KJP The Korean Journal of Pain
| Original Article |
Korean J Pain 2011 June; Vol. 24, No. 2: 87-92
pISSN 2005-9159 eISSN 2093-0569
DOI : 10.3344/kjp.2011.24.2.87

Piriformis Muscle: Clinical Anatomy with Computed Tomography in Korean Population

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Backgroud:

The objective was to evaluate the distance from the skin and the diameter of the piriformis muscle and their relationship to the body mass index (BMI).

Methods:

The study was a prospective study involving 60 patients. Patients were prepared on a radiological table in the prone position. Several images were obtained of each. In this view, the distance between the subcutaneous tissue and the piriformis muscle, and the diameter of the piriformis, were measured at three points (medially to laterally).

Results:

The distance to the piriformis from the skin was 6.6 ± 0.9 cm, 6.3 ± 0.8 cm, and 5.2 ± 0.9 cm in terms of the lateral, center, and medial measurement, respectively. The center of the piriformis had a greater diameter with 1.7 ± 0.4 (0.9−2.5) cm. The distance to the piriformis increased with BMI.

Conclusions:

This study shows that the lateral of the piriformis muscle has a relatively greater distance from the skin. The center of the piriformis showed a greater diameter than other two portions. We found that the distance of the piriformis from subcutaneous tissues was correlated with BMI, but the diameter of the piriformis was not affected by BMI. These measurements can be used as a reference for determining the piriformis injection site in patients with piriformis syndrome. (Korean J Pain 2011; 24: 87-92)

Key Words:

anatomy, CT, muscle, piriformis.

Received February 17, 2011. Revised March 23, 2011. Accepted March 23, 2011.
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INTRODUCTION

Piriformis syndrome is a reported cause of lower back pain and sciatica secondary to sciatic nerve entrapment in piriformis muscle at the greater sciatic notch [1,2]. It is usually due to an abnormal condition of the piriformis muscle such as hypertrophy, inflammation, or anatomic variations [1], caused by various conditions [3-7]. The common symptoms are buttock and leg pain. The diagnosis of piriformis syndrome is made using electromyography, computed tomography, magnetic resonance imaging, and bone scan [8-10].

The management of the piriformis syndrome may includes physical therapy, ultrasound [2], and local anesthetic and/or steroid injection into the piriformis to reduce inflammation, spasm and pain [11,12]. The piriformis muscle injections are an important treatment modality which are either given blindly, or with the help of fluoroscopy, ultrasound, computed tomography, and magnetic resonance imaging [4,13-15]. Currently, many clinicians use C-arm guided piriformis injections, although the popularity of ultrasound guidance may be increasing [11,16]. In these techniques, the expected position of the piriformis muscle is identified using bony anatomical landmarks. When the injection of the local anesthetic into the sciatic nerve is performed either with fluoroscopic guidance or blindly, the sensory and motor blockade of the leg and foot increased. There is a literature on anatomical landmarks [17]. However, comprehensive anatomical data concerning the diameter of the piriformis muscle and the distance to the piriformis are lacking. Such information is importance for the injection of the piriformis muscle, both increase efficacy and decrease complications.

The purpose of the present study was to determine in detail the distance to the piriformis and the diameter of the piriformis in Korean population. Furthermore, the present study examined the correlation between the body mass index (BMI) and the distance of the piriformis from the skin.

MATERIALS AND METHODS

We performed a prospective study involving 60 subjects consisting 30 male and 30 female subjects. The study was conducted with the full approval of the Institutional Review Board and written informed consent was obtained from all patients. Inclusion criteria were: 1) No clinical evidence of piriformis syndrome. In practice term, this meant distributed pain over an appreciable area (unilateral pain in the buttock, hip, down the posterior thigh, calf and ankle), 2) Ages greater than 18 years. The exclusion criteria were a previous surgery for disc disease or any abdominal cavity tumor, abnormal anatomy, rheumatoid disease or radiculopathy, sacroiliac joint disease, inflammatory disease or avascular necrosis on the femur.

