Int. J. Morphol.,
42(3):623-630, 2024.

Compressive Structures of the Median Nerve at the Elbow

Estructuras Compresivas del Nervio Mediano en el Codo

**Edie Benedito Caetano; Luiz Angelo Vieira; Vinicius Santos Bueno;
Tulio Stefanin Volpiani; Giovanni Caetano Padilha & Vinicius Parron Keller**

CAETANO, E. B.; VIEIRA, L. A.; BUENO, V. S.; VOLPIANI, T. S.; PADILHA, G. C. & KELLER, V. P. Compressive structures of the median nerve at the elbow. *Int. J. Morphol., 42(3)*:623-630, 2024.

SUMMARY: The objective of this study was to analyze the potential for compression of the median nerve (MN) caused by the bicipital aponeurosis (BA), the humeral and ulnar heads of the pronator teres muscle (PTM) and the arcade of the flexor digitorum superficialis muscle (FDS) in recently deceased cadavers. In this analysis 20 forearms of 10 recently deceased adult male cadavers were dissected. Dissections were performed in the institution's autopsy room or anatomy laboratory. The short and long heads of the biceps brachii muscle, as well as the BA were identified in all upper upper limbs. The BA received contribution from the short and long heads of the biceps brachii muscle. In 12 upper limbs the BA was wide and thickened and in 8 it was supported by the MN. In 5 upper limbs, the BA was wide but not very thick, and in 3 it was narrow and not very thick. We identified the existence of the FDS muscle arcade in all dissected upper limbs. A fibrous arcade was identified in 4 forearms, a muscular arcade in 14 and a transparent arcade in 2 upper limbs. In all of them, we recorded that the arcade was in contact with the MN. We recorded the humeral and ulnar heads of the PTM in all dissected upper limbs, with the presence of fibrous beams between them along their entire length. The MN was positioned between the humeral and ulnar heads of the PTM in all upper limbs. In eight upper limbs (40 %), we identified that the BA had thickness and contact with the MN with the potential to cause its compression. Compression between the humeral and ulnar heads of the PTM by the fibrous connections has the potential to cause nerve compression in all upper limbs (100 %). We did not identify that the anatomical structure of the FDS arcade had the potential to cause compression in the MN.

KEY WORDS: Musculoskeletal abnormalities; Nerve compression syndromes; Dissection in cadavers.

INTRODUCTION

In their respective paths, peripheral nerves can suffer compression in anatomical locations, where there is a disproportion between the content of the nerve and the continent of the structures it crosses, determining compressive neuropathies. The most common site of compression of the median nerve is the carpal tunnel; however, it can often be compressed by anatomical structures in the region of the elbow and proximal third of the forearm (Testut, 1884; Spinner, 1978; Hartz *et al*., 1981; ElMaraghy & Devereaux, 2013; Dubois de Mont-Marin *et al*., 2021).

The median nerve (MN) is formed by the junction of the lateral and medial fascicles of the brachial plexus. In the middle third of the arm, the MN crosses the brachial artery from lateral to medial and in front of it, both being surrounded by a neurovascular sheath (Testut, 1884). The nerve then goes towards the cubital fossa, where it is located medially to the brachial artery and the tendon of the biceps brachii muscle, courses posteriorly to the bicipital aponeurosis (BA), follows its path between the superficial and deap heads of the pronator teres muscle (PTM) (Spinner, 1978) and passes through the arch formed by the two insertions of the flexor digitorum superficialis muscle (FDS) (Hartz *et al*., 1981; ElMaraghy & Devereaux, 2013). The MN can suffer compression in any of these mentioned locations and, regardless of where it occurs, this compressive neuropathy is called pronator teres syndrome. Median nerve compression in the forearm should be considered as a differential diagnosis of patients with forearm pain and persistent median nerve compression symptoms, especially in patients with symptoms after carpal tunnel release (El-Haj *et al*., 2021).

BA is a thickening of the brachial fascia that joins the biceps brachii to the ulna, covering the proximal portion of the flexor-pronator muscle group. The BA has the functions of protecting the neurovascular bundle in the cubital fossa and serving as anchorage for the bicipital tendon, which is inserted into the bicipital tuberosity of the

Pontifícia Universidade Católica de São Paulo. Faculdade de Ciências Médicas e da Saúde, Sorocaba, São Paulo, Brasil.

Received: 2024-01-04 Accepted: 2024-02-25

radius (Caetano *et al*., 2018a). When the BA is too thick, it can compress the median nerve and cause symptoms (ElMaraghy & Devereaux, 2013).

The PTM is made up of two heads. The humeral (or superficial) head is more extensive and originates on the medial epicondyle of the humerus and surrounding areas. The ulnar (or deep) head originates from the coronoid process of the ulna. The two portions come together to insert themselves into the diaphysis of the radius, bypassing it. The median nerve is positioned between the two heads of the PTM (Jamienson & Anson, 1952; Johnson *et al*., 1979; Dellon & Mackinnon, 1987; Nebot-Cegarra *et al*., 1992; Tulwa *et al*., 1994).

