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Original Research Article

INNERVATIONS OF PRONATOR TERES MUSCLE BY MEDIAN NERVE: A CADAVERIC STUDY

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ABSTRACT

Background: Median nerve innervates muscles of forearm & hand. Anatomical variations are found in its innervations to muscles, one of them is pronator teres. The knowledge of variation of median nerve in relation with Pronator teres muscle is very important for understanding of pronator teres syndrome, its accurate diagnosis and proper treatment, so as to avoid the injury to either nerve or Pronator teres muscle.

Materials and methods: The study was carried out at the Department of the Anatomy, Bharati Vidyapeeth (deemed to be university) Medical College and Hospital, Sangli and GMC Miraj.100 formalin fixed specimens of upper limb from 50 adult cadavers (irrespective of sex and age 25-70 years), were dissected. After careful dissection, relation of median nerve with pronator teres muscle, number of branches innervating muscle, distance between intercondylar line and median nerve piercing Pronator Teres were noted and recorded. Data was analyzed by microsoft excel analysis.

Observation and Results: In present study, in all the specimens (100%) the median nerve entered the forearm by passing between the two heads of Pronator teres muscle. Median nerve innervated Pronator teres by 2 branches in 75% specimens. Innervation by 3 branches was observed in 15% specimens and by only 1 branch in 15% specimens. One new parameter was introduced i.e. the distance from intercondylar line to a point where median nerve (trunk) pierced the pronator teres muscle.It was measured with the help of vernier caliper. The minimum distance observed was 23mm and maximum distance was 73mm.

Conclusion: The study will add to the knowledge of variations in innervations of Pronator teres muscles by median nerve and can be of use in treatment of MN entrapment syndrome and surgical procedures.

KEYWORDS: Median Nerve, Branches, Cadaver, Pronator teres muscle, Injury, Syndrome.

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INTRODUCTION

Variations of the nerves of the upper limb may have clinical implications, so it is important to report them during cadaveric dissection [1]. The structures adjacent to nerves often have an impact on functioning of nerves, as nerves haveto constantly adapt to changes in limb movements. The upper limb known for mobility requires the nerves to adapt continuously to new positions. They achieve this through translation (sliding) and strain deformity (stretching). Anatomical structures adjacent to nerves may thus compress, tether or entrap nerves, which may lead to neuropathy or loss of sensation [2].

The median nerve is formed by the union of the lateral root from the lateral cord and medial root from the medial cord of the brachial plexuses. The median nerve is closely related to Pronator teres & usually enters the forearm by passing between the two heads of this muscle. It usually gives a branch to Pronator teres, at a variable distance proximal to the elbow joint [3,4].

Although Carpal tunnel syndrome is the most common cause of the median nerve entrapments [5], compression can occur during its course of entry into forearm. Nerve entrapment, known as ''Pronator Teres syndrome'', may occur in this passage. Factors responsible for compression at distal Humerus or proximal part of forearm can be Struthers ligament, presence of anomalous artery & muscle or Pronator teres syndrome. Anatomical variations in this region may be potential risk factors of this pathology.

The course of the Median nerve in relation to Pronator teres depends on the morphology of the muscle and its adjacent anatomical structures &is clinically important because of the difficulty in diagnosing PT syndrome. [6] Pronator teres muscle has a significant role not only as a muscle for pronation movement, but also as a donor muscle. Hence the relation of median nerve to this muscle and its motor innervation is of special importance for restoring functional ability of fingers after trauma [7]. Regarding the sharing of PTM median nerve branches for innervations of other muscles, there are more controversy in the literature [8].

It has also been reported that whenever more than one branch to the PTM is present, there is the possibility of a nerve transfer. The proximal branch of the PTM when long enough can be transferred to the Anterior Interosseous nerve and branches of the radial nerve. Neural connections remained tension free with full pronation and supination. A branch of median nerve to the pronator teres that is long enough to reach the radial nerve in the cubital fossa can be considered for neurotization of the radial nerve in the cubital fossa [9].

Pronator teres rerouting is an important surgery to improve both, active supination and dynamic forearm positioning in children with cerebral palsy [10].

The knowledge of branches of median nerve (extra & intramuscular) to pronator teres & other muscles of flexor compartment of forearm can be of use in treatment of relieving pronation & flexion deformity due to the spasticity & hypertonia of muscles. The spasticity can be treated with injections of botulinum toxin and sometimes with selective fascicular neurotomy [11].