All examination was performed with a CT unit (Big Bore, Philips, USA). Patients were prepared on radiological table in the prone position and a marking device wire was

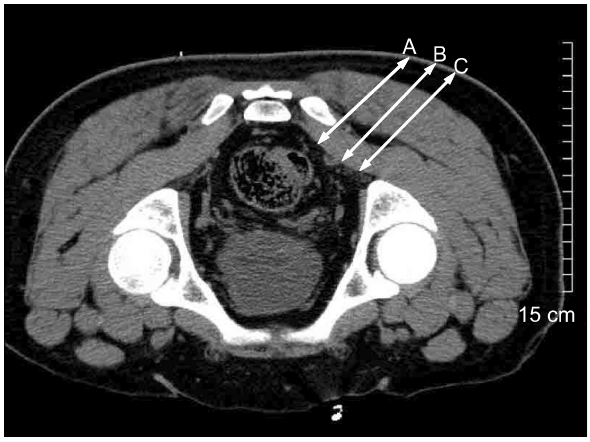

Fig. 1. This figure shows the measurement in this study. The (A), (B), and (C) represent the skin entry distance from medial, central, and lateral respectively. A right piriformis muscle seen in the computed tomography (arrow).

Fig. 2. This figure shows the measurement in this study. The (A), (B), and (C) represent the diameter of the piriformis from medial, center, and lateral respectively. Computed tomography views of right piriformis muscle (arrow).

placed on the buttock as scanning of the pelvis was acquired at 120 kV and 60 mA: slice diameter and index 1 mm. Scans were acquired of the anterior-superior iliac spine to the ischial spine in order to include the piriformis muscle body. In mid sciatic notch level with CT scan, the distance between the skin and the piriformis muscle, as well as the anterior-posterior diameter of the piriformis was measured at the three points (medially to laterally) with bilaterally (Fig. 1, 2).

The Mann-Whitney U test was used for statistical analysis. The correlation between BMI and the distance or diameter of the piriformis was analyzed by Pearson's correlation coefficient. *P* values equal or less than 0.05 considered statistically significant. All statistical analysis was performed on SPSS version 17.

Table 1. Profile of Patients

	Total (N = 60)	Male (n = 30)	Female (n = 30)
Age (yr)	51.9 ± 12.9	46.8 ± 14.7	54.4 ± 11.3
Weight (kg)	63.5 ± 10.7	73.4 ± 8.6	58.6 ± 7.9
Height (cm)	162.4 ± 8.7	171.5 ± 7.4	157.4 ± 4.2
Body mass index (kg/cm^2)	24.0 ± 2.9	24.7 ± 2.2	23.6 ± 3.1

Values are means ± SD.

RESULTS

All 60 patients were examined by a single investigator. The study population was comprised of female patients (50%) and the mean age the all subjects were 51.9 years (Table 1). The longest distance from the skin entry point to the piriformis muscle was lateral, followed by the central and medial portion. The distance to the piriformis increased with BMI (Fig. 3). There was no difference in the

