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The Lumbosacral Ligament (LSL), with Special Emphasis on the "Lumbosacral Tunnel" and the Entrapment of the 5th Lumbar Nerve

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Summary: *The lumbo-sacral ligament (LSL) was studied in 42 specimens. It extends from the L5 vertebra to the ala of the sacrum and forms, with the structures to which it is attached, an osteofibrotic tunnel as an extension of the intervertebral foramen. The 5th lumbar nerve root passes through the tunnel over the ala of the sacrum and behind the LSL. A branch of the 4th lumbar nerve root passes in front of the LSL to join the 5th below the ligament to form the lumbo-sacral trunk. The sympathetic ramus communicans to the L5 root always penetrates the LSL at its superior border and reaches the nerve inside the tunnel. Branches of the ilio-lumbar vessels accompany the L5 root. Large osteophytes on the inferior border of L5 and tightness of the LSL were often found to cause entrapment and compression of the L5 nerve root against the ala of the sacrum.*

Résumé. *Le ligament lombo-sacré (LSL) a été étudié sur 42 spécimens anatomiques. Il s'étend de la 5ème vertèbre lombaire à l'aileron sacré pour former, avec les structures auxquelles il se rattache, un canal ostéo-fibreux qui prolonge le trou de conjugaison correspondant. La 5ème racine lombaire traverse ce canal au-dessus de l'aileron sacré et en arrière du LSL. Un rameau anastomotique de la 4ème racine lombaire passe en avant du LSL et rejoint la 5ème racine lombaire pour former le tronc lombo-sacré. Le rameau sympathique communicant pénètre le bord supérieur du LSL pour s'unir au nerf à l'intérieur du canal. La 5ème racine lombaire est accompagnée par des branches des vaisseaux ilio-lombaires. Des ostéophytes développés à partir du bord inférieur de L5, de même que la tension du ligament sont assez souvent la cause de l'irritation et de la compression de la 5ème racine lombaire contre l'aileron sacré.*

Key words: *Lumbosacral ligament, Fifth lumbar nerve, Osteophytes, Ramus communicans*

The anterior ramus of the fifth lumbar nerve (Ln5) is frequently affected by irritation or compression as it passes through the intervertebral foramen and descends over the ala of the sacrum to reach the sacral plexus as part of the lumbosacral trunk. We present an anatomical study of the structures related to the nerve in its course which may throw some light on some affections of the nerve.

We have particularly investigated the frequent presence of a membranous ligament, the lumbosacral ligament (LSL), which extends from the fifth lumbar vertebra to the sacrum in front of the Ln5 and forms, with the structures to which it is attached, an osteofibrotic tunnel for the nerve which we propose to name the "lumbosacral tunnel". Osteophytes developing from the lower border of the body of the fifth lumbar vertebra and the upper border of the sacrum may contribute to the formation of the inferior part of this tunnel (Figs. 1–5). The LSL and the osteophytes were found to be compressing the Ln5 in some cases. Little attention has been paid to the LSL in the anatomical literature, where it is described under a variety of names, the sacrolumbar or lumbosacral ligament [26, 30], the sacro-vertebral ligament, Bichat's ligament [29, 32], the lateral lumbosacral

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ligament [28], and the sickle-shaped ligament [5]. Most of the authors stress its inconstant presence and the considerable variability in size and strength.

Material and Methods

Forty-two lumbosacral specimens in 26 cadavers of adults of both sexes were dissected. In each case the psoas muscle and the various structures which run in the depression between the muscle and the lumbosacral region of the spine were initially identified and dissected. Among these, superficially were the common iliac vessels crossing laterally and downwards, the obturator nerves descending deep and medial to the psoas, the iliolumbar vessels ascending deeper in the depression from their origin at the internal iliac vessels in the pelvis, and the lumbosacral trunk, formed by the Ln5 and a branch of Ln4 deep against the ala of the sacrum. The sympathetic trunk was then defined and cleared along the anteromedial border of the psoas muscle. After theses structures had been dissected the psoas muscle was detached from the lumbar vertebrae, care being taken to preserve the rami communicantes (RC) of the lumbar nerves. All other dissected structures were separated or removed from the region, leaving only the lumbosacral trunk and its roots, the sympathetic trunk and the lumbar branches of the iliolumbar vessels. The lumbar plexus and its roots were cleared.

