

# A new clinical test for radial tunnel syndrome—the Rule-of-Nine test: A cadaveric study

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## ABSTRACT

**Purpose.** Radial tunnel syndrome refers to pain on the lateral aspect of the forearm as a result of compression of the posterior interosseous nerve within a tunnel with specific anatomical boundaries. Diagnosis of the condition is difficult because of its close association with lateral epicondylitis, which warrants different methods of treatment. Based on a cadaveric study, a new clinical test, the Rule-of-Nine test, is proposed to improve the diagnostic accuracy in radial tunnel syndrome. The test involves constructing 9 equal squares on the anterior aspect of the forearm and noting those squares where tenderness can be elicited. **Methods.** 19 upper limbs were dissected to delineate

the path of the posterior interosseous nerve through the radial tunnel, and the relationship of the path of the nerve with the 9 squares.

**Results.** A consistent mapping of the posterior interosseous nerve to the lateral column of 3 squares was observed.

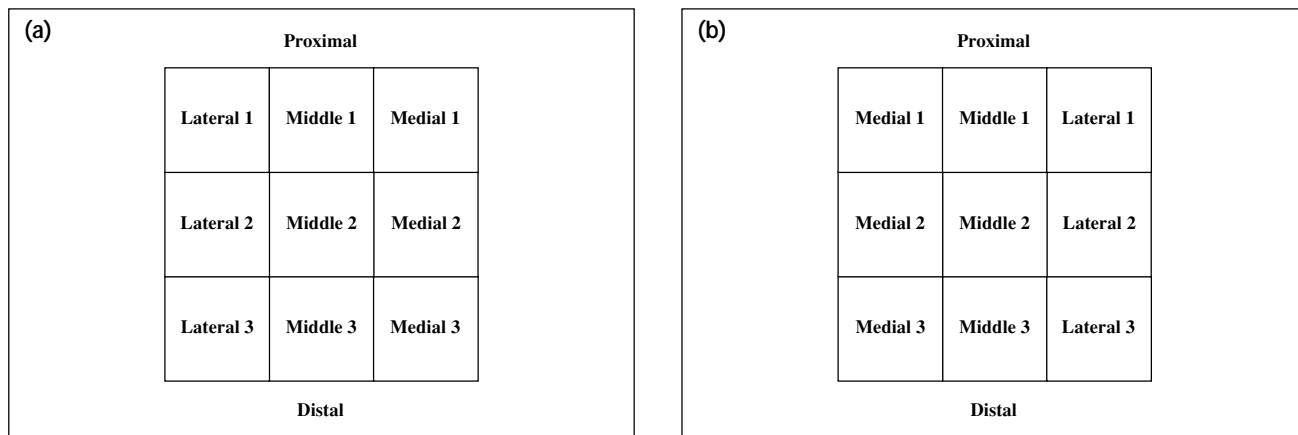
**Conclusion.** The Rule-of-Nine test is proposed as a reliable method of diagnosing radial tunnel syndrome.

*Key words:* diagnostic test; radial tunnel syndrome

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## INTRODUCTION

Compression of the posterior interosseous nerve (PIN) produces a wide spectrum of clinical signs and



**Figure 1** The 9 labelled squares over the volar aspect of the elbow in (a) the right arm, and (b) the left arm.

symptoms, ranging from PIN syndrome to radial tunnel syndrome (RTS). The former produces paralysis or marked weakness of finger and/or wrist extension, whereas the latter causes pain along the radial tunnel. Although PIN syndrome is rarer, it has been well described and accepted as a clinical entity. The diagnosis of RTS as a clinical condition is controversial for a number of reasons, including the disputed radial tunnel anatomy, inconclusive findings on electrodiagnostic testing, and its close association with lateral epicondylitis (tennis elbow syndrome).

RTS was described as early as 1883, as a cause of resistant tennis elbow.<sup>1</sup> The symptoms of these 2 conditions were so similar that the difficulty in making a differential diagnosis between them might be the reason why they were considered as identical clinical entities. It was not until 1956 that RTS was recognised as a distinct clinical entity.<sup>2</sup> When the anatomy of the radial tunnel and the potential compression structures in it were described,<sup>3</sup> the aetiology of tennis elbow syndrome was separately delineated.<sup>4,5</sup>

The middle finger extension test,<sup>3</sup> resisted supination of the forearm,<sup>4</sup> local anaesthetic radial tunnel block,<sup>6</sup> and nerve conduction studies,<sup>4,6</sup> have been described to help in the diagnosis of RTS. Based on a cadaveric study, we propose a new clinical test, the Rule-of-Nine (RON) test, to improve the diagnostic accuracy.