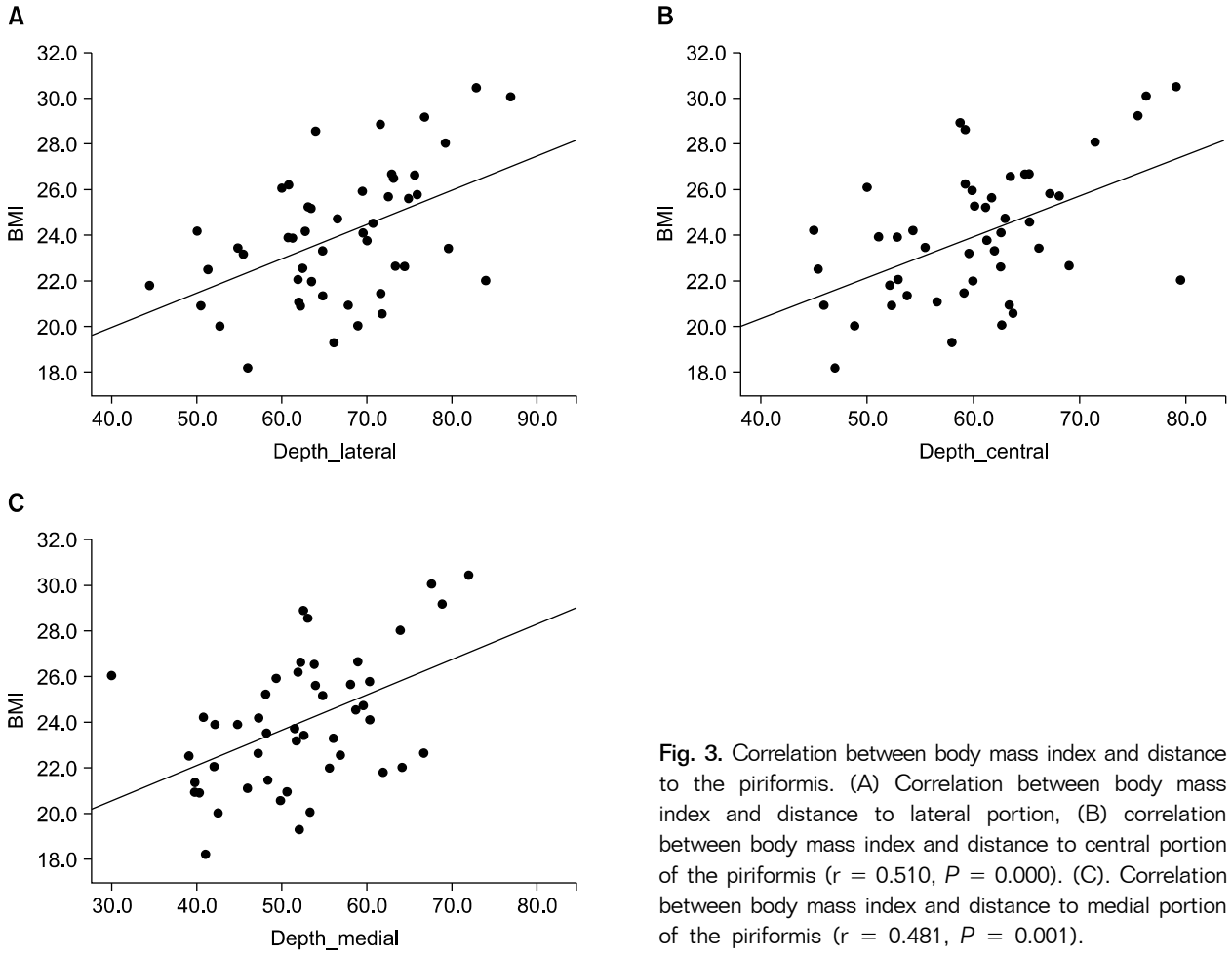

Fig. 3. Correlation between body mass index and distance to the piriformis. (A) Correlation between body mass index and distance to lateral portion, (B) correlation between body mass index and distance to central portion of the piriformis (r = 0.510, *P* = 0.000). (C). Correlation between body mass index and distance to medial portion of the piriformis (r = 0.481, *P* = 0.001).

Table 2. Distance and Diameter of Piriformis

		Total (N = 60)	Male (n = 30)	Female (n = 30)
Distance (cm)	Lateral	6.6 ± 0.9 (4.5-8.7)	6.3 ± 1.0	6.8 ± 0.9
	Central	6.3 ± 0.8 (4.5-8.0)	5.8 ± 0.9	6.1 ± 0.8
	Medial	5.2 ± 0.9 (30.0-72.0)	5.1 ± 1.0	5.3 ± 0.8
Diameter (cm)	Lateral	1.2 ± 0.4 (0.4-2.1)	1.1 ± 0.3	1.7 ± 0.4
	Central	1.7 ± 0.4 (0.9-2.5)	1.7 ± 0.4	1.7 ± 0.4
	Medial	1.0 ± 0.3 (0.4-1.7)	0.9 ± 0.3	1.0 ± 0.3

Values are means ± SD.