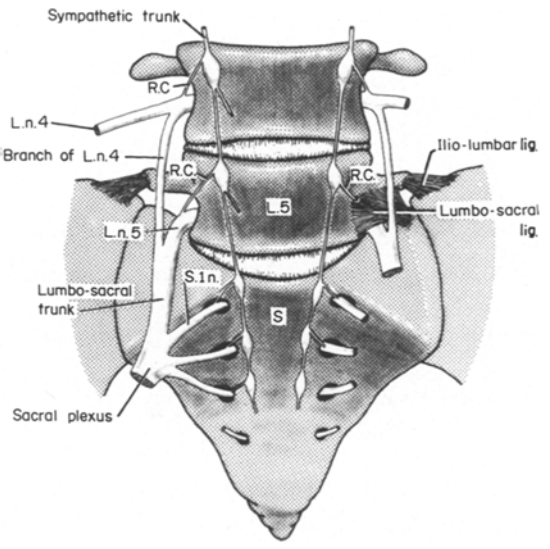

Fig. 1. Drawing to show the right side the course of Ln5 over the ala of the sacrum, the branch of Ln4 merging with Ln5 to form the lumbosacral trunk and the RC of Ln5. On the left side the lumbosacral ligament (LSL) is shown attached to the tranverse process and body of L5 and to the ala of the sacrum. Ln5 runs behind the ligament and appears at its inferior border. The branch of Ln4 runs in front of the ligament. The RC of Ln5 is seen penetrating the LSL at its superior border

Anatomical Considerations

The course and relations of the anterior ramus of the Ln5 is different from that of the other lumbar nerves. The first to the fourth nerves emerge from their respective intervertebral foraminae and run laterally to enter the psoas muscle, where they form the lumbar plexus. The Ln5 first runs inferolaterally against the superior border of the ala of the sacrum and then descends into the pelvis in front of the ala. Here it receives a branch of Ln4 with which it forms the lumbosacral trunk (Figs. 1–3). The intervertebral foramen between L5 and the sacrum is bounded by the pedicle of L5 above and the ala of the sacrum below, and is the smallest of the lumbar intervertebral foraminae although the Ln5 is the largest of the lumbar nerves [5, 6, 16]. In its course the nerve runs first behind and then lateral to the lumbosacral intervertebral disc (Fig. 1).

Observations

The lumbosacral ligament was present in all cases (Figs. 1–5, 7), but the size, thickness, shape and attachments were variable. It extended from the transverse process and body of L5 to the ala of the sacrum in 31 cases (73%), from the body of L5 to the ala of the sacrum in 8 cases (20%), and from the transverse process of L5 to the promontory of the sacrum in 3 cases (7%). In all specimens it formed, with the bony structures to which it was attached, an osteofibrotic "lumbosacral tunnel" whose floor was the medial part of the upper surface of the ala of the sacrum. The inferior border of the LSL formed the anterior limits of the distal opening of the tunnel.

After its exit from the intervertebral foramen the fifth lumbar nerve root ran posterior to the LSL and only after emerging from beneath the inferior border of the LSL did it become exposed on the ala of the sacrum (Figs.1–4). In some cases the LSL was found to be compressing the nerve tightly against the ala, and the nerve was then flattened at that point.

The branch of Ln4 always descended in front of the LSL which separated it from the proximal part of Ln5. The two nerves met to form the lumbosacral trunk below the ligament (Figs. 1, 3, 4).

