Radial tunnel syndrome—diagnosis and treatment

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Abstract—Radial tunnel syndrome is defined as intermittent compression of the deep branch of the radial nerve through the borders of the radial tunnel. This is one of the diagnosis in the spectrum of the causes for lateral elbow pain. The condition is associated with pain in the area of radial nerve compression which is located in most of the cases at the entrance of the nerve in the arcade of Frohse. The clinical examination is of utmost importance for determination of the diagnosis. The standard static electromyography can’t record the intermittent compression of the nerve and it is not sensitive for the injury of the unmyelinated fibers (C-type) which is the main source of the pain. The goals of the treatment of RTS are to eliminate the pain and to encourage the patients to return to their routine activities. A trial of nonsurgical treatment is warrant in all the patients. In the cases with no respond to the conservative methods we advocate for surgical decompression of the nerve.

Keywords—radial tunnel syndrome, deep branch of radial nerve, lateral elbow pain, intermittent compression, arcade of Frohse, scratch collapse test, decompression

1. Introduction

Michelle and Krueger first described the radial tunnel syndrome in 1954 as “radial pronator syndrome”⁵. In 1972, Roles and Maudsley reposted an association between pain and compression of the deep branch of the radial nerve which they referred to as “resistant tennis elbow”⁹. The terminology, “Radial Tunnel Syndrome” was used by Eversmann in 1993 to describe the effect of the nerve compression by the supinator brevis muscle⁷.

The radial tunnel extends from the radial head to the inferior border of the supinator muscle⁴. The boundaries is formed by the supinator, extensor carpi radialis longus and extensor carpi radialis brevis and brachioradialis⁸. Multiple potential sites of compression have been described, including from proximal to distal: fibrous bands around the radial head, arcade of anastomosing branches of the recurrent radial artery at the level of the radial neck, fibrous edge of the extensor carpi radialis brevis, arcade of Frohse, distal edge of the supinator muscle. In most of the cases the area of compression was identified at the level of arcade of Frohse (Fig. 1).
The study of Roquelaure et al. demonstrates three risk factors of radial tunnel syndrome related to work conditions\textsuperscript{10}: regular use of force of at least 1 kg, constantly extended elbow in the range between 0\degree and 45\degree, repetitive pronosupination.

The reported male to female occurrence radios vary from 1:1 to 1:6\textsuperscript{6}. The patients are typically between 30-50 years old. The compression usually affects the dominant site. Bilateral involvement is rare.

The main clinical feature of radial tunnel syndrome is tenderness over the entrance of the motor branch of the radial nerve at 5 cm distal to the lateral epicondyle. Several clinical test\textsuperscript{13} are used to confirm the compressive neuropathy as the diagnosis is entirely clinical. The clinical examination includes exacerbation of the pain with resisted supination, hyperextension of the wrist under resistance, resisted extension of the middle finger, resisted ulnar deviation.

Scratch collapse test (SCT) is a test which is based on the concept of transitory inhibition of the voluntary muscle activity following painful skin stimulus or scratching on the area of the compression. This period of electromyographic “silence”, which is interpreted as blockage of the electrical impulse transmission, is known as cutaneous silent period. SCT is performed with scratching or light pressure at the site of the suspicious compression immediately followed by testing for weakness of external rotation of the shoulder. A positive test is noted if there is transient loss of muscle resistance, resulting in collapse of upper limb\textsuperscript{3}.

Neurophysiologic testing does not appear useful in radial tunnel syndrome since only in 2 of 21 patients demonstrates abnormalities. All patients had normal posterior interosseous nerve conduction velocity studies in rest except those with structural changes.
of the nerve. The lack of abnormal findings with static testing has led to the hypothesis that dynamic posterior interosseous nerve compression is the cause of radial tunnel syndrome. This has been supported by the work of Rosen and Werner who have documented elevated radial tunnel pressure and prolonged posterior interosseous nerve latencies with muscular contraction, passive stretch of the supinator muscle and resisted active supination.\textsuperscript{11}

2. Method

From May 2020 to May 2023 we have diagnosed 35 patients with radial tunnel syndrome. The diagnosis is based on three clinical tests: pressing on the area of arcade of Frohse, scratch collapse test and evaluation of the strength of extensor carpi ulnaris muscle.

Selection criteria to exclude patients from the study—non cooperative patients, cervical spine disorders, bilateral compressive syndrome which will question the accuracy of the clinical test.