Table 3. Measument Results of Right and Left Piriformis

		Right piriformis (n = 60)	Left piriformis (n = 60)
Distance (cm)	Lateral	6.5 ± 0.9 (4.4-8.6)	6.6 ± 0.9 (4.1-8.3)
	Center	5.8 ± 0.8 (3.8-7.5)	5.8 ± 0.5 (3.7-8.0)
	Medial	5.0 ± 0.9 (3.2-6.9)	5.0 ± 0.9 (3.1-7.2)
Diameter (cm)	Lateral	1.3 ± 0.3 (0.6-2.2)	1.3 ± 0.4 (0.5-2.6)
	Center	1.9 ± 0.4 (1.0-3.0)	2.0 ± 0.4 (0.9-3.2)
	Medial	1.1 ± 0.3 (0.5-1.8)	1.2 ± 0.3 (0.6-2.3)

Values are means ± SD.

distance to the piriformis muscle or the diameter between males and females.

The range of the piriformis muscle diameter from lateral to medial portion was 0.4–2.5 cm (Table 2). The order of the diameter size was the central, lateral, and medial portion. There was no correlation between the lateral, central or medial diameter of the piriformis and BMI (Table 2). Correlation analyses showed no significant difference between the right and left portion of the piriformis (Table 3).

DISCUSSION

This study shows that the lateral of the piriformis muscle has a relatively greater distance from the skin, with a maximum distance of 8.7 cm (lateral) and a minimum of 3.0 cm (medial). The center of the piriformis showed a greater diameter than other two portions. We found that the distance of the piriformis from subcutaneous tissues was correlated with BMI, but the diameter of the piriformis was not affected by BMI.

The BMI and mean distance to piriformis muscle were correlated in the present study. As the BMI increased, the distance to the piriformis from the skin increased. This suggests that there is an increase in the volume of tissue that lies in the region from the skin to the piriformis muscle instead of in the piriformis muscle itself when the BMI is increased. In present study, there was no difference between male and female in the distance to the piriformis. We suspected that it would be higher in males than at females. However, in fact it was greater in the females than males, due to the effect of the larger volume of subcutaneous tissue. In the cadaver, the mean distance between musculocutaneous junction and the insertion is from 3.6 cm to 4 cm. This result is different from our results, but the present study contains living subjects in contrast to cadaver. Furthermore, the author reported that there was no difference between males and females [17].

To evaluate which variation of the piriformis, we measured in the three portion of the piriformis muscle. In the present study, the center portion of the piriformis was shown to have a greater diameter with a mean of 1.7 cm. Statistical analyses indicated that there was no difference in term of the piriformis diameter between the sexes and no correlation with BMI. However, it was greater in females than males. Russell et al. [18] reported that the piriformis muscle ranged in size from 0.8–3.2 cm, with an average size of 1.9 cm. In addition nineteen percent of the patients reportedly have greater than 3 mm of asymmetry in the

size of the piriformis muscle, with a maximum asymmetry of 8 mm note.

Numerous variations in the anatomical shape of the piriformis have been described. There are four types of the piriformis tendon shapes [17]. The diameter of the piriformis tendon at musculotendinous junction, i.e upper muscle belly type, and lower muscle belly type was 6.3 mm, 40.4 mm, and 36.2 mm, respectively in a cadaver study [17].

The piriformis muscle originates from the anterior surface of the second through fourth sacral vertebrae, the sacrotuberous ligament, and the superior margin of the sciatic notch. It exits the pelvis through the sciatic foramen and inserts on the superior aspect of the greater trochanter. The sciatic nerve arises from the lumbosacral plexus and includes fibers from the L4-S1 nerve. As the sciatic nerve exits the sciatic notch, it lies anterior to the muscle belly of the piriformis. The distance from the lower border of the sacroiliac joint to the sciatic nerve is 2.9 cm laterally and 0.7 caudally. And the width of the sciatic nerve, at its widest diameter, is 1.5 cm. The depth to the sciatic nerve is 9.2 cm [19].

To be best of our knowledge this is first report on the distance and diameter of the piriformis and the correlation between the piriformis and BMI. There was some limitation to this present study. While none of our enrolled patients had radicular pain, we could not exactly ruled out piriformis muscle syndrome. Second, although we paid close attention to bilateral symmetry piriformis muscle scan using CT, image did not completely symmetrical vertically.

