT	Yes	Yes
13	5.75	PT	Yes	Yes
Mean	6.9			

NA, not available; PT, physical therapy; specific to distal biceps tendonitis in all cases.
[a]Acute, relief within 3 months.
[b]Chronic, sustained relief at final follow-up.
[c]Distal biceps repair.
[d]Ulnar collateral ligament reconstruction for instability over 1 year after initial presentation (pain improved acutely before surgery with conservative management).

Discussion

The diagnosis of radial tunnel syndrome is rare and lacks a pathognomonic finding (1–3). While one study demonstrated what was called denervation edema along the PIN distribution (most commonly in the supinator) in 52% of patients, MRI has long been regarded as unhelpful in the diagnosis of RTS (31). Similarly, other objective tests, including static EMG, have also proven unhelpful in confirming PIN compression or pathology (4–9). This problem has made RTS a source of debate within the orthopedic community (15, 16).

One theory is that intermittent compression of the PIN allows the pathology to escape EMG diagnosis while remaining symptomatic (8, 32). Given its nonspecific nature, many clinical entities can mimic RTS and confuse the diagnostic picture. One diagnosis that has essentially been ignored in the differential diagnosis is distal biceps tendonitis (15, 18–26). The current article presents a series of patients in support of the proposal that many patients diagnosed with RTS clinically may actually have distal biceps tendon pathology in disguise.

The physical exam findings used to confirm RTS localize to the distal biceps tendon as well as any other structure. Despite attempts at improving the specificity of the physical exam (11), in practice the diagnosis remains somewhat ambiguous and nonspecific. Surgical outcomes after decompression of the radial tunnel have also provided disappointing results, and this outcome has been postulated to be secondary to misdiagnosis (1–3, 5, 6, 12–14, 17, 27–30). This series also revealed that while the patients' diagnosis was related to the distal biceps tendon, there was still a high frequency of lateral epicondylitis (46% clinically, 62% radiographically) in these patients, similar to RTS.

It has been anecdotally noted by multiple authors that RTS clusters in patients with occupations requiring repeated pronation of the forearm (2, 33, 34). The long-standing hypothesis has been that this pronation leads to increased pressures in the radial tunnel and therefore exacerbates PIN compression (32). However, given the insertion of the distal biceps tendon on the radial tuberosity, the distal biceps tendon also sees increased pressure during pronation as it wraps around the radius, which could also account for the correlation with repeated pronation of the forearm (18). This series was not large enough to comment on this theory directly, but three of the patients were laborers and eight worked desk jobs where pronation during computer use would be frequent.

The primary limitations of this study include its retrospective nature and small sample size. However, as previously mentioned, distal biceps tendon pathology (outside of rupture) has been sparsely reported on. Additionally, given that RTS is a clinical diagnosis, only subjective findings on exam can be relied on. However, the study used primarily three findings (pain 5 to 6 cm distal to the lateral epicondyle, pain with supination, and pain with palpation over the volar elbow) on physical exam, and all exams were performed by a single surgeon. Finally, the presence of distal biceps pathology on MRI does not prove this to be the symptomatic pathology, nor does it rule out the possibility of concomitant RTS. However, the fact that 12 of the 13 patients improved with distal biceps-directed therapy does lend credence to this claim.

In conclusion, while MRI is not a routine test in the workup for proximal forearm pain (9), the authors' experience indicates that an MRI may be of diagnostic benefit in chronic cases of suspected RTS to rule out other etiologies before surgical intervention is undertaken. Specifically, while not previously routinely considered, distal biceps pathology should be one of the primary diagnoses included in the differential for proximal and lateral forearm pain as its clinical presentation can closely mimic that of RTS. A diagnosis of insertional biceps tendonitis could explain both the typical success with conservative treatment and the poor results from surgical intervention for RTS. The authors' experience indicates that with physical therapy directed specifically at the distal biceps tendon, patients will improve with conservative measures and, as a result of the correct diagnosis, may avoid unnecessary surgery.

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