## MATERIALS AND METHODS

19 cadaveric upper limbs from 10 subjects (2 females and 8 males) were studied. Their mean age was 72 years (range, 65–91 years). The major cause of death

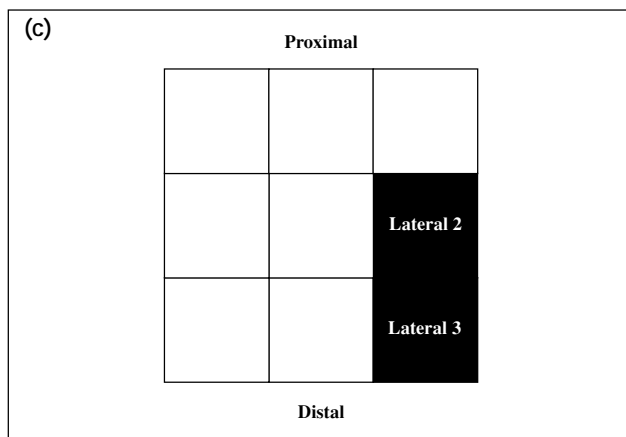
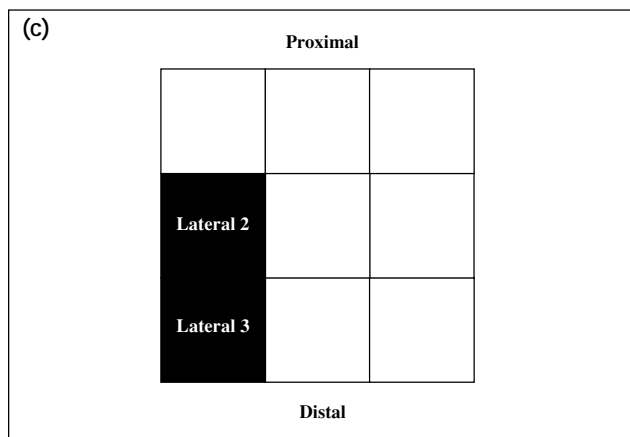
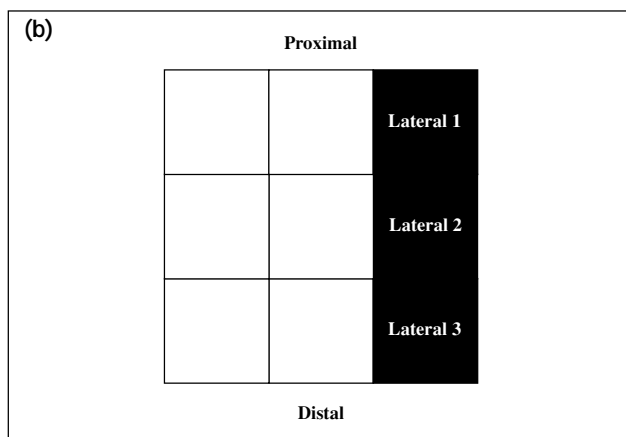
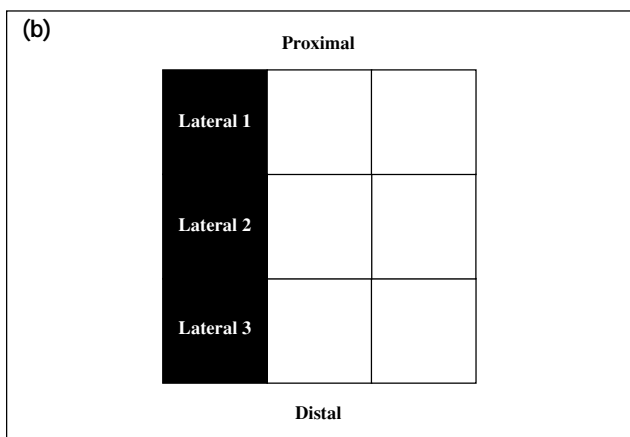
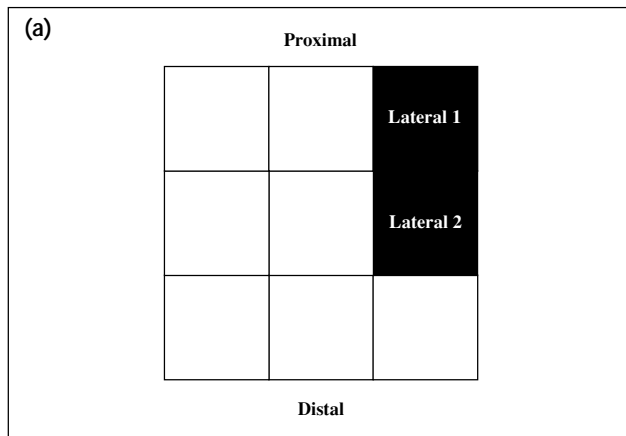
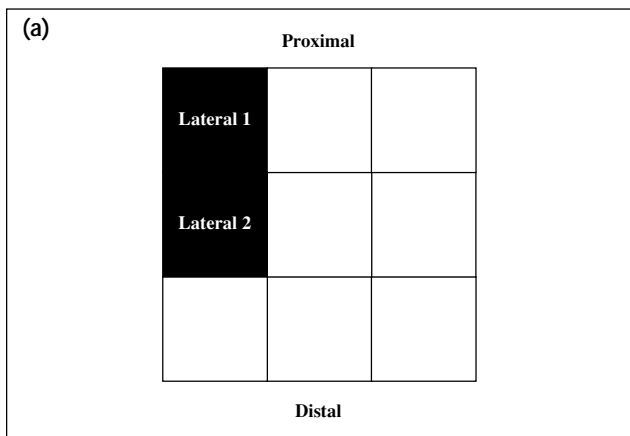
was ischaemic heart disease. Hand dominance and occupation were unknown.