The FDS muscle is the largest muscle in the forearm. It forms an intermediate muscular layer in the forearm between the superficial and deep groups. The median nerve and ulnar artery enter the forearm passing through an arch made up of the insertions of the radial and humero-ulnar heads of the FDS (Kopell & Thompson, 1958; Bilecenoglu *et al*., 2005; Athwal *et al*., 2007; Tubbs *et al*., 2010; Guo & Wang, 2014; Caetano *et al*., 2018b).

The objective of this work was to analyze, in the forearms of recently deceased cadavers, the potential of these structures to cause compression of the median nerve.

MATERIAL AND METHOD

In the study 20 forearms were dissected from 10 recently deceased adult male cadavers. The forearms did not show deformations due to trauma, malformations or scars. Dissections were performed in the institution's autopsy room or anatomy laboratory. Through a median incision in the arm and forearm, two flaps were reflected, including the skin and subcutaneous, for the radial and ulnar sides respectively. The same was done in relation to the fascia of the arm and forearm, thus exposing the entire musculature. The median nerve was identified in the proximal third of the arm on the medial margin of the biceps brachii muscle and dissected distally. The biceps brachii and brachialis muscles were dissected to their insertions. The participation of the short and long heads of the biceps brachii muscle in the composition of the BA was analyzed. The dissection continued distally in the forearm where the relationship of the median nerve with the superficial and deep heads of the pronator teres muscle and with the arch formed between the insertions of the flexor digitorum superficialis muscle was analyzed. We analyzed the anatomical characteristics of the BA, the humeral and ulnar heads of the PTM and the arch formed by the proximal insertions of the FDS muscle. The anatomical variations identified were noted and photographed. A Keeler magnifying glass with 2.5X magnification was used as a means of magnification.

This manuscript was analyzed and approved by the Ethics Committee of the Faculty of Medical and Health Sciences of the Pontifical Catholic University of São Paulo - FCMS/PUC with Certificate of Presentation of Ethical Appreciation number 70128223.0.0000.5373.

RESULTS

The short and long heads of the biceps brachii muscle, as well as the BA, were identified in all upper limbs. BA received contributions from the short and long heads, with the most significant contribution always coming from the short head. The BA joined the antebrachial fascia, covering the flexus pronator group, inserting into the proximal third of the ulna. The length of the BA from its origin to its insertion varied from 4.2 to 6.0 cm and its width from 0.5 to 2.0 cm. In eight upper limbs, the BA was thickened, in contact with the median nerve, with the elbow being extended (Fig. 1). In four upper limbs, even though thick, the BA did not rest on the median nerve (Fig. 2). In five upper limbs it was wide, but not thick enough to compress the nerve (Fig. 3). In three upper limbs, the BA was very narrow and thin (Figs. 4 and 5). The bicipital tendon was identified in all cases forming a variable angle with the BA.

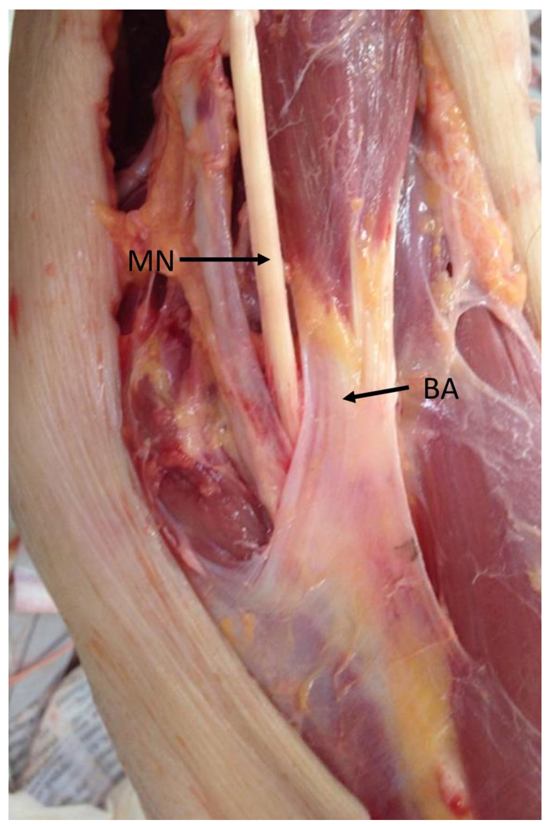

Fig. 1. In 8 upper limbs, the bicipital aponeurosis was thickened, in contact with the median nerve, with the elbow in extension

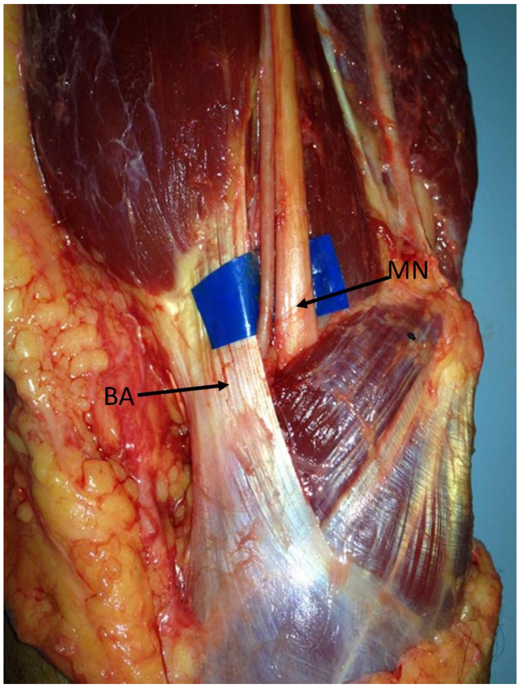

Fig. 2. In 4 upper limbs, even though the bicipital aponeurosis was thick, it did not rest on the median nerve.