The ramus communicans always took origin from a sympathetic ganglion or trunk above the lumbosacral ligament. It then descended inferolaterally over the body of vertebra L5, penetrated the anterior surface of the LSL at its superior border and continued deep to the LSL until it

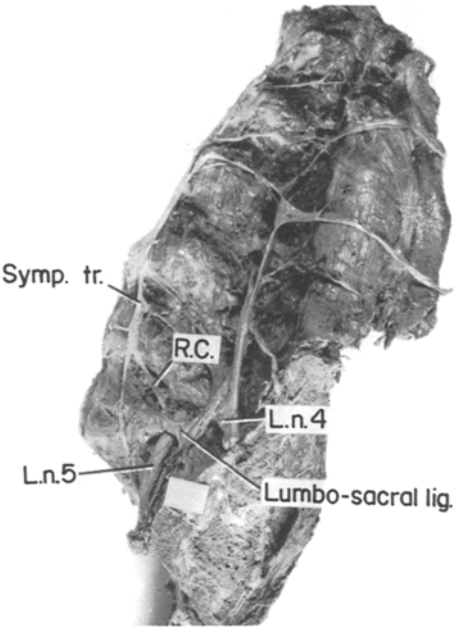

Fig. 2. Left lateral view of dissected specimen; Ln5 is seen appearing from under cover of the LSL. The RC to the Ln5 is penetrating the ligament

reached the Ln5. (Figs. 1, 2, 4, 6). The ramus was often found to be thicker than the main sympathetic trunk at this level (Fig. 4). Small accessory intermediate sympathetic ganglia were sometimes found attached to it [2, 20].

Branches of the iliolumbar arteries were always seen accompanying the Ln5 and entering the intervertebral foramen. Veins or plexuses of veins, very often of relatively large size, left the vertebral canal with the nerve.

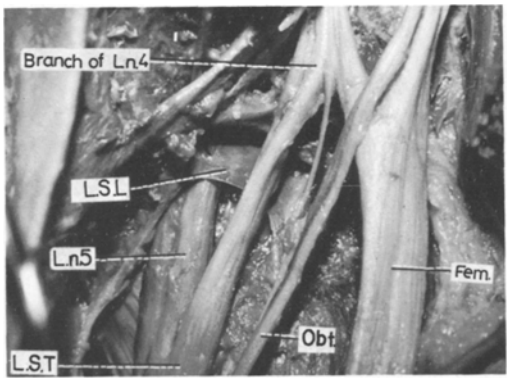

Fig. 3. Dissected specimen; left anterior oblique view. The Ln5 appears emerging from under the sharp inferior border of the LSL, while the branch of Ln4 descends in front of its. *LST* = lumbosacral trunk. *Fem.* = Femoral nerve. *Obt.* = Obturator nerve

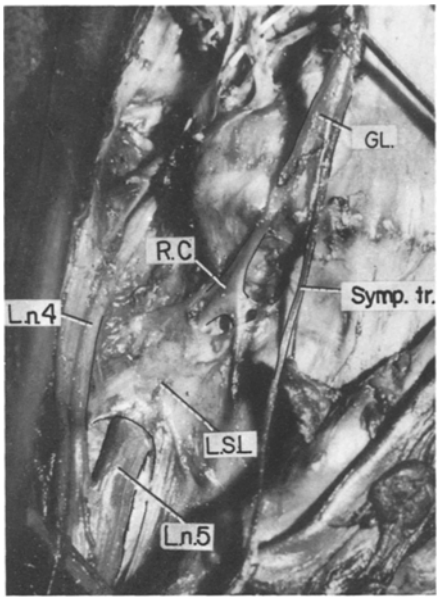

Fig. 4. Dissected specimen; right anterior oblique view. The Ln5 appears from under the LSL to join the branch of Ln4 which passes in front of the LSL. The RC of Ln5 takes origin from a ganglion *(Gl)* of the sympathetic trunk *(Symp. Tr.)* descends in front of L5 and disappears behind the LSL at its superior border. Note that the RC is here thicker than the sympathetic trunk

Osteophytes were frequently observed on the borders of L5 and the sacrum. When large, these osteophytes passed in front of the Ln5 forming with the ala of the sacrum a deep osseous canal which was closed by the LSL and formed the inferior (distal) part of the "lumbosacral tunnel" (Figs. 5–8). Very often the nerve was found to be compressed or entrapped to some degree by osteophytes or by the LSL while passing through this tunnel.