The RON test consisted of drawing up a large squared box over the anterior aspect of the proximal forearm. The sides of the square were determined by the width of the elbow crease with a fully extended elbow and a fully supinated forearm. Hence, the distal extent of the box was delineated. This large square was further divided into 9 smaller equal squares, giving 3 columns and 3 rows. The columns were labelled lateral, middle, and medial, whereas the rows were labelled, from proximal to distal, 1, 2, and 3 (Fig. 1a and b). It was postulated that the PIN travelled through the lateral column, the median nerve travelled through the middle column, while the medial column was traversed by none. The position of the 9 smaller squares was mapped on to a transparency acetate which was then placed over the dissected specimen.

The 19 upper limbs were dissected to determine the path of the PIN through the radial tunnel and the relationship of this path to the 9 constructed squares. The frequency of the smaller squares being crossed by the PIN was recorded. The PIN and supinator were exposed by retracting between extensor carpi radialis brevis (ECRB) and extensor digitorum communis.

## RESULTS

It was observed that the PIN travelled consistently across the lateral column of the constructed square grid in both right and left arms of all specimens. Figs. 2 and 3 show the squares crossed by the PIN along the lateral columns of right and left forearms, respectively.



**Figure 2** PIN course in the right arm in (a) 2 subjects, (b) 2 subjects, and (c) 5 subjects.

**Figure 3** PIN course in the left arm in (a) 2 subjects, (b) 3 subjects, and (c) 5 subjects.

In the 9 right cadaveric arms, 2 PINs travelled across the lateral 1 and 2 squares (Fig. 2a), 2 traversed the entire lateral column (Fig. 2b), and 5 involved the

lateral 2 and 3 squares (Fig. 2c). None travelled across the middle or medial columns. In the remaining 10 left cadaveric arms, 2 PINs involved the lateral 1 and 2

squares (Fig. 3a), 3 involved the entire lateral column (Fig. 3b), and 5 the lateral 2 and 3 squares (Fig. 3c). Again none travelled across the middle or medial columns.

## DISCUSSION

The radial tunnel is described as a 5-cm long furrow bounded by brachialis and the biceps tendon medially and the mobile extensor muscles anterolaterally, beginning just proximal to the radiocapitellar joint and ending at the distal edge of supinator.<sup>7</sup> The capsule of the radiocapitellar joint forms the floor of the tunnel.<sup>3</sup> After the point of bifurcation of the radial nerve, the PIN travels through the tunnel.

The PINs were found to travel mostly across the squares in the lateral column. Consequently this is the region where the PIN is most likely to be located. Furthermore, the majority of the nerve paths were found to cross the lateral 2 and 3 squares. This is due to the varied location of the bifurcation of the radial nerve. The higher point of bifurcation explains the involvement of the lateral 1 square, whereas the lower point explains the involvement of the lateral 2 square.

The point of bifurcation of the radial nerve at the elbow joint is variable. In a cadaveric study conducted in Thailand, it was found to occur at a point 1.3 cm proximal to the elbow joint.<sup>7</sup> However, most authors

agree that the point of bifurcation is more varied, and occurs within an area 3 cm proximal or distal to the elbow joint.<sup>8</sup> This variability explains the frequency of the involvement of the lateral 1 square in both left and right arms. The frequent and consistent involvements of the lateral 2 and 3 squares are due to the consistency of the PIN path distal to the point of bifurcation in normal anatomy.

The various causes of PIN compression may also explain the discrepancy of the lateral 1 square involvement. The presence of the fibrous bands connecting brachialis and brachioradialis overlying the PIN at the level of the radial head is most likely to involve the lateral 1 square. The leash of Henry, the tendinous medial edge of the ECRB, the arcade of Froshe, the distal tendinous edge of the supinator, bands within the 2 heads of supinator, and a bifid ECRB make the involvement of lateral 2 and 3 squares most likely.

## CONCLUSION

The RON test effectively specifies the site of tenderness for the diagnosis of RTS. This cadaveric study allows us to locate and press on confidently the PIN to elicit pain. By specifying the sites of tenderness to this region of the elbow, we can effectively exclude other causes of forearm pain, particularly tennis elbow syndrome.

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