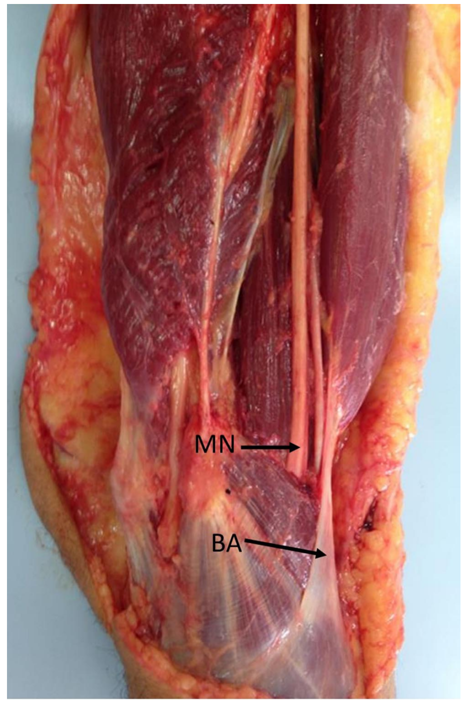

Fig. 4. In 3 upper limbs the bicipital aponeurosis was very narrow and thin

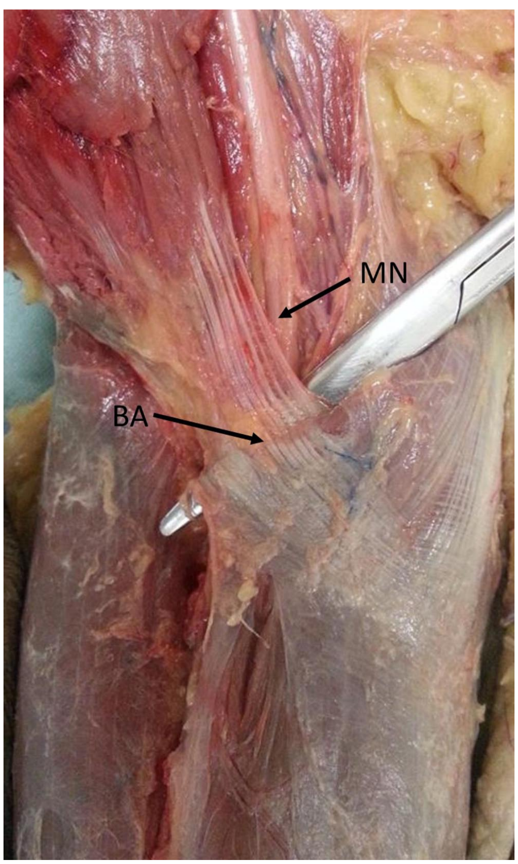

Fig. 3. In 5 upper limbs, the bicipital aponeurosis was wide, but not thick enough to compress the nerve

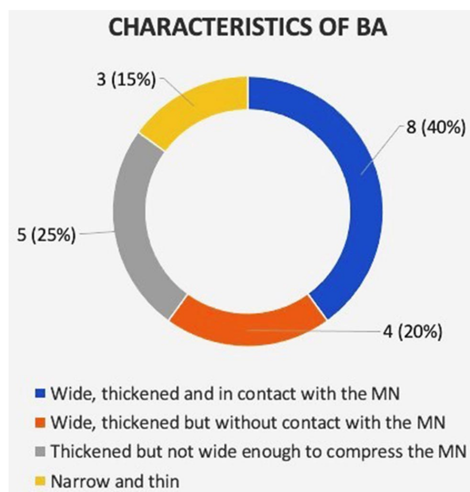

Fig. 5. Characteristics of bicipital aponeurosis.

We recorded that in all dissected upper limbs the humeral and ulnar heads of the PTM were well individualized, with the presence of fibrous beams between them throughout their entire length (Fig. 6). The two heads joined distally to insert themselves through an enlarged tendon, bypassing and inserting themselves in the middle third of the radius diaphysis (Fig. 7). The median nerve was positioned between the humeral and ulnar heads of the PTM in all upper limbs (Figs. 6 to 8) We observed the humeral head to be always more extensive in relation to the ulnar head (Fig. 6). In all upper limbs, the proximal origin of the ulnar head of the PTM was always through a tendinous component (Fig. 7).

