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Original Research Article

STUDY OF THE MORPHOMETRY OF THE PYRAMIDALIS MUSCLE AND ITS INCIDENCE IN THE INDIAN POPULATION

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ABSTRACT

Introduction: The paired pyramidalis muscles are small triangular muscles that lie between the anterior surface of the rectus abdominus and the posterior surface of the rectus sheath. The muscles are not always present, or are often unilateral, and vary greatly in size. Their wider inferior margins attach to the pubic symphyses and pubic crests, whereas their narrow superior margins attach to the linea alba.

Aims and objectives: In recognition of the variations in occurrence, shape and size of the pyramidalis muscle in different races, sexes and nationals and its relevance in flap and graft, this study was carried out to determine the incidence of its agenesis, variation in occurrence, shape and mean values of length and breadth in Indian population.

Materials and Methods: The material for this study comprised of 15 well preserved cadavers (Male:Female -13:2) obtained from the Department of Anatomy. These were dissected to expose pyramidalis muscle and different morphometric measurements were taken.

Results: Only one case (Case no-14) had a unilateral pyramidalis on the right side. There was no case of supernumerary presence and the predominant shape was triangular with no difference in shape on either side. The mean values of the length and the breadth for the right pyramidalis muscle were 48.14 mm and15.39 mm, respectivelty while the corresponding mean values of 47.96 mm and 16.38 mm were recorded for the left. The Pyramidalis-Puboumbilical Index was calculated which varied between 33-39% in 10 male bodies while in two of the cases it was between 47-49.9% and in one case it was 15.2%. In two cases it was 35.5% and 56.8% respectively.

Conclusion: Our findings suggest that the incidence of agenesis of the pyramidalis muscle in north Indian people is not common and there are no significant differences in the sizes of the muscle on either size. The Pyramidalis-Puboumbilical Index may be useful for surgeons executing midline incision in the supra pubic region.

KEY WORDS: Pyramidalis muscle, rectus abdominus, rectus sheath, linea alba, Pyramidalis-Puboumbilical Index.

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INTRODUCTION

Pyramidalis is a triangular muscle in front of the lower part of rectus abdominis within the rectus sheath. It is attached by tendinous fibres to the front of the pubis and by the ligamentous fibres in front of the symphysis. The muscle passes upwards diminishing in the size as it runs upwards and ends in a pointed apex that is attached to the linea alba midway between umbilicus and pubis but may extend to a higher level. It varies much in size and may be larger on one side than on the other, or may be absent on one or both sides. Occasionaly it may be double [1]. The precise function of pyramidalis muscles is unclear, but together the muscles are thought to tense the linea alba [2]. Also after long-term cryopreservation pyramidalis muscle specimens are used as a source of striated muscle stem cells for treatment of post-prostatectomy stress urinary incontinence [3].

The first anatomist to refer to the pyramidalis was Massa (1536) [4] who assumed that this muscle assisted in the erection of the penis. Bergman et al (1996) [5] citing the Works of Riolan (1649) [6], Rolfinck (1656) [7], and Crooke (1650) [8] stated that the muscle is occasionally absent bilaterally or unilaterally. In later case it is almost invariably present on the right side. Even double pyramidalis on one side (total being three) (Winslow, 1749) [9] or on both sides (total being four) [10-13] have also been reported. Vallois (1926) [14] emphasized that this muscle is a constant feature of man and other primates so it may be related to the assumption of upright posture in man.

When present the muscle tenses the linea alba. Its attachment to the linea alba is used by surgeons as a landmark for an accurate median abdominal incision [15]. Thus its presence and the knowledge is of paramount anatomical and clinical significance.

The incidence of its absence depending on the side, sex and race varies greatly. So the present study was undertaken to find the same in population of this region.

