

An Anatomical Study on the Localization of the Palmar Cutaneous Branch without Epineural Dissection and Its Clinical Relevance to Functional Recovery in Fencers

Un Estudio Anatómico Sobre la Localización del Ramo Palmar sin Disección Epineural y su Relevancia Clínica para la Recuperación Funcional en Esgrimistas

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SUMMARY: The aim of this study is to investigate the anatomical location of the palmar cutaneous branch (PCB) of the median nerve and to evaluate the therapeutic effects of non-invasive recovery methods. Following meticulous dissections of 12 cadavers to identify the course of the nerve, the effects of applying regular pressure to the corresponding region were evaluated in fencing athletes, focusing on changes in wrist-related pain and grip strength. The median nerve was located 2.3 cm medially from the styloid process of the radius, while the PCB was positioned 2.9 cm medially. The branching point of the PCB was identified at 3.7 cm proximal to the distal end of the radial styloid process. In fencing athletes, the application of targeted pressure to this region resulted in a reduction in wrist pain and an improvement in grip strength. When applied consistently, these effects were sustained across all participants. It is hoped that these findings will contribute to both surgical guidance and the development of effective non-invasive recovery strategies.

KEY WORDS: Anatomy; Palmar cutaneous branch; Median nerve; Fencer; Recovery.

INTRODUCTION

The palmar cutaneous branch (PCB) of the median nerve is responsible for the sensory innervation of the palmar region and branches off from the distal forearm portion of the median nerve. From an anatomical perspective, there may be variations in the location at which the PCB originates (Smith & Ebraheim, 2019).

In individuals engaged in occupations or athletic activities that involve frequent hand use, such as forceful gripping or making a fist, sensory disturbances in the proximal palmar area may occur due to repetitive contraction of the anterior compartment muscles of the forearm (Parizher & Emery, 2022). Although it is often challenging to clinically trace symptoms related to cutaneous nerves in fencers, many athletes report issues involving the wrist or hand. Given that cutaneous nerves are highly sensitive to pain, it is plausible that compression of the palmar cutaneous branch of the median nerve may contribute to discomfort in the wrist or proximal palm region (Eong & Sebastin, 2021; Bargemon *et al.*, 2023; Cross *et al.*, 2024).

Whereas numerous gross anatomical studies have been conducted to identify the location of nerves, those that involve removal of the epineurium may not provide entirely objective information regarding the branching points of the nerves. Therefore, it is essential to conduct detailed dissections without removing the epineurium to obtain accurate data on nerve branching patterns in anatomical research (Sohn *et al.*, 2015; Smith & Ebraheim, 2019).

Even though several anatomical studies have reported on the PCB of the median nerve, it remains difficult to find studies that specifically examine its origin without removal of the epineurium.

The aim of this study is to anatomically investigate the location at which the PCB originates from the median nerve, as well as its course in relation to the forearm. Additionally, this study briefly examines how applying moderate pressure between the elbow crease and the branching point of the PCB affects palmar sensation and grip strength in fencing athletes.

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MATERIAL AND METHOD

Twenty-four specimens from 12 adult Korean cadavers (8 males and 4 females, age range from 56 to 88 years) were investigated. Cases with pathological changes or leg trauma were excluded. Cadavers were placed in the supine position during dissection and measurement. A single investigator obtained all measurements using an Absolute digimetric digitalized caliper (Mitutoyo Corp., Kanagawa, Japan).

After making a skin incision in the distal forearm and carefully dissecting the underlying structures to expose the median nerve without damaging the epineurium, the branching point of the PCB was identified (Fig. 1). Following this, five parameters were measured:

1. A reference vertical line from the most prominent point of the lateral epicondyle of the humerus to the most distal point of the styloid process of the radius,

