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Vertical Foramina in the Lumbosacral Region: CT Appearance

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Several computed tomographic (CT) examples of vertically oriented foramina in the neural arches of the lumbosacral vertebrae are presented. The literature is reviewed briefly, and the possible clinical and embryologic significance of these foramina is discussed.

In performing routine computed tomography (CT) of the lower lumbar spine in patients with backache and sciatica, we have encountered several foramina running perpendicularly to the axial plane lateral or posterolateral to the spinal canal. In this report we present these variations, briefly review some of the older literature on them, and discuss their possible significance.

Materials and Methods

Each of the four cases described in this article was scanned for evaluation of possible spinal stenosis or disk herniation. Each was scanned on an Elscint 905 scanner with 5-mm-thick slices at 4 mm intervals or a 1002 or 2002 scanner with 6-mm-thick slices at 5 mm intervals.

Results

In one case there was evidence of a small tunnel or foramen at the bases of the transverse and superior articular processes of L5 (fig. 1). In three other cases there were vertical foramina through the medial part of the transverse process of L5 (figs. 2 and 3) at the base of the sacral ala (fig. 4).

Discussion

On the posterior aspect of the base of the superior articular process is a protuberance of variable size known as the mamillary process [1–3]. At the base of the transverse process is the accessory process, similarly of variable size [1–3]. Between the mamillary and accessory processes there is usually a fibrous band, which recently has been named the mamilloaccessory ligament [4, 5]; it bridges a groove of variable depth between the two processes to form a tunnel about 6 mm long [6] that transmits vessels to the dorsal paraspinal muscles [2, 7], as well as the nervous supply from the medial division of the dorsal ramus of the spinal nerve exiting at the intervertebral space immediately above [4–6, 8]. The bridge forming the tunnel occasionally is ossific rather than fibrous [4, 5]; thus, apparently it can be visible on plain radiographs [9] and has led to the appearance in anatomic dissection of a "canal in the bone" containing the medial division [6]. Manners-Smith [7], noting these bony canals in skeletons, referred to them as a "retro-transverse foramina." We believe our first case demonstrates this foramen bilaterally (fig. 1).

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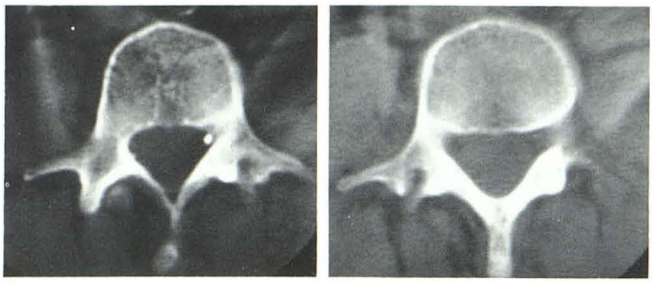
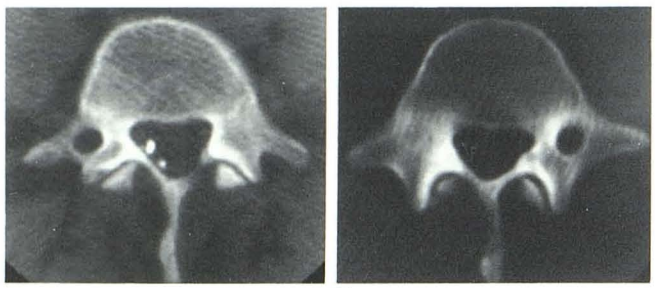


A B

Fig. 1.—**A**, Axial cut through L5 with patient slightly tilted. Calcific or ossific density extends from base of left superior articular process to base of left transverse process. **B**, Axial cut 5 mm inferior to **A**. Calcific or ossific density extends from base of superior articular process on right to right transverse process.



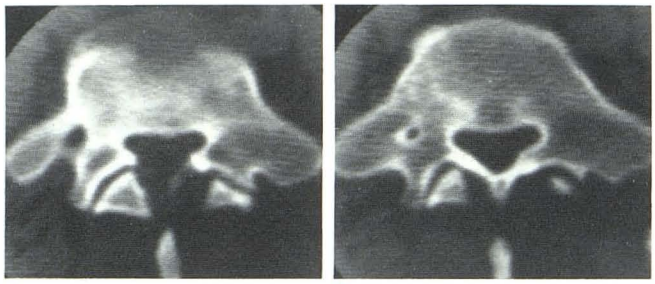
2 3

Fig. 2.—Axial cut through L5 demonstrates well defined foramenlike defect in base of right transverse process. Suggestion of circular region of bone in similar position on left with texture slightly different in appearance from that of surrounding bone.