The knowledge of innervations pattern of Median nerve to Pronator teres is important not only in diagnosis & investigations of various conditions but also in planning various treatment modalities & surgical interventions. Thus the present study was undertaken with the objectives to study relation of median nerve to Pronator teres, number of branches innervating the muscle & the distance between intercondylar line & the site where the trunk of Median nerve pierced Pronator teres.

MATERIALS AND METHODS

Fig. 1: Showing median nerve passing between the two heads of pronator teres and innervation of pronator teres muscle by single muscular branch: median nerve (1), pronator teres (2), single muscular branch (3).

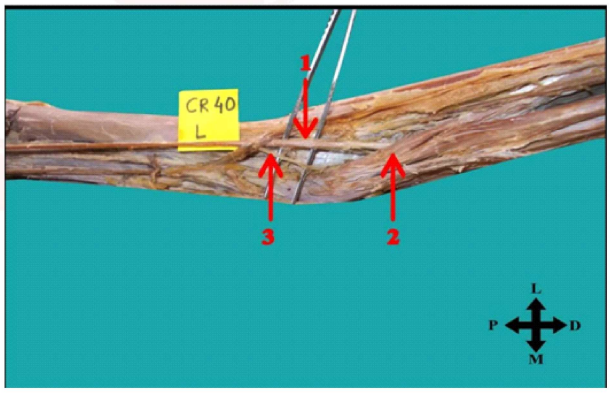


Fig. 2: Showing MN passing between the two heads of PT and innervation of PT by two muscular branches: MN (1), PT (2), Muscular Branches (3).

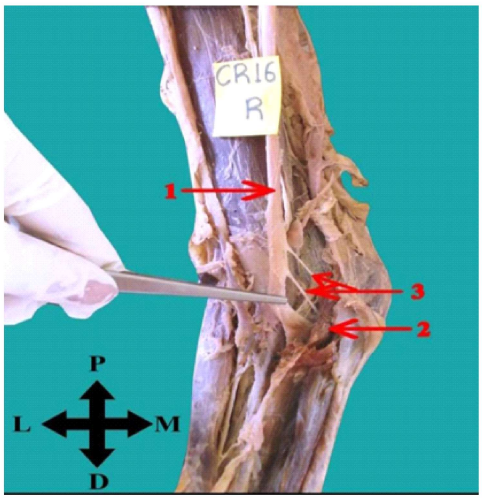


Fig. 3: Showing MN passing between the two heads of PT and innervation of PT by three muscular branches: MN (1), BA (2), PT (3), Muscular Branches (4)

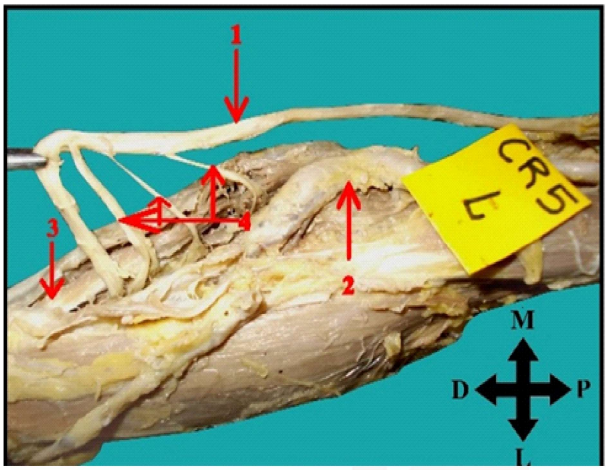
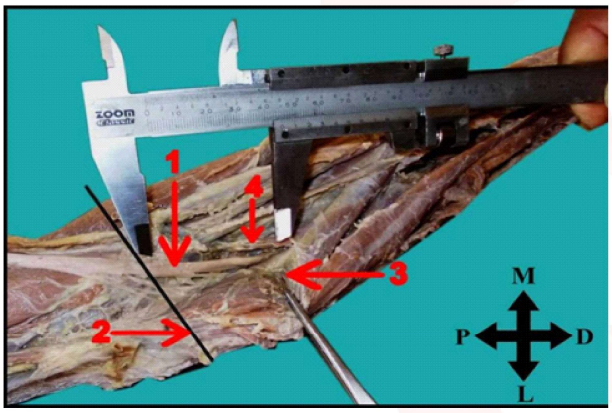