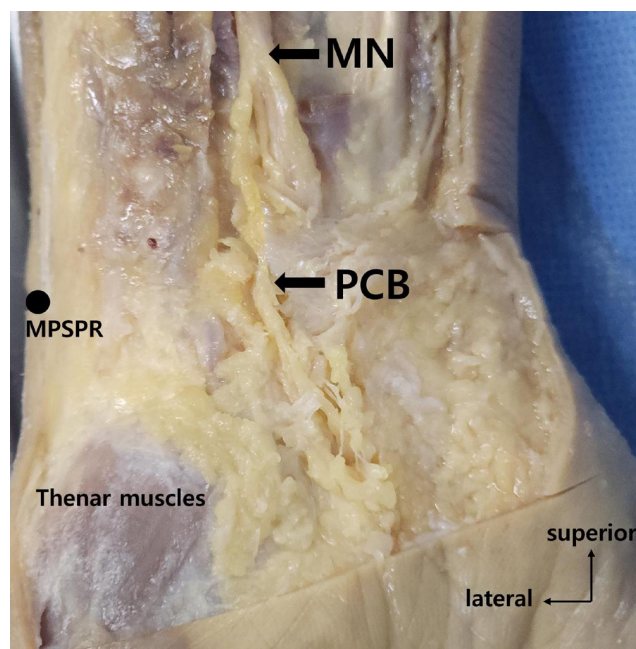


Fig. 1. Anatomical image of palmar cutaneous branch. Dissection was performed without removing the surrounding fat tissue in order to minimize any alteration in the position of the nerve, and the course of the nerve was identified through careful observation. MPSPR: most prominent point of styloid process of radius, PCB: palmar cutaneous branch, MN: median nerve.



Fig. 2. Numerical rating scale (NRS).

2. The horizontal distance of the styloid processes of the ulna and radius,
3. The horizontal distance from the styloid process of the radius to the median nerve,
4. The horizontal distance from the styloid process to the PCB,
5. The vertical distance from the most distal point of the styloid process of the radius to the branching point of the PCB.

These data were obtained by direct section of fresh cadavers that had not been previously dissected. All data were analyzed using SPSS version 15.0 (SPSS, Chicago, IL). Comparisons between males and females were performed using the t-test. P values < 0.05 were considered significant.

In this study, ten fencing athletes who reported wrist pain or discomfort during gripping were selected. Participants were instructed to indicate the level of discomfort experienced during wrist pain or while gripping the weapon in fencing by using a numerical rating scale (NRS). A higher score, closer to 10, indicated greater discomfort (Fig. 2). And then based on the anatomical findings of this study, pressure was applied for 5 seconds at locations corresponding to 20% to 100% of the reference line measured from the wrist side, along the distal forearm. This intervention was performed 20 times daily for one week. Subjective feedback was collected from each participant regarding any improvement in symptoms.

RESULTS

The mean length of the reference line was 24.6 ± 1.4 cm. The average horizontal distance of the styloid processes of the ulna and radius was 5.8 ± 0.5 cm. The average horizontal distance from the styloid process of the radius to the median nerve was 2.3 ± 0.2 cm. The average horizontal distance from the styloid process to the PCB was 2.9 ± 0.3 cm. The average vertical distance from the most distal point of the styloid process of the radius to the branching point of the PCB 3.7 ± 0.5 cm (Table I; Fig. 3).

Among the fencing athletes who initially reported NRS scores between 4 for 3 person, 5 for 3 person and 6 for 4 person, those who underwent repeated stimulation at tender points identified between 20% and 100% of the reference line exhibited a substantial reduction in perceived pain. Post-intervention NRS scores decreased significantly, with most values falling between 0 for 9 persons and 1 for 1 person. This effect was maintained when the technique was consistently applied during the recovery period following daily training sessions.

Table I. The metrical results of this study.

	A (cm)	B (cm)	C (cm)	C (%)	D (cm)	D (%)	E (cm)	E (%)
Average	24.6	5.8	2.3	9.3	2.9	11.7	3.7	14.9
Standard	1.4	0.5	0.2	0.8	0.3	1.3	0.5	2.4

A: Reference vertical line from the most prominent point of the lateral epicondyle of the humerus to the most distal point of the styloid process of the radius, B: The horizontal distance of the styloid processes of the ulna and radius, C: The horizontal distance from the styloid process of the radius to the median nerve, D: The horizontal distance from the styloid process to the PCB, E: The vertical distance from the most distal point of the styloid process of the radius to the branching point of the PCB.

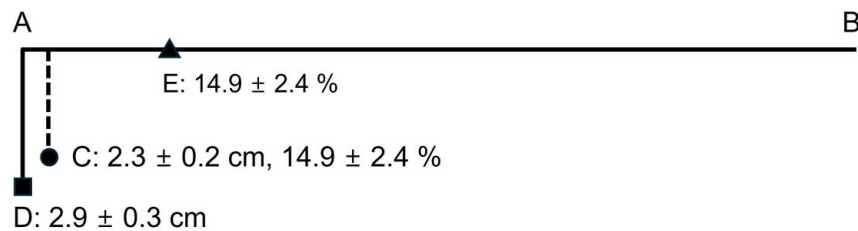


Fig. 3. The diagram visualizing the anatomical locations of each subject based on the results of this study. A: most distal point of styloid process of radius, B: lateral epicondyle of humerus, C: the horizontal distance from the styloid process of the radius to the median nerve, D: the horizontal distance from the styloid process to the palmar cutaneous branch (PCB), D: the vertical distance from the most distal point of the styloid process of the radius to the branching point of the PCB.