Prior to setting the treatment algorithm the patients are evaluated by following criteria—age, gender, profession, site of compression (dominant/nondominant), previous treatment duration of presence of the symptoms. The mean age of the male group is 36,2 (22-52). For the female group it is 38,5 (36-40). All the patients were diagnosed and treated in MBAL”Maichin dom- Varna”.

In 23 of the patients we’ve done conservative treatment which includes ultrasound, deep oscillation, high intensity laser and local application of cortisone (Triamcinolon) in the punctum maximum of the pain. In 12 cases method of choice has been the operative decompression of the nerve. We’ve performed the intervention under general or regional block anesthesia is provided. The forearm is positioned in pronation on a hand table, the upper limb is exsanguinated and a tourniquet is inflated. The incision follows the interval between brachioradialis and extensor carpi radialis longus. We ask the patient to provide resisted elbow flexion so we can precisely determine the interval. Then the antebrachial fascia is incised. After passing through the right muscle interval the fat pad of the nerve structures is directly visualized—the superficial and deep branches of the radial nerve. The recurrent branches (Fig. 2) of radial artery are ligated and the fibrous band which are adjacent to the radial head are released. The medial border of extensor carpi radialis brevis is defined and routinely divided (Fig.3). Finally, the fibrous edge of the supinator (Fig.4) is released longitudinally and the underlying nerve is protected (Fig.5). An advantage of the procedure is that by releasing of the extensor carpi radialis brevis concomitant existence of lateral epicondylitis can be managed only by one approach.
Fig. 2 Recurrent branches of radial artery

Fig. 3 Medial border of extensor carpi radialis brevis
Fig.4 Arcade of Frohse

Fig.5 Deep branch of radial nerve- macroscopic signs of compression
3. Results

23 of 35 (65.71%) patients were treated conservatively. In 16 (69.57%) of the cases in this group an application of cortisone was used. The pain was successfully managed with physical therapy only in 3 (13.04%) of the patients. In the rest 4 (17.39%) of the patients have been performed combined treatment which includes physical therapy and local cortisone shots.

Decompression of the deep branch of radial nerve was the treatment decision in 12 of the cases because of the poor results of previous conservative treatment and the expanded duration of the presence of symptoms. The mean period from onset of the compression to the operative management is between 6 and 24 months.

We applied Roles and Maudsley score for assessment of the results. (Table 1) 11 (47.83%) of the patients treated conservatively have excellent results, 8 (34.78) show up with good outcomes and 4 (17.39%) report acceptable effect of the procedure. 9 (75%) of the patients who sustained surgery have excellent outcome, 2 (16.67%) report good results and for 1 (8.33%) the intervention has acceptable effect.

<table>
<thead>
<tr>
<th>Level</th>
<th>Roles and Maudsley score</th>
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<tbody>
<tr>
<td>Excellent</td>
<td>No pain, full movement, full activity</td>
</tr>
<tr>
<td>Good</td>
<td>Occasional discomfort, full movement, full activity</td>
</tr>
<tr>
<td>Acceptable</td>
<td>Some discomfort after prolonged activity</td>
</tr>
<tr>
<td>Poor</td>
<td>Pain limiting activity</td>
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4. Discussion

The radial nerve compression at the site of the deep branch is a hardly known and often overlooked pathological entity. The number of the patients, who are misdiagnosed and treated for lateral epicondylitis, cervical spinal pathology, frozen shoulder and carpal tunnel syndrome, is significant. Despite the rest of the compressive neuropathies, EMG remain a examination with limited informative value and the diagnose is based on clinical observation only.

The success of the treatment depends on the proper selection of the cases. The conservative management is step one in the treatment algorithm. Patients who do not respond or continue to progress despite conservative treatment are candidates for surgical decompression. The result of the surgical release of the radial tunnel have been good in
the majority of the studies. Roles and Maudsley described excellent or good results in 35 of 38 extremities. Similarly, Werner et al noted excellent or good results in 73 of 90 extremities. Rosen and Werner obtained complete pain relief in 18 of 28 patients and Hagert et al and Lister et al describe excellent or good results in 42 of 50 and 19 of 20 patients, respectively.

5. Conclusion

Radial tunnel syndrome is compressive neuropathy of the deep branch of the radial nerve in the area of the radial tunnel. The diagnosis is set entirely on the base of physical findings. In the cases where satisfactory results cannot be achieved by conservative management the nerve decompression is recognized as the only successful approach.

6. References


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