Discussion and Conclusions

The lumbosacral tunnel may be considered as an extension of the L5-S1 intervertebral foramen through which the Ln5, the sympathetic ramus communicans to this nerve and branches of the iliolumbar arteries and veins pass.

The particular course and relation of the Ln5 and its ramus communicans in the tunnel make these nerves extremely vulnerable to compression by any of the structures forming the tunnel. A tight LSL, osteophytes on the borders of the L5-S1 disc or a combination of the two may impinge on the nerve and compress it against the ala of the sacrum [5, 7]. Similar observations were made by

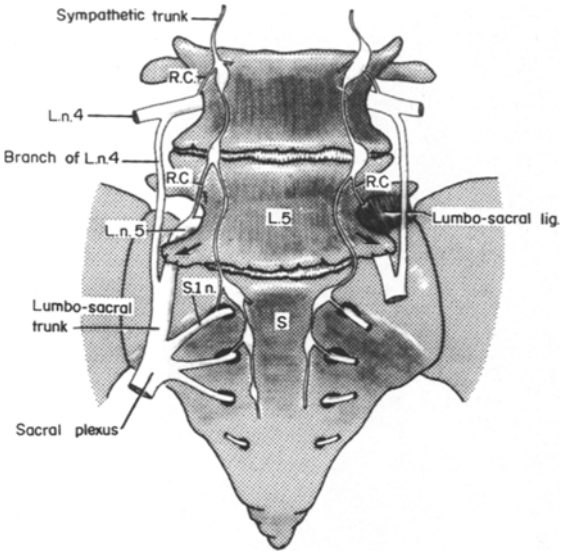

Fig. 5. Drawing to show osteophytes *(arrows)* on both sides of the fifth lumbar vertebra *(L5)* compressing Ln5 against the ala of the sacrum. On the left side the LSL and the osteophyte are shown covering the proximal part of Ln5 which comes into view below the osteophyte

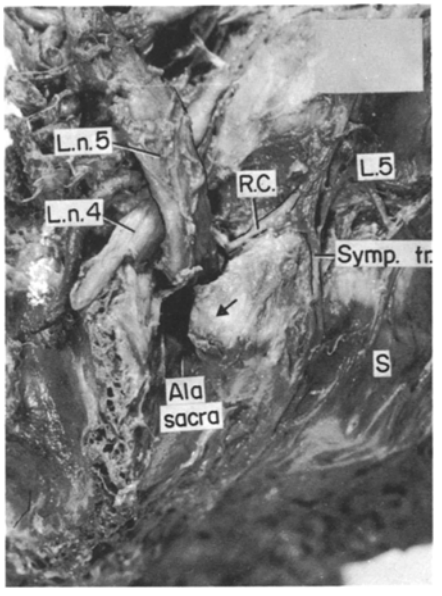

Fig. 7. Same specimen as in Fig. 4 (a). Ln5 has been reflected upwards in front of Ln4 in order to show the deep bony canal formed between the osteophyte *(arrow)* and the ala of the sacrum. Originally, with the LSL in place, the canal was converted into an osteofibrotic tunnel through which the Ln5 passed

one of the authors (H. N.) in previous reports [18, 21]. In those studies it was stressed that osteophytes frequently exert pressure on the sympathetic trunk and rami communicantes as well as on spinal nerves in general, and the Ln5 and its ramus communicans in particular.