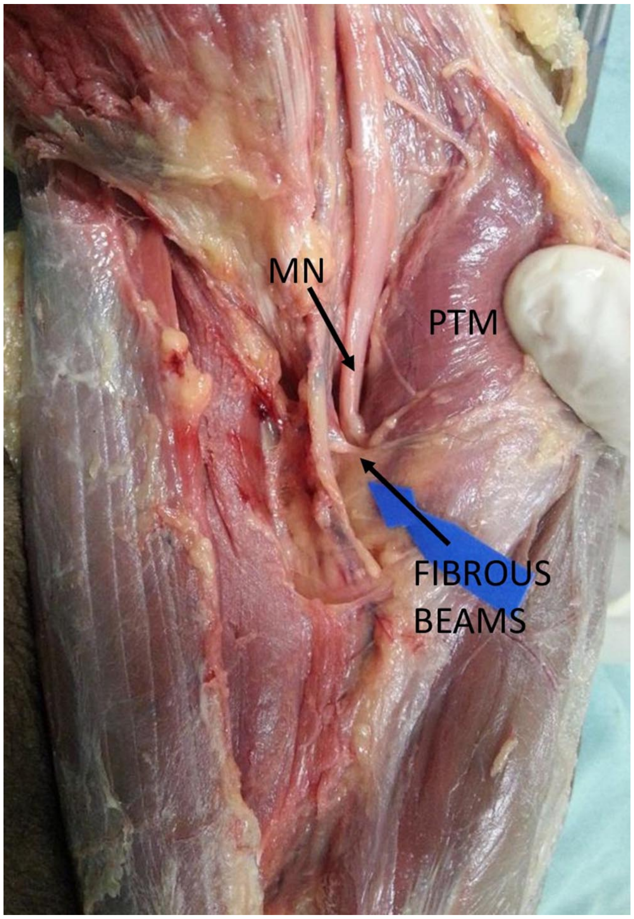

Fig. 6. In all the dissected upper limbs, the humeral and ulnar heads of the PTM were well individualized, with the presence of fibrous beams between them along their entire length.

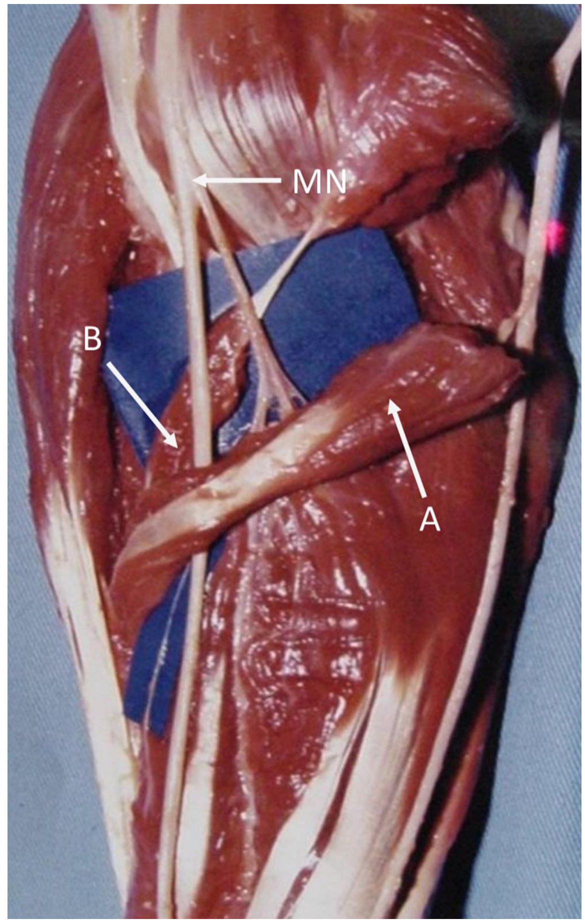

Fig. 7. The superficial (A) and deep (B) heads of the pronator teres muscle join distally to insert through an enlarged tendon, bypassing and inserting into the middle third of the radius diaphysis.

We identified the existence of the FDS muscle arcade in all dissected upper limbs. The radial head of the FDS muscle was identified in the 20 forearms, with an extension of 2.5 to 7.0 cm. The humeral head, in the same way, was recorded on all forearms, inserting on the medial epicondyle, next to the pronator teres muscle. The ulnar head was identified in four forearms, inserting itself close to the coronoid process of the ulna. The fibrous arcade was identified in four forearms (Fig. 9). The muscular arch was recorded in 14 upper limbs (Fig. 10). The transparent arch was identified in two upper limbs and, in this case, the arch was very thin, making it possible to visualize the nerve through transparency inside it (Fig. 11). In all upper limbs we recorded that the median nerve was in contact with the arch. The average distance from the arch point that rested on the median nerve and the medial epicondyle was 6.6cm (average 5.8 to 7.0cm). The anterior interosseous nerve originated from the median nerve proximal to the arch in all forearms. The muscular arcade was recorded in 14 upper limbs (Fig. 10).

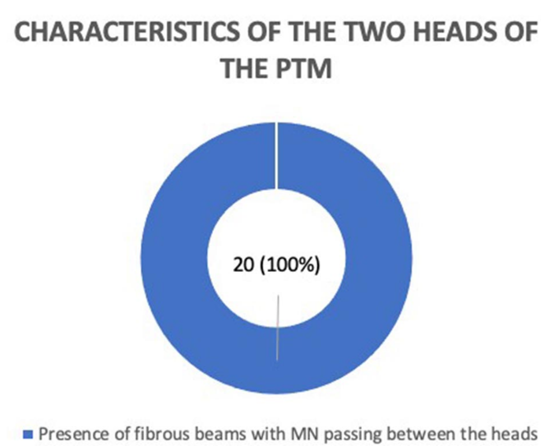

Fig. 8. Characteristics of the two heads of pronator teres muscle.