In conclusion, the distance to the piriformis from the subcutaneous tissue was variable between individuals, but is affected by the BMI. These measurements can be used as a reference for determining the piriformis injection site in patients with piriformis syndrome. This result in terms of entry distance may be an additional indicator for physicians to consider, because the entry distance is important when using fluoroscopy, which is currently the standard and the success rate may be increased and complication decreased by taking it into account.

REFERENCES

1. Ozaki S, Hamabe T, Muro T. Piriformis syndrome resulting from an anomalous relationship between the sciatic nerve and piriformis muscle. Orthopedics 1999; 22: 771-2.
2. Hallin RP. Sciatic pain and the piriformis muscle. Postgrad Med 1983; 74: 69-72.
3. Parziale JR, Hudgins TH, Fishman LM. The piriformis syndrome. Am J Orthop (Belle Mead NJ) 1996; 25: 819-23.
4. Pace JB, Nagle D. Piriform syndrome. West J Med 1976; 124: 435-9.
5. Chen WS. Bipartite piriformis muscle: an unusual cause of sciatic nerve entrapment. Pain 1994; 58: 269-72.
6. Sayson SC, Ducey JP, Maybrey JB, Wesley RL, Vermilion D. Sciatic entrapment neuropathy associated with an anomalous piriformis muscle. Pain 1994; 59: 149-52.
7. Jeon SY, Moon HS, Han YJ, Sung CH. Post-radiation piriformis syndrome in a cervical cancer patient: a case report. Korean J Pain 2010; 23: 88-91.
8. Fishman LM, Zybert PA. Electrophysiologic evidence of piriformis syndrome. Arch Phys Med Rehabil 1992; 73: 359-64.
9. Jankiewicz JJ, Hennrikus WL, Houkom JA. The appearance of the piriformis muscle syndrome in computed tomography and magnetic resonance imaging. A case report and review of the literature. Clin Orthop Relat Res 1991; 262: 205-9.
10. Karl RD Jr, Yedinak MA, Hartshorne MF, Cawthon MA, Bauman JM, Howard WH, et al. Scintigraphic appearance of the piriformis muscle syndrome. Clin Nucl Med 1985; 10: 361-3.
11. Reus M, de Dios Berná J, Vázquez V, Redondo MV, Alonso J. Piriformis syndrome: a simple technique for US-guided infiltration of the perisciatic nerve. Preliminary results. Eur Radiol 2008; 18: 616-20.
12. Smith J, Hurdle MF, Locketz AJ, Wisniewski SJ. Ultrasound-guided piriformis injection: technique description and verification. Arch Phys Med Rehabil 2006; 87: 1664-7.
13. Betts A. Combined fluoroscopic and nerve stimulator technique for injection of the piriformis muscle. Pain Physician 2004; 7: 279-81.
14. Fanucci E, Masala S, Sodani G, Varrucciu V, Romagnoli A, Squillaci E, et al. CT-guided injection of botulinic toxin for percutaneous therapy of piriformis muscle syndrome with preliminary MRI results about denervative process. Eur Radiol 2001; 11: 2543-8.
15. Huerto AP, Yeo SN, Ho KY. Piriformis muscle injection using ultrasonography and motor stimulation--report of a technique. Pain Physician 2007; 10: 687-90.
16. Finnoff JT, Hurdle MF, Smith J. Accuracy of ultrasound-guided versus fluoroscopically guided contrast-controlled piriformis injections: a cadaveric study. J Ultrasound Med 2008; 27: 1157-63.
17. Windisch G, Braun EM, Anderhuber F. Piriformis muscle: clinical anatomy and consideration of the piriformis syndrome. Surg Radiol Anat 2007; 29: 37-45.
18. Russell JM, Kransdorf MJ, Bancroft LW, Peterson JJ, Berquist

TH, Bridges MD. Magnetic resonance imaging of the sacral plexus and piriformis muscles. Skeletal Radiol 2008; 37: 709–13.
19. Benzon HT, Katz JA, Benzon HA, Iqbal MS. Piriformis syndrome: anatomic considerations, a new injection technique, and a review of the literature. Anesthesiology 2003; 98: 1442–8.