Besides the compression produced by the osteofibrotic structures described in the present investigation the presence of branches of the iliolumbar vessels accompanying the Ln5 in its course under the LSL and through the intervertebral foramen may also be of significance. In re-

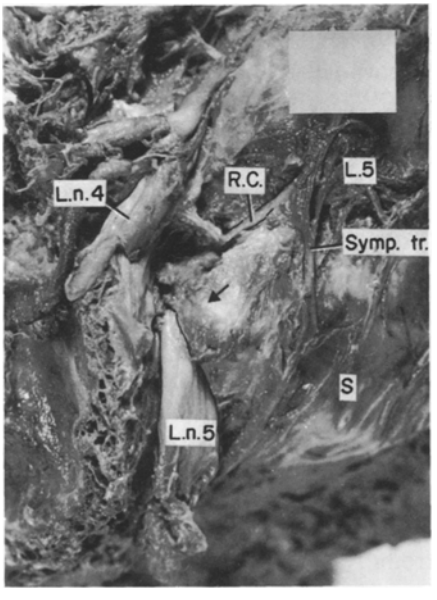

Fig. 6. Dissected specimen; right anterior oblique view. The LSL has been dissected away. Ln5 is seen compressed *(entrapped)* between a large osteophyte *(arrow)* and the ala of the sacrum. The RC of Ln5 is seen descending from the sympathetic trunk and disappearing under the osteophyte

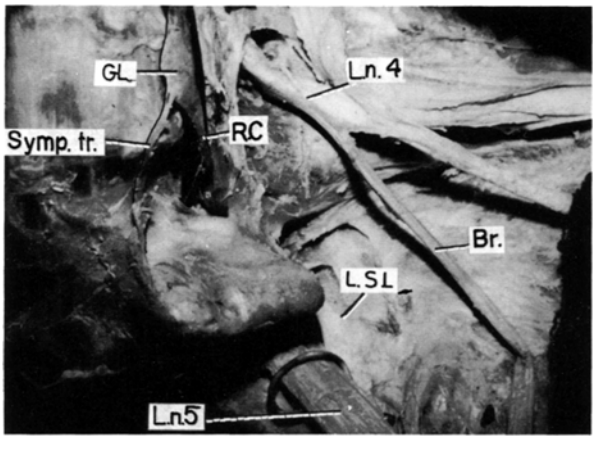

Fig. 8. Dissected specimen; left anterior olbique view. The *Ln5* is seen emerging from under a big osteophyte of L5, and the inferior border of *LSL* (laterally). *Ln4:* fourth L. nerve; *Br:* Branch of Ln4; *Gl:* sympathetic ganglion; *Symp. Tr.:* sympathetic trunk; *RC:* Ramus communicans

cent years many reports have been published describing paresis or neuralgia of cranial nerves due to compression by arteries running in close relation to nerves (8–10, 12–15, 22–25, 27, 31). It may well be that atheromatous, sclerotic, tortuous and dilated branches of the iliolumbar arteries could affect the Ln5. Boniot and Forestier [1] have suggested that the extensive venous plexuses accompanying Ln4 and 5 might irritate these nerves, and this opinion is shared by Brailsford [3] and by Mitchell [16].

Our observations may also have some practical use for anatomists and students. Students and teachers may have difficulty in finding or recognizing the Ln5 during dissection because of the LSL covering the nerve and the branch of Ln4 running in front of the LSL may be mistaken for Ln5. The ramus communicans of Ln5 is inconspicuous and even more difficult to find. A surgeon looking for the nerve in that region may encounter the same difficulty. An accurate knowledge of the course and relations of Ln5 may also assist in some anaesthetic infiltration procedures [4].

The lumbosacral region is a transitional segment of the spine and is therefore a site where anatomical variations frequently occur [11, 17]. These include the number of vertebrae, sacralization of lumbar vertebrae, lumbarization of sacral vertebrae, spondylolysis and spondylolisthesis [18]. Such skeletal variations are accompanied by changes and adjustments of the related soft tissues, including the nerves and vessels to which we have referred in the present study.

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