Fig. 4: Showing the Measurement of distance from ICL to a point where the MN passing between two heads of PT: MN (1), ICL (2), Humeral head of PT (3), Ulnar head of PT (4)



It was descriptive, observational, cadaveric study. After an ethical approval of RRC & IEC, the study was conducted with 100 formalin fixed specimens of upper limb from 50 adult human cadavers (irrespective of sex and age 25-70 years).It was carried at Bharati vidyapeeth (deemed to be university) medical college and hospital, sangli and Government Medical College (GMC), Miraj. The steps of dissection were followed as described in Cunningham's manual of dissection [12]. Following observations were noted

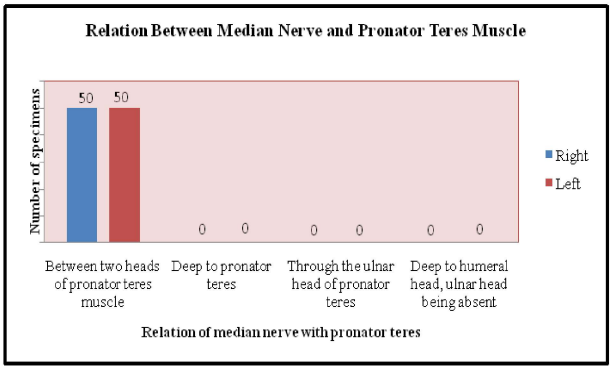
1) Relation of median nerve with Pronator teres muscle

2) Number of branches of median nerve to Pronator teres

3) The distance (mm) between Intercondylar Line and the Site where Median Nerve pierced Pronator teres muscle

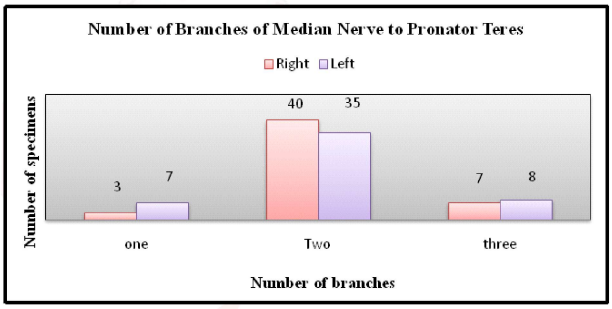
RESULTS

Graph 1: Relation of median nerve with Pronator teres muscle.,



In all the specimens the median nerve passed between the two heads of Pronator teres muscle (100%). (Photograph 1)

Graph 2: Number of branches of Median nerve to Pronator teres muscle.



Pronator teres was innervated by Median nerve with -1 branch in 10% (Unilateral-6 Bilateral-2). (Photograph 1), 2 branches in 75% (Unilateral-9 Bilateral-33).(Photograph 2)&3 branches in 15% (Unilateral-11 Bilateral-2). (Photograph 3)

Thus innervation by 2 branches was the most commonly observed pattern.

Table 1: The Distance (in mm) between Intercondylar Line and the Site where Median nerve (trunk) pierced Pronator teres muscle.

Distance of Median nerve between intercondylar line & site of piercing Pronator teres	Number of specimens		
	Rt 50	Lt 50	Total 100
20-30mm	02 (4%)	02 (4%)	04 (4%)
31-40mm	10 (20%)	13 (26%)	23 (23%)
41-50mm	17 (34%)	16 (32%)	33 (33%)
51-60mm	17 (34%)	14 (28%)	31 (31%)
61-70mm	03 (6%)	04 (8%)	07 (7%)
71-80mm	01 (2%)	01 (2%)	02 (4%)

Distance between the intercondylar line and the point where Median nerve pierced the Pronator teres muscle ranged from 20-80mm. (Photograph 4) The minimum distance was 23 mm and the maximum was 73 mm. From above table it

was evident that, the median nerve pierced the pronator teres most frequently at a distance of 41-50 mm (33%) from intercondylar line and next frequent distance was 51-60 mm (31%).

DISCUSSION

Variations of nerve in terms of branches, relations with other nearby structures may present clinically or may be a finding during investigations, surgery, autopsy or cadaveric dissection. Entrapment neuropathies are one of the common causes of peripheral neuropathies. Median nerve is commonly involved in compression neuropathy. Many studies have found that the most common site of compression of Median nerve is carpal tunnel leading to carpal tunnel syndrome; the other being compression near elbow as in cases of Pronator teres syndrome. So the knowledge of variations of median nerve with Pronator teres is important.