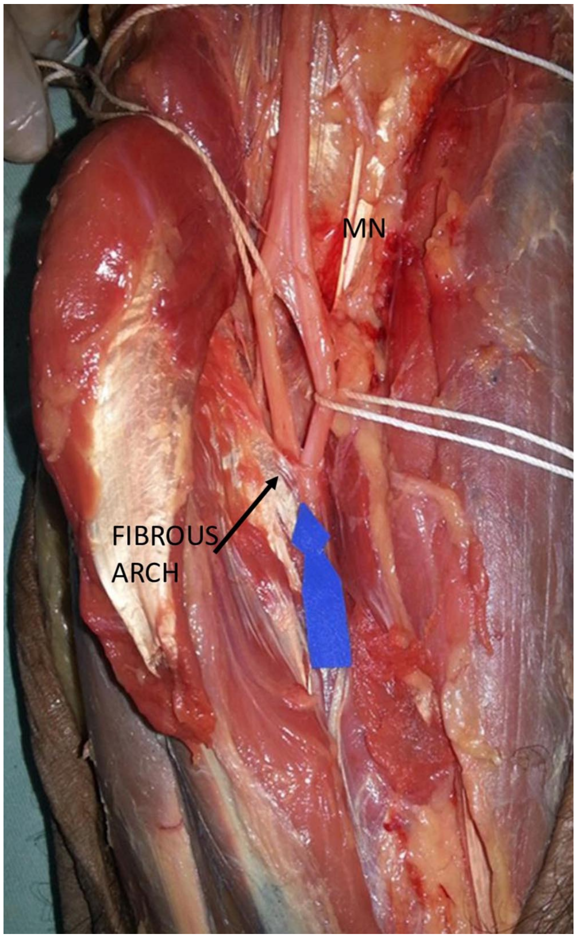

Fig. 9. The fibrous arch of the superficial flexor muscle was identified in 4 forearms.

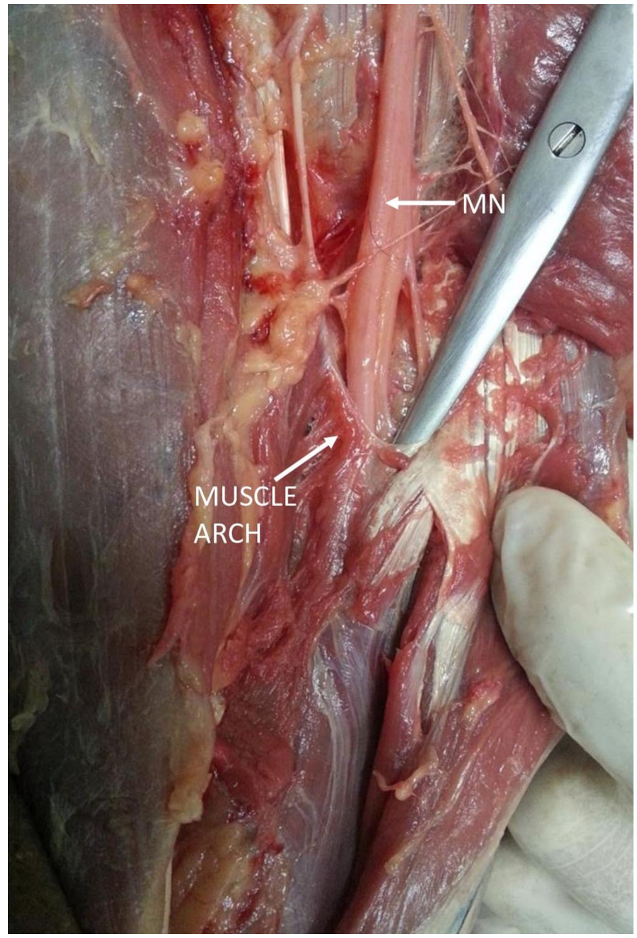

Fig. 10. The flexor superficial muscle arch was recorded in 14 upper limbs.

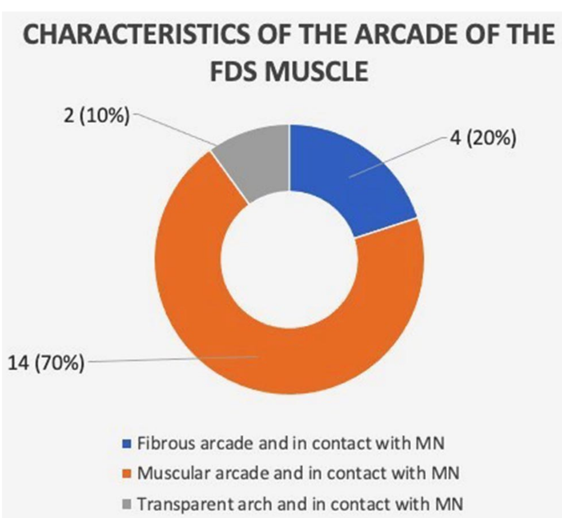

Fig. 11. Characteristics of the arcade of the flexor digitorum superficialis muscle muscle.