Aims and Objective:

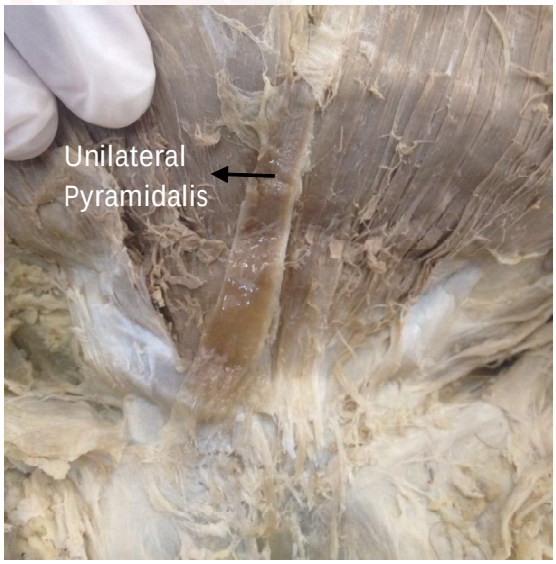
The goal of the present study was to analyze the morphological and morphometric diversity of the pyramidalis muscle (PM) and to evaluate its incidence in north Indian population.

MATERIALS AND METHODS

The material comprised of Fifteen (13 males and 2 females) formalin fixed cadavers obtained from the Department of Anatomy, Government Medical College, Patiala. The cadavers were labelled from 1-15 with suffix "M" for male and "F" for female. The distance between pubic symphysis and umbilicus was measured. Rectus sheath was dissected on both the sides. Presence of pyramidalis muscle and its shape was noted. Different morphometric observations namely height of the muscle along its medial border, and width at the base were taken. The Pyramidalis-Puboumbilical index was calculated as follows:

$$\frac{\text{Total Length (Height) of pyramidalis}}{\text{Distance b/w umbilicus \& pubis symphysis}} \times 100$$

Fig. 1: Showing unilateral pyramidalis muscle on right side.



RESULTS

Presence or absence: Out of the 15 cadavers, the pyramidalis muscle was bilaterally present in 14 cadavers (93.3%). In one Female cadaver (Sr. No.14) it was absent on left side (Figure 1).

Length (Height) along medial border: As seen above, out of 15 bodies the muscle was present bilaterally in 14 bodies. An interesting observation was that in all these the length /height of the muscle along medial border was same on two sides of any particular body. Thus as far as

height is concerned it was symmetrical. The range and mean value of height was 25.31-72.56 mm and 49.78mm respectively in males and 47.84-49.62 mm and 48.73 mm in females. (See table 1)

Table 1: Mean and Range of Length of Pyramidalis muscle along medial border (mm).

Side	Male (n=13)		Female (n=2)	
Right	Range (mm)	Mean (mm)	Range (mm)	Mean (mm)
	25.31-72.56	49.78	47.84-49.62	48.73
Left	25.31-72.56	49.78	47.84 (Single value)	

Breadth at base: The breadth at the base was different on the two sides of the same body. Thus it was asymmetrical. The range and mean value of this parameter as observed in the present study on the two sides and sexes is depicted in Table 2.

Table 2: Mean and Range of Width of Pyramidalis muscle at base (mm).

Side	Male		Female	
Right	Range (mm)	Mean (mm)	Range (mm)	Mean (mm)
	10.38-21.67	17.05	9.48-14.57	12.05
Left	11.53-21.81	17.2	14.57(Single value)	

Pyramidalis- Puboumbilical Index: This term was coined in the present study to find out the percentage of distance between pubic symphysis and umbilicus into which the pyramidalis extends. It was calculated as given vide supra. The values observed in the present study are depicted in Table 3.

Table 3: Pyramidalis-Puboumbilical Index as found in both males and females.

S. No.	Sex	Length of pyramidalis (mm)	Distance b/w umbilicus and pubic symphysis (mm)	Pyramidalis-Puboumbilical Index
1	M	50.31	130.78	38.46
2	M	42.35	114.57	36.96
3	M	49.83	130.2	38.27
4	M	46.83	140.76	33.26
5	M	72.56	145.24	49.95
6	M	48.66	152.09	31.99
7	M	25.31	166.32	15.21
8	M	68.52	145.34	47.14
9	M	47.68	132.38	36.01
10	M	48.81	140.15	34.82
11	M	49.62	133.24	37.24
12	M	46.52	122.87	37.86
13	M	50.16	149.81	33.48
14	F	49.62	87.26	56.86
15	F	47.84	134.7	35.51

DISCUSSION

Presence or absence of pyramidalis muscle: Table no 4 shows the comparative incidence of presence or absence of pyramidalis muscle as observed by earlier authors in different populations with the present study.