Classically the nerve is described to pass between two heads of Pronator teres. In the study of Channabasangauda, the median nerve passed between the two heads of pronator teres muscle in 54 out of 62 specimens(87.09%), deep to the pronator teres muscle in 3 specimens(4.83%), through the ulnar head of pronator teres muscle in 3 specimens (4.83%) and deep to the humeral head of pronator teres muscle, ulnar head being absent in 2 specimens (3.22%) [13]. The study of Gaikwad AP, Pandhare SR & Vaishali Paranjpe noted that median nerve passed between ulnar and humeral head in 36(92%) extremities. In 3(8%) among the 39 extremities, ulnar head was absent and median nerve was passing below humeral head [14]. The study by Edie Benedito Caetano, Luiz Angelo Vieira, Fábio Antonio AnversaSprovieri et al observed that in 72 out of the 86 limbs(83.72%), the median nerve was positioned between the two heads of the PTM; in 11(12.79%), it passed through the muscle belly of ulnar head of the PTM, and in 3(3,48%), posteriorly to both headsof the PTM. When both heads were present, the median nerve was not observed as passing through the muscle belly of the humeral head of PTM [15].

Various studies revealed that in majority of cases median nerve passed between two heads of Pronator teres muscle. In present study, both the heads of Pronator teres were present & in all the specimens (100%) the median nerve passed between the two heads of pronator teres muscle.

Variation is also present in number of branches innervating Pronator teres muscle.

Table 2: Number of branches of Median nerve to Pronator teres muscle

Name of Author	No. of Specimens	Number of branches of Median nerve to Pronator teres & % of specimens (PTM branches)				
		1	2	3	4	5
Channabasanagouda, Manjunath Halagatti [13]	62	47	13	2	-	-
Bindurani et al [17]	50	34	14	2	-	-
Chandani Gupta et al [18]	24	20.8	50	20.8	8.3	-
Demirci SM et al [16]	34	11.8	55.9	29.4	2.9	
Gaikwad AP et al [14]	40	3	23	54	8	8
Present Study	100	10	75	15	-	-

In the study by Channabasanagouda, Manjunath Halagatti&Bindurani et al, innervations to Pronator teres by one branch was predominant whereas in other studies including present study; innervations by two branches was the most common finding. Study of Chandni Gupta et al, Demirci et al & Gaikwad et al reported finding of 4 PTM branches. Study by Gaikwad also reported 5 PTM branches. Maximum number of PTM branches were 3 in present study.

The knowledge of PTM branches has great clinical significance as the use of the PTM branch may be considered for transfers in C7-T1 root injuries of the brachial plexus, with care regarding the availability of multiple PTM branches and tension to the AIN and radial nerve branches [8]. Study of Tubbs SR, Beckman MJ has mentioned the use of PTM branch in neurotization of radial nerve. A branch of median nerve to the pronator teres that was long enough to reach the radial

nerve in the cubital fossa can be considered for neurotization of the radial nerve in the cubital fossa Neural connections remained tension free with full pronation and supination [9].

Pronator teres rerouting is an important surgery to improve both, active supination and dynamic forearm positioning in children with cerebral palsy. Injection of botulinum toxin and selective fasicular neurotomy is used for treatment of spasticity of upper limb and hence for such conditions a precise anatomical knowledge of motor innervation of pronator teres is very much needed [10].

In this study a new parameter was considered - Distance (in mm) between Intercondylar Line and the Site where Median nerve (trunk) pierced Pronator teres muscle. Researchers of present study thought that the knowledge of such measurements can be of help while undertaking the surgical intervention procedures of forearm like in pronator teres syndrome or neurotomy etc. Many studies are available on distance between intercondylar line & innervations of PTM muscular branches but authors could not come across study mentioning above such parameter. So, Authors could not find references for comparison.

CONCLUSION

The median nerve is susceptible to variations. Normal functioning of the limbs may not be altered by these variations, but the knowledge of such variations would be helpful not only to anatomist but also to physicians, orthopedicians, plastic surgeons, vascular and onco surgeons. The study will add to the knowledge of variation of median nerve with Pronator teres in terms of relation, number of branches & site of piercing the muscle. It can be of help in understanding entrapment neuropathy in pronator teres syndrome, its investigations & during surgical interventions.

ABBREVIATIONS

MN – Median Nerve

PT- Pronator teres

BA – Brachial artery

ICL- Intercondylar line

PTM – Pronator teres muscle

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Conflicts of Interests: None

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