Fig. 3.—Axial cut through L5 demonstrates foramenlike defect at base of left transverse process of L5. Hint of circular region of bone at base of transverse process on opposite side with texture slightly different in appearance from that of surrounding bone.

The medial branches of the dorsal rami transmitted through the tunnel underneath the mamilloaccessory ligaments (or their ossified equivalents) are of some clinical significance. They supply not only paraspinal musculature but also the apophyseal joints both immediately above and immediately below. There has been renewed interest [4, 10, 11] in the older notion [12–14] that lumbar joint pain may be referred to the legs. Consequently attempts are sometimes made to interfere with the nerves that supply the apophyseal joints to alleviate sciatica and back pain. These attempts would fail, however, if the mamilloaccessory ligament is ossified to the extent that an electrode cannot penetrate the ligament [4, 5]. Moreover, it has been postulated that nerves could be entrapped in the canal formed by the mamilloaccessory ligament [6].

Bogduk [5] suspected that there was a tendency for ossification of the mamilloaccessory ligament to be associated with spondylitic proliferative changes. Alternatively the ossification conceivably could be congenital, especially since both the mamillary and accessory processes are thought to derive embryologically from the so-called transverse element [3].



A B

Fig. 4.—**A**, Axial cut through S1 demonstrates superior-most part of vertical foramenlike defect that begins superiorly in groove between right superior articular process and extends inferiorly through ala to communicate with right S1 foramen. **B**, Axial cut through S1 5 mm below **A** demonstrates foramen in right sacral ala 5 mm above S1 foramina.

In two of our cases there were vertical foramina (figs. 2 and 3) that were larger and located more anteriorly than the foramina in our first case (fig. 1). Several anatomists have reported fifth lumbar vertebrae with nearly identical foramina or ones centered slightly more anterolaterally [7, 15, 16]. Manners-Smith [7] grouped all these foramina together, calling them costotransverse foramina in contradistinction to the retrotransverse foramina between the mamillary and accessory processes. Nevertheless, until it is determined what these lumbar costotransverse foramina transmit, one cannot be completely certain that they might not transmit the medial division nervous supply.

It is thought that the bulk of the lumbar transverse process embryologically is homologous to the ribs (and is said to arise from the "costal element"), while a smaller medial and posterior part (including the accessory process) is homologous to the transverse process of the thoracic vertebrae (and therefore is said to arise from the "transverse element") [3]. Therefore, lumbar costotransverse foramina, like the foramina transversaria in the cervical region, probably arise because the transverse and costal elements have failed to unite completely [7, 16]. Noting that there are anastomotic vessels in the thoracic region running between costal and transverse elements connecting adjacent intercostal vessels, Szawlowski [16] postulated that there are similar anastomotic vessels between the coastal and transverse elements in the lumbosacral region in the embryo. If a lumbar intervertebral vessel became atrophied during development, a vertical foramen might persist to transmit an enlarged anastomotic vessel. Of interest, in connection with this hypothesis is the appearance of the contralateral side in our cases 2 and 3, where in place of the foramen there is a circular region, possibly reflecting a foramen that has filled in where the texture of the bone appears slightly different from surrounding bone.

Szawlowski [16] also presented a case of a foramen in S1 similar to that in one of our cases (fig. 4); it began superiorly in the groove between the superior articular process and the sacral ala and then extended inferiorly to communicate with the S1 foramen. In beginning near the superior articular process, these foramina resemble somewhat the retrotrans-

verse foramina, but, in ending by communicating with the S1 foramina, these sacral foramina extend too far anteriad and inferiad to be likely to carry the medial-division nervous structures. These foramina, like the lumbar costotransverse foramina, probably arose when the costal and transverse elements failed to unite completely at the site of a vertically oriented anastomotic vessel [16].

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