Table 4: Incidence of presence of pyramidalis muscle in different populations.

S. No	Authors	Population	Incidence
1	LeDouble (1897) [16]	French	89
2	Loth (1912) [17]	Black	79
3	Valloiis (1926) [14]	Black	82
4	Wagenseil (1927) [18]	Chinese	99
5	Mori (1964) [19]	Japanese	94.5
6	Present Study	North Indian	93.33

If we have a closer look at table 4 it is seen that the table is silent about bilateral or unilateral presence. It is because none of these authors have commented upon it. However table 5 provides an incidence of bilateral or unilateral presence or complete agenesis. It is evident from table 5 that our incidence of bilateral presence is almost same as that of Nigerian population but much more than Greek population.

Table 5: Incidence of bilateral and unilateral presence and complete absence of Pyramidalis Muscle.

S.No.	Authors	Year	Population	%age Presence		Complete Agenesis (%)
				Unilateral	Bilateral	
1	Didia et al [20]	2009	Nigerian	-	91.67	8.33
2	Natsis et al [21]	2015	Greek	14.6	79.2	6.2
3	Present study	2016	North Indians	6.67	93.33	-

Length along medial border: Table 6 compares the length of pyramidalis muscle as observed by earlier authors with the present study.

Table 6: Comparison of length and breadth of pyramidalis muscle.

S. No	Authors (Year)		Length (mm)		Breadth (mm)	
			Right	Left	Right	Left
1	Didia et al (2009) [20]		80.9	79.4	15.5	16
2	Natsis et al (2015) [21]	Male	83.7	75	16.1	15.6
		Female	61.8	65.6	15	15.5
3	Present study	Male	49.78	49.78	17.5	17.2
		Female	48.73	47.84 (Single value)	12.5	14.57

It is evident from the table the mean length along medial border was much less in the present study as compared with the earlier ones. It could be due to racial reasons. However an interesting observation was that length of the 2 muscles of any particular body was same in all the bodies of the present study.

Breadth at the base: Table no 6 also compares the breadth of pyramidalis muscle along its base as observed by earlier authors with the present study. It is found to be in consonance with the earlier studies.

Pyramidalis-Puboumbilical Index: As seen in Table 6, there is a good variation in length of Pyramidalis Muscle being about 50 mm in the present study and 60 mm-80 mm in earlier studies. The difference may be attributed to the racial variations i.e. difference of stature in different populations. Moreover since pyramidalis muscle serves as a guide for surgeon for executing a midline infraumbilical incision this index was calculated and is expected to be more useful clinically. As evident from Table 3, out of thirteen male bodies the Pyramidalis- Puboumbilical Index varied between 33-39 in ten bodies (77) while in two (15) it was between 47- 49.9 and in one (8) it was 15.2. In two female bodies it was 35.5 and 56.8 respectively. Thus these values may be useful for surgeons as pyramidalis muscle covers lower 33-39% of distance between umbilicus and pubic symphysis.

Clinical implications: Though literature on function of the pyramidalis has been very less defined yet it is definitely said to tense the linea alba. Some authorities consider it to be insignificant and vestigial, but it is frequently encountered by gynaecologists [22]. Lovering and Anderson studied the architecture and fibre type of pyramidalis muscle and estimated that this muscle generates even < 1% of the estimated force generated by the rectus abdominis in normal sized males [23]. This led them to comment that the relative importance of this modest amount of force on linea alba is not clear. However, on the contrary it is often harvested to conduct electrophysiological experiments [24]. Apart from this clinically the muscle is used as a source of striated muscle stem cells for the treatment of post prostatectomy stress urinary incontinence. After confirming its presence a complete removal of prostate gland without fear of injury to the urethral sphincter may be possible in patients with apical or T_3 prostate cancer [3] and can also be used as a donar muscle for microsurgical transfer because of negligible donor site morbidity after its harvesting [25].

CONCLUSION

In the present study pyramidalis was present in all the cases except one which showed unilateral agenesis. Its length was same on the both sides of any particular body in all the cases while breadth was different. A new term pyramidalis-puboumbilical Index was coined which may be useful for surgeons executing midline infraumbilical incisions.

Conflicts of Interests: None

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