DISCUSSION

In proximal compression of the median nerve, there may be several simultaneous compressive structures, which, in a limited view, may mean that some of these structures go unnoticed in the assessment of the pathology. Therefore, the separation of proximal compressive neuropathies of the median nerve into smaller anatomical syndromes should be discussed, as none of them truly represents the mixture of overlapping anatomical variations found in clinical practice (Löppönen *et al*., 2022).

The reviewed literature presented different points of view on the morphology of the BA and the amount of contribution of fibers from the short head and long head to its formation. Athwal *et al*. (2007), dissected 15 upper limbs from cadavers and in all of them, they identified BA originating from the short head of the biceps brachii muscle, so that the short head contributed to the formation of the bicipital tendon and the BA, while the long head only contributed to the formation of the bicipital tendon. Dirim *et* *al*. (2008), reported that the BA is made up of fibers originating from the short and long heads of the biceps brachii muscle, and in only one of 17 upper limbs they identified that only the short head contributed to the formation of the BA. Joshi *et al*. (2014), studied 30 cadaveric upper limbs and recorded that the fibers that formed the distal portion of the BA originated from the short head, while those that formed the proximal portion of the BA originated from the long head of the biceps brachii muscle. Caetano *et al*. (2017), observed that in 90 % of the dissected upper limbs the BA received contributions from the short and long heads. In this study we observed that the short and long heads of the biceps brachii muscle were identified in all upper limbs. In all members, the BA received contributions from the short and long heads, with the most significant contribution always coming from the short head. We identified that, in eight upper limbs (40 %), the BA was of consistent width and thickness and in contact with the median nerve, with the elbow in extension. In four upper limbs (20 %), the BA was also consistent in width and thickness, but did not rest on the median nerve. In five upper limbs it was wide, but not thick enough to compress the nerve; in three upper limbs, the BA was very narrow and thin. Kopell & Thompson (1958) report that thickened bicipital aponeurosis can compress the median nerve and cause motor and sensory symptoms. Spinner (1978) report four cases of compressive neuropathy of the median nerve caused by accessory bicipital aponeurosis, which originated in the distal third of the forearm, and in two of these cases it was associated with the third head of the biceps brachii muscle. In this study, in contrast to other authors (Spinner, 1978; Dirim *et al*., 2008), we did not identify the presence of the third head of the biceps brachii muscle.

We recorded that the humeral and ulnar heads were present in all of the 20 dissected upper limbs and the median nerve was positioned between them. The absence of the ulnar head described by some authors (Jamienson & Anson, 1952; Nebot-Cegarra *et al*., 1992; Tulwa *et al*., 1994; Stabille *et al*., 2002; Caetano *et al*., 2017) was not observed in the present study. Some authors report that the median nerve may be positioned posterior to the two heads of the pronator teres muscle (Jamienson & Anson, 1952; Caetano *et al*., 2017) and also report that the ulnar head may be poorly developed, with a fibrous component in its proximal portion in the coronoid process of the ulna. In this study, we noted in all upper limbs that the proximal origin of the ulnar head was always through a tendon component. The median nerve crossing the muscular mass of the humeral head of the PTM has been described by several authors (Tulwa *et al*., 1994; Stabille *et al*., 2002; Caetano *et al*., 2017) but in this study we did not record this anatomical variation. In his treatise, Le Double (1897) describes that the humeral and ulnar heads of the PTM can be completely independent, with distal insertions in different locations. In this study we noticed that the two heads of the PTM joined distally, bypassing and inserting into the diaphysis of the radius, which agrees with other authors (Stabille *et al*., 2002; Caetano *et al*., 2017). Barret (1936) describes that among 200 dissected cases, he recorded an additional portion of the humeral head in one and called it the third head of the PTM. Wehave not identified an additional PTM head.

Hartz *et al*. (1981), reported that, based on their experience, they noticed that compression of the median nerve caused by the bicipital aponeurosis resulted in pain that spread diffusely on the volar surface of the forearm, while compression by the arch of the FDS muscle resulted in well-localized pain. Tubbs *et al*. (2010), noted, in 60 dissected forearms, that elbow extension placed the median nerve under greater compression by the FDS muscle arch, and pronation and supination movements did not alter the median nerve relationship with the FDS muscle arch. In this study we noticed that in all upper limbs the FDS arcade was in contact with the median nerve. We only used recently deceased cadavers and observed that flexion and extension movements, as well as pronation and supination of the forearm, altered the relationship between the arch of the FDS muscle and the median nerve. However, we did not identify that the arch has the potential to cause nerve compression. Few descriptions regarding the anatomical formation of the FDS muscle arcade are found in the literature. Bilecenoglu *et al*. (2005) dissected 30 upper limbs from 15 cadavers fixed in formalin and recorded in 97.7 % the existence of two heads of the FDS muscle, forming an arch through which the median and anterior interosseous nerves passed. Our findings are in line with those of Caetano *et al*. (2018b), who identified the radial and humeral head of the FDS muscle in all forearms. Tubbs *et al*. (2010) dissected 60 forearms from 30 prepared cadavers and identified the arch with a tendinous constitution in 45 cadavers (75 %), and in 15 (25 %) the arch had a muscular constitution. Dellon & Mackinnon (1987) identified the presence of a fibrous arch in 11 of 31 dissected upper limbs (36 %). Johnson *et al*. (1979) dissected 40 preserved cadavers, and in 12 (30 %) they identified a fibrous arch on the proximal margin of the FDS muscle, in 10 (25 %) they did not identify any fibrous band in the passage of the median nerve in the proximal region of the forearm. Guo & Wang (2014) also reported that the anterior interosseous nerve originated distally from the arch of the FDS muscle in 74 % of the forearms. In contrast, Tubbs *et al*. (2010), reported that in the 60 upper limbs they dissected, they identified the anterior interosseous nerve originating proximally from the arch of the superficial flexor muscle. Our results agree with those of Tubbs *et al*. (2010), and