DISCUSSION

The PCB is frequently involved in surgical procedures for carpal tunnel syndrome or for managing persistent pain in the wrist region. However, in some patients, postoperative complications such as prolonged pain or sensory disturbances may persist, which could be attributed to injury of the PCB (Chaynes *et al.*, 2004; Xu *et al.*, 2013). Therefore, anatomical studies that localize the PCB based on reliable bony landmarks are essential. Furthermore, accurate knowledge of the PCB's course around the wrist joint can enhance the efficacy and safety of minimally invasive interventions, such as local injections. Consequently, this study, which investigates the course of the PCB in relation to the styloid process of radius, may provide clinically valuable information for both surgical and nonsurgical approaches. Various studies have investigated the alleviation of wrist pain following injection therapy. One study examined the effects of post-injection icing on pain reduction (An *et al.*, 2016), while another focused on the efficacy of the injected substances and their influence on grip strength and symptom improvement (Heyworth *et al.*, 2008). In contrast, the present study identified the branching point and anatomical course of the palmar cutaneous branch and applied a muscle relaxation technique targeting the potential entrapment site in fencing athletes, demonstrating therapeutic benefit. For athletes involved in sports that require frequent hand use, incorporating such anatomically-informed, evidence-based rehabilitation strategies may contribute positively to both recovery and athletic performance.

Regardless of whether surgical or procedural approaches are employed, non-invasive treatment methods are generally preferred. When sensory disturbances or pain arise in the region innervated by the PCB, it is important to note that the PCB typically branches off at approximately 14.9% of the distance from the most distal point of the styloid process of the radius (Table I; Fig. 3). Based on this anatomical localization, applying pressure to relax the surrounding musculature between the 20% and 100% region of the wrist has demonstrated significant efficacy in alleviating sensory disturbances and pain in the wrist and palmar regions (Figs. 1 and 3).

The location of nerve branching is clinically important, as both surgical procedures and non-invasive pressure techniques carry the risk of neurovascular injury or neuropathic complications if the anatomical course is not well understood. Thus, anatomical studies that aim to accurately localize these branching points are of significant value. A previous study reported that the PCB of the median nerve originates approximately 11 cm proximal to the palmar crease (Naff *et al.*, 1993). In contrast, the present study found that the PCB branches at approximately 14.9% of the reference length measured from the most distal point of the radial styloid process. When converted to an absolute value, this corresponds to a branching point located 3.7 cm proximal to the styloid process, indicating a considerable discrepancy from earlier findings (Table I; Fig. 3). As the PCB travels toward the palm, it was observed to run approximately 0.6

cm more medially than the median nerve, which lies 2.3 cm from the radial styloid process at the level of the wrist. This information provides further insight into the anatomical relationships of the nerves at the wrist, which may aid in both surgical planning and targeted non-invasive interventions.

It is hoped that the findings of this study will serve as a valuable guideline for both invasive and non-invasive treatment approaches. Further clinical studies are anticipated to build upon these results and explore their practical applications in therapeutic settings.

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RESUMEN: El objetivo de este estudio fue investigar la localización anatómica del ramo palmar (RP) del nervio mediano y evaluar los efectos terapéuticos de métodos de recuperación no invasivos. Tras realizar disecciones meticulosas de 12 cadáveres para identificar el trayecto del nervio, se evaluaron los efectos de la aplicación regular de presión en la región correspondiente en atletas de esgrima, centrándose en los cambios en el dolor de muñeca y la fuerza de agarre. El nervio mediano se localizó a 2,3 cm medialmente del proceso estiloides del radio, mientras que la RP se posicionó a 2,9 cm medialmente. El punto de ramificación del RP se identificó a 3,7 cm proximal al extremo distal del proceso estiloides del radio. En atletas de esgrima, la aplicación de presión dirigida a esta región resultó en una reducción del dolor de muñeca y una mejora de la fuerza de agarre. Con una aplicación constante, estos efectos se mantuvieron en todos los participantes. Se espera que estos hallazgos contribuyan tanto a la guía quirúrgica como al desarrollo de estrategias eficaces de recuperación no invasivas.

PALABRAS CLAVE: Anatomía; Ramo palmar; Nervio mediano; Esgrimista; Recuperación.

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