PRENATAL DEVELOPMENT OF THE ILIOLUMBAR LIGAMENT

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Serial sections, in the frontal plane, of 12 human fetuses showed that the iliolumbar ligament was always present at the gestational age of 11 to 15 weeks; in younger specimens, it could not be identified. The ligament develops during the prenatal period and is not formed by metaplasia of the quadratus lumborum muscle during the second decade of life.

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Ligaments develop during the late embryonic or early fetal period. Luk, Ho and Leong (1986), however, examined serial cross-sections of specimens from five new-born cadavers and two from the first decade of life and reported that the iliolumbar ligament was not present. They concluded that it develops as a result of stress-induced metaplasia of the quadratus lumborum muscle later in life. Since no such origin of a ligament has been reported before, we made a detailed study of 12 specimens from fetuses to confirm or refute their conclusion.

MATERIAL AND METHODS

The embryology collection of the Bone and Joint Research Laboratory of the University of Ottawa includes 313 serially cut specimens of the lumbosacral spine, the gestational age of the fetuses ranging from 5.5 weeks to term. Of these, 33 specimens satisfied the following requirements: serial sections had been cut in the frontal plane; the dorsolumbar spine, the sacrum and part of the iliac bone were on the same section; and other sections through the posterior elements were available.

Specimens over eight weeks of age were decalcified

in ethylenediaminetetra-acetic acid before embedding in paraffin, sectioning and staining with Goldner, HPS or azan stains. The sacrum and/or the twelfth rib served as reference points for the location of the vertebral body and the posterior elements of L5. It is important for an understanding of the direction of the ligament to note that the lumbosacral spine forms a continuous kyphosis during the embryological and early fetal periods. It gradually straightens to reach an angle of 0° at 30 weeks and thereafter the formation of lumbar lordosis begins.

RESULTS

In none of the 21 specimens under the gestational age of 11 weeks could the iliolumbar ligament be identified. After 11.5 weeks it was well formed in all 12 specimens (Fig. 1). Both the anterior and posterior parts could be identified although never in the same section. The anterior part always originated from the tip of the transverse process of L5 and inserted into the anterior aspect of the iliac wing. The posterior part, also originating from the transverse process of L5 (Fig. 3), took a more oblique and more cranially orientated direction towards the crest of the ilium. In two instances, it also originated from the transverse process of L4 (Fig. 2), and from here, its direction was more horizontal. The iliolumbar ligament was quite distinct from the vertically orientated L4/L5 intertransverse ligament which lay lateral to the lumbar nerve root and ganglion, and it was already well developed by eight weeks. No observations could be made on specimens older than 16.5 weeks since beyond that age they had been removed without the iliac bone.

The iliolumbar ligament was always easily distinguishable from the quadratus lumborum muscle, not least by the different, craniocaudal direction of the muscle (Fig. 1).

DISCUSSION

Ligaments develop in utero even before there is a functional stimulus and the iliolumbar ligament is no exception. It can already be detected at 11 weeks of gestation. As with other ligaments, the cellular content

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Fig. 1

Section in the frontal plane of a fetus, crown-rump length 65 mm, age of gestation 11 weeks. The section shows the transverse processes of L4 and L5 and between them, the intertransverse ligament (ITL). The iliolumbar ligament (ILL) can be seen arising from the tip of the transverse process of L5 and passing to the iliac crest (I). The quadratus lumborum muscle is seen lateral to the intertransverse ligament and cranial to the iliolumbar ligament. Its fibre direction is at 90° to that of the iliolumbar ligament. SIL = sacroiliac ligament; s = sacrum. (Goldner $\times 4$).

Fig. 2a

Fig. 2b

Fetus, crown-rump length 80 mm, age of gestation 12 weeks. Figure 2a - Frontal section of the lumbar spine from T12 (plus rib) to L4. The L3/L4 intertransverse ligament is well seen ($\times 3$). Figure 2b - Higher magnification of the area outlined in Figure 2a. The iliolumbar ligament originates from the transverse process of L4 (azan $\times 60$).

Fig. 3a

Fig. 3b

Fetus, crown-rump length 95 mm, age of gestation 13 weeks. Figure 3a – Frontal section of the left lumbosacral region (HPS $\times$ 3). Figure 3b – Higher magnification of the area outlined in Figure 3a. A well-developed iliolumbar ligament originates from the tip of the transverse process of L5 and inserts into the iliac crest (IC). (HPS $\times$ 25).

decreases and the collagenous component increases as development progresses (Caughell, Martin and Uthoff 1990). The anterior and posterior parts of the ligament are quite distinct in their location and direction, and since the transverse process lies posterior to the vertebral body, only sections cut through the posterior elements include the ligament.

I believe that Luk et al (1986) were wrong to conclude that this ligament develops as a result of metaplasia after the first decade of life. They failed to explain how the direction of some of the fibres of the quadratus lumborum muscle could have changed from craniocaudal to transverse during the assumed process of metaplasia, and the

cross-sections which they used made topographical orientation impossible.

I conclude that the iliolumbar ligament is formed during the early stages of prenatal development.

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