Caetano *et al*. (2018b), as we identified the anterior interosseous nerve originating proximally to the FDS arch in all forearms. Caetano *et al*. (2018b), they identified the fibrous arch in 32 forearms (64 %), muscular in 11 (22 %), transparent in four (8 %), and in three (6 %) forearms they considered the arch to be irregular, as there was discontinuity between the fibers that formed the arcade. In this study we found different results, as we did not identify that the fibrous arch, with a tendinous consistency that could compress the median nerve. The fibrous arch was identified in five forearms and the muscular arch was recorded in 14. The use of recently deceased cadavers allowed flexion-extension and prone supination maneuvers and thus it was possible to evaluate the contact of the arch with the median nerve, which could be a explanation for such different results.

CONCLUSION

In eight upper limbs (40 %) of recently deceased cadavers, we identified that the BA was thick and in contact with the median nerve with the potential to cause compression. Compression between the humeral and ulnar heads of the PTM by fibrous connections has the potential to cause nerve compression in all upper limbs (100 %). We did not identify that the anatomical structure of the FDS arch had the potential to cause nerve compression.

CAETANO, E. B.; VIEIRA, L. A.; BUENO, V. S.; VOLPIANI, T. S.; PADILHA, G. C. & KELLER, V. P. Estructuras compresivas del nervio mediano en el codo. *Int. J. Morphol., 42(3)*:623-630, 2024.

RESUMEN: El objetivo de este estudio fue analizar la potencial compresión del nervio mediano (NM) causado por la aponeurosis bicipital (AB), las cabezas humeral y cubital del músculo pronador redondo (MPR) y la arcada del músculo flexor superficial de los dedos (MFS) . En este análisis se diseccionaron 20 antebrazos de 10 cadáveres masculinos de individuos adultos fallecidos recientemente. Las disecciones se realizaron en la sala de autopsias o en el laboratorio de anatomía de la Institución. En todos los miembros superiores se identificaron las cabezas corta y larga del músculo bíceps braquial, así como la AB. La AB recibió contribución de las cabezas corta y larga del músculo bíceps braquial. En 12 miembros superiores la AB era ancha y engrosada y en 8 estaba sostenida por el NM. En 5 miembros superiores la AB era ancha pero poco gruesa, y en 3 era estrecha y de menor grosor. Identificamos la existencia de la arcada muscular MFS en todos los miembros superiores disecados. Se identificó una arcada fibrosa en 4 antebrazos, una arcada muscular en 14 y una arcada delgada y transparente en 2 miembros superiores. En todos ellos registramos que la arcada estaba en contacto con el NM. Registramos las cabezas humeral y cubital del MPR en todos los miembros superiores disecados, con presencia de haces fibrosos entre ellas en toda su longitud. El NM estaba situado entre las cabezas humeral y cubital del MPR en todos los miembros superiores. En ocho miembros superiores (40 %), identificamos que la AB era gruesa y tenía contacto con el NM con potencial para causar su compresión. La compresión entre las cabezas humeral y ulnar del MPR, por las conexiones fibrosas, tiene el potencial de causar compresión nerviosa en todos los miembros superiores (100 %). No identificamos que la estructura anatómica de la arcada MFS tuviera el potencial de causar compresión del NM.

PALABRAS CLAVE: Anomalías musculoesqueléticas; Síndromes de compresión nerviosa; Disección en cadáveres.

REFERENCES

Athwal, G. S.; Steinmann, S. P. & Rispoli, D. M.; The distal biceps tendon: footprint and relevant clinical anatomy. *J. Hand Surg., 32(8)*:1225-9, 2007.

Barret, J. H. An additional (third and separate) head of pronator teres muscle. *J. Anat., 70 (Pt. 4)*:577-8, 1936.

Bilecenoglu, B.; Uz, A. & Karalezli, N. Possible anatomic structures causing entrapment neuropathies of the median nerve: an anatomic study. *Acta Orthop. Belg., 71(2)*:169-76, 2005.

Caetano, E. B.; Sabongi Neto, J. J.; Vieira, L. A.; Caetano, M. B. F.; Bona, J. E. & Simonatto, T. M. Arcade of flexor digitorum superficialis muscle: anatomical study and clinical implications. *Rev. Bras. Ortop., 26(1)*:36-40, 2018b.

