High trifurcation of the ulnar nerve with the volar sensory branch entering the hand superficial and radial to the Guyon’s canal: A case report

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ABSTRACT

INTRODUCTION: Trifurcation of the ulnar nerve proximal to the Guyon’s canal is rare. In these cases, the main trunk of the nerve divides few cm proximal to the canal into 3 branches: a deep motor branch and two superficial volar sensory branches (the common digital nerve of the 4th web and the ulnar digital nerve of the little finger). All 3 branches then enter the Guyon’s canal.

PRESENTATION OF A CASE: We report on a rare case of high trifurcation of the ulnar nerve in the midforearm. The ulnar nerve divided into 3 branches: an ulnar dorsal sensory branch, an intermediate motor branch, and a radial volar sensory branch. The dorsal sensory branch entered the dorsal aspect of the forearm. The motor branch entered the Guyon’s canal. The radial volar sensory branch did not enter the Guyon’s canal, coursing superficial and radial to the canal to enter the hand.

DISCUSSION: The clinical implications of this very rare branching pattern of ulnar nerve are discussed along with a review of previously reported branching patterns of the nerve in the forearm.

CONCLUSION: Our case of high trifurcation of the ulnar nerve is unusual with no similar cases in the literature. This branching pattern is associated with an abnormal course of the volar sensory branch; marking it relevant in clinical practice.

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1. Introduction

Normally, the ulnar nerve enters the forearm passing between the two heads of flexor carpi ulnaris muscle. About 10 cm proximal to the wrist, the nerve gives off its dorsal sensory branch which enters the dorso-ulnar aspect of the distal forearm to supply sensation to the skin of the dorsal-ulnar aspect of the hand as well as the dorsal aspects of the little and ring fingers. The main trunk of the ulnar nerve continues under the flexor carpi ulnaris muscle (accompanied by the ulnar artery) to enter the Guyon’s canal. Within the canal, the nerve normally bifurcates into a superficial sensory branch (which gives off the common digital nerve of the 4th web and the ulnar digital nerve to the little finger) and a deep motor branch. This bifurcation within the canal occurs in about 80% of cases. In 10% of cases, the nerve trifurcates within the canal (one deep motor branch and two superficial sensory branches: the common digital nerve of the 4th web and the ulnar digital nerve of the little finger). In the remaining 10% of cases, other rare branching patterns of the ulnar nerve are seen in the forearm.

Trifurcation of the ulnar nerve proximal to the Guyon’s canal is an rare anomaly and usually occurs few cm proximal to the canal. In these cases, the nerve divides into a deep motor branch and two superficial sensory branches (the common digital nerve of the 4th web and the ulnar digital nerve of the little finger) [1–3]. All three branches then enter the Guyon’s canal.

In this report we describe a case with “high” trifurcation of the ulnar nerve in the mid-forearm into a dorsal sensory branch, a motor branch and a volar sensory branch. The dorsal sensory branch entered the dorsal aspect of the forearm. The motor branch entered the Guyon’s canal. The volar sensory branch passed subcutaneously, superficial and radial to the Guyon’s canal to enter the hand and supply the volar aspect of the little and ring fingers. This form of high ulnar nerve trifurcation has never been reported and has clinical implications. The work has been reported in line with the SCARE criteria [4].

2. Presentation of case

A 24-year old right-handed male was handling young lambs and sustained a puncture wound from the horn of a lamb to the ulnar aspect of the left forearm (about 2 cm proximal to the wrist crease). The patient noted a slow-growing swelling at the trauma site. He

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The patient was admitted, given intravenous cephalosporin, the hand was elevated, and the patient was prepared for surgery in the morning. A repeat pre-operative examination showed a tense forearm and moderate pain on passive extension of the fingers; suggestive of early compartment syndrome. Fasciotomy of the forearm was done along with evacuation of the hematoma. There was injury to a branch of the ulnar artery and that branch was ligated. During the fasciotomy, a high trifurcation of the ulnar nerve in the mid-forearm (14 cm proximal to the wrist crease) was noted (Fig. 2–4). The most ulnar branch was the dorsal sensory branch and it entered the dorso-ulnar aspect of the forearm about 4 cm distal to its origin from the ulnar nerve. The intermediate branch was the motor branch and it was accompanied by the ulnar artery; and eventually entering the Guyon’s canal. Intraoperative nerve stimulation of this branch showed contraction of the intrinsic muscles. The Guyon’s canal was not explored; but the branch to the abductor digiti minimi (as per intra-operative nerve stimulation) arose from the motor division at the entrance of the canal. The radial division was the volar sensory branch. The branch gradually diverged from the motor branch to enter the hand subcutaneously, superficial and radial to the Guyon’s canal. Intraoperative nerve stimulation of this branch did not result in muscle contraction. Pulling on the branch at the wrist crease resulted in visible movements under the skin at the 4th web space, the ulnar aspect of the little finger, and the hypothenar skin. This confirmed that it is the volar sensory division of the ulnar nerve. The fasciotomy wound was left open and then partially closed two days later (Fig. 5). The remaining distal open area was covered with a meshed split-thickness skin graft (Fig. 6).

There were no post-operative complications. At final follow-up two months later, there was full range of the digits and wrist. There was no subjective numbness or weakness of the hand. Objectively, the static 2-point discrimination of the pulp of the little finger returned back to normal (4 mm). A dynamometer was used to assess the grip strength of the hands, and this showed 33 kg on left compared to 36 kg on the right. A pinch gauge was used to assess pinch strength which showed 20 kg on the left compared to
23 kg on the right. These strength measurements were considered normal because the patient was right-handed.

