Radial Tunnel Syndrome

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KEYWORDS

• Radial • Tunnel • Posterior interosseous nerve • Entrapment • Neuropathy

KEY POINTS

- Radial tunnel syndrome is a pain syndrome caused by compression of the posterior interosseus nerve at the proximal forearm.
- Diagnosis depends on clinical presentation and physical findings.
- There are no specific electrodiagnostic findings.
- Conservative treatment should be tried first before resorting to surgical intervention.
- Surgical treatment is generally successful, but workers' compensation patients and those with associated lateral epicondylitis may have less successful outcomes.

INTRODUCTION

Radial tunnel syndrome (RTS) is a pain syndrome presumed to be caused by compression of the posterior interosseous nerve (PIN) at the proximal forearm. The lack of specific electrodiagnostic and pathophysiologic findings makes this syndrome somewhat controversial.[1] In 1883, Winckworth recognized the possibility of entrapment of the PIN as it passes through the substance of "supinator brevis muscle."[2] In 1966, Sharrard[3] reported the first series of patients with RTS treated surgically. In 1972, Roles and Maudsley[2] identified the association between pain and compression of the PIN, and termed the condition RTS or resisted tennis elbow.

ANATOMY

The radial tunnel is a potential space located anterior to the proximal radius through which the PIN passes. The tunnel extends for approximately 5 cm starting from the level of the humeroradial joint and extending past the proximal edge of the supinator.[4–7] The tunnel is bound on the lateral side by the brachioradialis (BR), the extensor carpi radialis longus (ECRL) and extensor carpi radialis brevis (ECRB) muscles, and on the medial side by the biceps tendon and the brachialis. Its floor is formed by the capsule of the radiocapitellar joint that extends distally to the deep head of the supinator muscle.[4–7] The radial nerve splits into the radial sensory nerve and the PIN proximal to the supinator at the elbow joint. The PIN is the motor terminal branch of the radial nerve. As the PIN crosses the elbow it passes beneath several potential compressing structures: the proximal aponeurotic edge of the supinator (also known as the arcade of Frohse); the sharp medial edge of the extensor carpi radialis brevis; the radial recurrent blood vessels; and the inferior margin of the superficial layer of the supinator muscle.[4,8–11] The arcade of Frohse is mentioned as the most frequent site of entrapment of the PIN. In a cadaveric dissection, Clavert and colleagues[10] found it to be tendinous in approximately 80% of cases. Passive stretching of the supinator muscle increases the pressure inside the radial tunnel from a normal value of 40 to 50 mm Hg to as high as 250 mm Hg.[12,13] Erak and colleagues[14] studied the radial tunnel pressure using a balloon catheter in 5 cadaveric elbows, and found that

The authors have nothing to disclose.

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the pressure inside the radial tunnel increased when the wrist was moved from neutral to a flexion-pronation position. That increase in pressure was reduced by lengthening the supinator. Lengthening the extensor carpi radialis brevis or the extensor digitorum communis had no effect.[14]

PATHOPHYSIOLOGY

It is worth noting here that the diagnosis of RTS is doubted by several investigators, based on the fact that this syndrome is primarily a pain syndrome with no identifiable radiologic, electrodiagnostic, or pathophysiologic findings.[6,7,15–17]

One of the issues not completely understood is why an entrapment of a "purely motor nerve" could present only as a pain syndrome with no motor involvement. One explanation is that the PIN also carries unmyelinated (Group IV) and small myelinated (Group IIA) afferent fibers from the muscles along its distribution.[18] The unmyelinated Group IV fibers are called C-fibers when they are of cutaneous origin, and they have long been associated with nociception and pain. The small myelinated Group IIA afferent fibers have been associated with temperature sensation. The unmyelinated and small myelinated fibers cannot be evaluated by nerve-conduction studies. It is postulated that moderate pressure on the unmyelinated and small myelinated fibers of the PIN may produce the pain associated with the clinical presentation of RTS. The large myelinated fibers of the PIN remain essentially normal, which may explain the normal electromyography (EMG) and nerve-conduction findings.[16–23]

CLINICAL PRESENTATION

Patients with RTS usually present with pain along the dorsoradial aspect of the proximal forearm. The pain may radiate proximally and distally. The pain has a tendency to increase with rotational activities of the forearm.[7] Muscle weakness may be present with RTS on account of the pain and may not due to specific muscle dysfunction or denervation.[19] There are no sensory symptoms associated with RTS.

OCCUPATIONAL RISK FACTORS

Very few studies in the literature have examined the correlation between work activities and the incidence of RTS. A systematic literature review by Van Rijn and colleagues[24] demonstrated an increased incidence of RTS with specific work activities such as handling tools with full extension of the elbow. Roquelaure and colleagues[25] compared 21 patients with RTS with 21 volunteers, and identified some risk factors related to work activities. It was found that regular use of a force of at least 1 kg for more than 10 times per hour with the elbow constantly extended between 0° and 45° with frequent pronation and supination of the forearm would increase the chance of developing RTS.[25]

PHYSICAL EXAMINATION

Localized focal tenderness over the anatomic landmark of the PIN is considered to be the hallmark of diagnosis of RTS.[19,26,27] The diagnosis can be difficult because of the close proximity of the site of maximum tenderness to the lateral epicondyle, which may be also involved with lateral epicondylitis. Loh and colleagues[28] proposed a novel test in which 9 equal squares are drawn on the anterior aspect of the forearm, which are then used to note where the tenderness can be elicited. Localized tenderness involving the lateral column of 3 squares was consistent with pressure over the PIN. Tenderness of RTS should be differentiated from that of lateral epicondylitis. The site of tenderness in RTS is approximately 3 to 5 cm distal to the lateral epicondyle over the supinator muscle mass. Furthermore, the pain of RTS usually does not increase by active extension of the wrist against resistance.

Patients with RTS may have weakness of their extensors. However, the weakness is mainly attributed to the pain and not to dysfunction of the extensor muscles.[19] There is no sensory deficit in patients with RTS.

Additional provocative tests have been described, including increased pain with resisted active forearm supination and pain with active extension of the middle finger against resistance.[19] The specificity and sensitivity of these tests have not been established.

Another diagnostic tool that can help to establish the clinical diagnosis, and to differentiate RTS from lateral epicondylitis, is injection of local anesthetic into the area of the localized tenderness.[20,29] However, it is important to ensure that the injected local anesthetic does not spread to the area of the lateral epicondyle.

RADIOGRAPHIC TESTING

Routine radiologic evaluation is nondiagnostic in RTS. However, magnetic resonance imaging techniques have been used to evaluate the area of the radial tunnel.[30–32] Ferdinand and colleagues[30] evaluated 10 asymptomatic volunteers and compared them with 25 patients with RTS. Fifty-two percent of RTS patients had evidence of

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