Caetano, E. B.; Vieira, L. A.; Almeida, T. A.; Gonzales, L. A. M.; Bona, J. E. & Simonatto, T. M. Bicipital aponeurosis. Anatomical study and clinical implications. *Rev. Bras. Ortop., 53(1)*:75-81, 2018a.

Caetano, E. B.; Vieira, L. A.; Sprovieri, F. A. A.; Petta, G. C.; Nakasone, M. T. & Serafim, B. Anatomical variations of the pronator teres muscle and their importance in compressive syndromes. *Rev. Bras. Ortop., 52(2)*:169-75, 2017.

Dellon, A. L. & Mackinnon, S. E. Musculoaponeurotic variations along the course of median nerve in the proximal forearm. *J. Hand Surg. Br., 12(3)*:359-63, 1987.

Dirim, B.; Brouha, S. S.; Pretterklieber, M. L.; Wolff, K. S.; Frank, A.; Pathria, M. N. & Chung, C. B. Terminal bifurcation of the biceps brachii muscle and tendon: anatomic considerations and clinical implications. *AJR Am. J. Roentgenol., 191(6)*:W248-55, 2008.

Dubois de Mont-Marin, G.; Laulan, J.; Le Nen, D. & Bacle, G. Topographic anatomy of structures responsible to compress the median nerve at the elbow and proximal forearm. *Orthop. Traumatol. Surg. Res., 107(2)*:102813, 2021.

El-Haj, M.; Ding, W.; Sharma, K.; Novak, C.; Mackinnon, S. E. & Patterson, J. M. M. Median nerve compression in the forearm: a clinical diagnosis. *Hand (N. Y.), 16(5)*:586-91, 2021.

ElMaraghy, A. & Devereaux, M. The "bicipital aponeurosis flex test": evaluating the integrity of the bicipital aponeurosis and its implications for treatment of distal biceps tendon ruptures. *J. Shoulder Elbow Surg., 22(7)*:908-14, 2013.

Guo, B. & Wang, A. Median nerve compression at the fibrous arch of the flexor digitorum superficialis: an anatomic study of the pronator syndrome. *Hand (N. Y.), 9(4)*:466-70, 2014.

Hartz, C. R.; Linscheid, R. L.; Gramse, R. R. & Daube, J. R. The pronator teres syndrome: compressive neuropathy of the median nerve. *J. Bone Joint Surg. Am., 63(6)*:885-90, 1981.

Jamienson, R. W. & Anson, B. J. The relation of the median nerve to the heads of origin of the pronator teres muscle, a study of 300 specimens. *Quart. Bull. Northwest. Univ. Med. Sch., 26(1)*:34-5, 1952.

Johnson, R. K.; Spinner, M. & Shrewsbury, M. M. Median nerve entrapment syndrome in the proximal forearm. *J. Hand Surg. Am., 4(1)*:485-1, 1979.

Joshi, S. D.; Yogesh, A. S.; Mittal, P. S. & Joshi, S. S. Morphology of the bicipital aponeurosis: a cadaveric study. *Folia Morphol. (Warsz.), 73(1)*:79-83, 2014.

Kopell, H. P. & Thompson, W. A. Pronator syndrome: a confirmed case and its diagnosis. *N. Engl. J. Med., 259(15)*:713-5, 1958.

Le Double, A. S. *Traité des System Variations Man's Musculaire.* Paris, Schelicher, 1897. pp.103-71.

Löppönen, P.; Hulkkonen, S. & Ryhänen, J. Proximal median nerve compression in the differential diagnosis of carpal tunnel syndrome. *J. Clin. Med., 11(14)*:3988, 2022.

Nebot-Cegarra, J.; Perez-Berruezo, J. & Reina de la Torre, F. Variations of the pronator teres muscle: predispositional role to median nerve entrapment. *Arch. Anat. Histol. Embryol., 74*:35-45, 1992.

Spinner, M. *Injuries to the Major Branches of the Peripheral Nerves of the Forearm.* Philadelphia, W. B. Saunders, 1978. pp.160-227.

Stabille, S. R.; Duarte, E. & Carvalho, V. C. Pronator teres muscle: anatomical variations and predisposition for the compression of the median nerve. *Acta Sci. Biol. Sci., 24*:631-7, 2002.

Testut, L. *Les Anomalies Musculaires chez l'Homme*. Paris, Masson, 1884. pp.401-3.

Tubbs, R. S.; Marshall, T.; Loukas, M.; Shoja, M. M. & Cohen-Gadol, A. A. The sublime bridge: anatomy and implications in median nerve entrapment. *J. Neurosurg., 113(1)*:110-2, 2010.

Tulwa, N.; Limb, D. & Brown, R. F. Median nerve compression within the humeral head of pronator teres. *J. Hand Surg. Br., 1B(6)*:709-10, 1994.

Corresponding author:
Edie Benedito Caetano
Pontifícia Universidade Católica de São Paulo
Faculdade de Ciências Médicas e da Saúde
Rua Joubert Wey
290 CEP.: 18030-070
Sorocaba, SP
BRAZIL

E-mail: ediecaetano@uol.com.br