3. Discussion

Our case demonstrates a rare variant of the branching pattern of the ulnar nerve which is named as the “high trifurcation” branching pattern. Furthermore, the volar sensory branch gradually diverged from motor branch to enter the hand subcutaneously, superficial and radial to the Guyon’s canal. An extensive literature review did not reveal similar cases. This variant has several clinical implica-
tions. A laceration radial to the Guyon’s canal at the wrist crease will result in loss of sensation in the little and ring fingers. A compression of ulnar nerve at the Guyon’s canal (by space occupying lesions) will always produce pure motor symptoms. Exploration of the Guyon’s canal will only identify the motor branch. Finally, the abnormally located volar sensory branch is at the risk of injury while harvesting radial forearm free flaps.

We reviewed the literature for previously reported branching patterns of the ulnar nerve in the forearm and Guyon’s canal and we grouped these patterns into five groups. The first is the normal branching pattern mentioned in the introduction; and this is seen in 90% of cases. In the second group, there is “bifurcation” or “aberrant branching” of the ulnar nerve in the distal forearm. The “bifurcation” usually occurs few cm proximal to the Guyon’s canal, with the nerve dividing into two branches: one deep motor branch and one superficial volar sensory branch [5]. Both branches then enter the Guyon’s canal. “Aberrant branching” of the ulnar nerve means that a branch is given off the main trunk of ulnar nerve in the distal forearm and this branch then rejoins the main nerve trunk or its sensory division within the Guyon’s canal [6,7]. Occasionally, splitting of the ulnar nerve occurs around a split flexor carpi ulnaris tendon, and then the two parts of the nerve rejoin proximal to the Guyon’s canal [8–10]. Anomalous muscles are known to cause ulnar nerve compression in the distal forearm [11]. Occasionally, the anomalous muscle passes between the motor and sensory branches of the ulnar nerve; splitting it in the distal forearm [12].

The third group is low or high “trifurcation” of ulnar nerve proximal to the Guyon’s canal. In low trifurcation, the dorsal sensory branch of the ulnar nerve originates normally 8–10 cm proximal to the wrist. The main trunk of the nerve then trifurcates just proximal to the Guyon’s canal into 3 branches: a deep motor branch, and two superficial sensory branches (the common digital nerve the 4th web and the ulnar digital nerve of the little finger) [2,3]. All 3 branches then enter the Guyon’s canal. In high trifurcation, the ulnar nerve trifurcates in the middle or proximal forearm into 3 branches: an ulnar dorsal sensory branch, an intermediate motor branch and a radial volar sensory branch. Our case demonstrates this variant and shows that the volar sensory branch may enter the hand subcutaneously, superficial and radial to the Guyon’s canal.

Accessory branches arising from the dorsal sensory branch of the ulnar nerve are frequently called the “accessory branches of Kaplan” and these make the fourth group. Kaplan described an accessory branch arising from the dorsal cutaneous branch of the ulnar nerve which joined the volar sensory branch within the Guyon’s canal [13]. Since the description of this variant by Kaplan in 1963, many other similar variants have been described; but the accessory branch joined the volar sensory branches of the ulnar nerve at different levels within or distal to the Guyon’s canal [14,15]. In one case, the Kaplan accessory branch was noted to have no connection to main trunk of the ulnar nerve or any of its branches; continuing distally as a separate sensory branch to the little finger [16]. In another case, the dorsal sensory branch had a high origin (just distal to the elbow) from the ulnar nerve and the branch gave off motor branches to the hypothenar muscles at the wrist [17].

Finally, communicating branches from the ulnar to the median nerve in the forearm make up the final group. In the Martin-Gruber anastomosis (seen in 11–39% of forearms, there is a communicating branch from the median to the ulnar nerve [18]. This should not be considered as a branching pattern of the ulnar nerve because the communicating branch arises from the median nerve. In the Marinacci anastomosis (seen in 1–6% of forearms), the communicating branch is from the ulnar to the median nerve [19]. We only reviewed the branching patterns of the ulnar nerve in the forearm. Hence, we did not include median-ulnar communicating branches within the palm such as the Riche-Cannieu anastomosis (a motor
communication between the deep branch of ulnar nerve and the motor branch of median nerve) [20] and the Berrettini anastomosis (a sensory communication in the palm between the common digital nerves of the 3rd and 4th web spaces) [21].

4. Conclusion

We describe a rare case of high trifurcation of the ulnar nerve in which the volar sensory branch entered the hand subcutaneously, superficial and radial to the Guyon’s canal. The clinical implications of this branching pattern are described along with a review of the branching patterns of the ulnar nerve in the forearm.

Conflict of interest

None.

Funding

None.

Ethical approval

The study was approved by the research committee, National Hospital (Care), Riyadh, Saudi Arabia.

Consent

Written informed consent was obtained from the patient for publication of this case report. A copy of the written consent is available for review by Editor-In-Chief of this journal on request.

Authors’ contribution

The first author (MMA) performed the surgery. All authors contributed significantly and in agreement with the content of the manuscript. All authors participated in data collection and in writing of the manuscript.

Registration of research studies

Not relevant here.

Guarantor

M M Al-Qattan.

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