

CLINICAL ROENTGENOLOGY OF THE BORDER OF THE VERTEBRAL BODY

A Review

By

FOLKE KNUTSSON

Our knowledge of the normal development and anatomy of the vertebral body and of its pathology is largely due to Schmorl's highly comprehensive research. The results of his investigations are presented in *Die gesunde und kranke Wirbelsäule in Röntgenbild und Klinik* of Schmorl and Junghanns, together with a critical review of the relevant literature. My intention with this article is to describe certain characteristic changes of the border of the vertebral body which are of clinical significance.

It is important to bear in mind that the border of the vertebral body is not only the junction between the curved and basal surfaces of a cylinder but is also laid down independently and develops as an independent structure. It develops as a bony ring which fuses with the surface of the base at its periphery (fig. 1). A layer of hyaline cartilage lies in the concavity within the bony ring, and the true disk lies between the vertebral-body surfaces thus coated. The outer layer of the annulus joins the bony rings of the contiguous vertebral-body surfaces, and is firmly fixed owing to the continuation of the structure into the substance of the bony rings as Sharpey's fibres. In this manner a strong, cylindrical outer layer is formed in the annulus fibrosus, enclosing the rest of the disk substance.

Spondylosis deformans and degeneration of the disk (osteochoondrosis) are distinguished both by their morbid anatomy and clinical picture. It is therefore desirable also to be able to distinguish them roentgenologically. In typical cases this is possible, but often the picture is uncharacteristic.

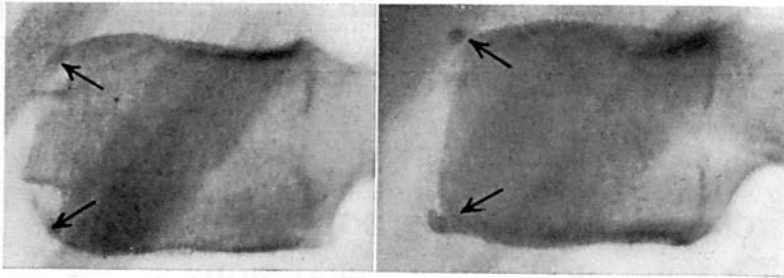


Fig. 1.

Lumbar vertebra at 14 years. The corner of the vertebral body shows a ledge filled with cartilage. In this, one year later, appears the centre of ossification that develops into the bony ring surrounding the border of the vertebral body.



Fig. 2.

Incipient spondylosis deformans. A fissure is seen in the annulus fibrosus near the border of the vertebra. (After Junghanns, *Die Pathologie der Wirbelsäule*. Hb. d. spez. Path. Anat. u. Hist. 1939 (Henke-Lubarsch)).

In *spondylosis deformans* the annulus is detached to a greater or lesser extent from the surface of the vertebral body. In fig. 2 can be seen the fissure-formation that constitutes the typical requirement for the development of spondylosis deformans. Fissuring of this kind can sometimes be detected clinically owing to the 'vacuum phenomenon' (fig. 3). In this way the barrier is broken down, and some protrusion

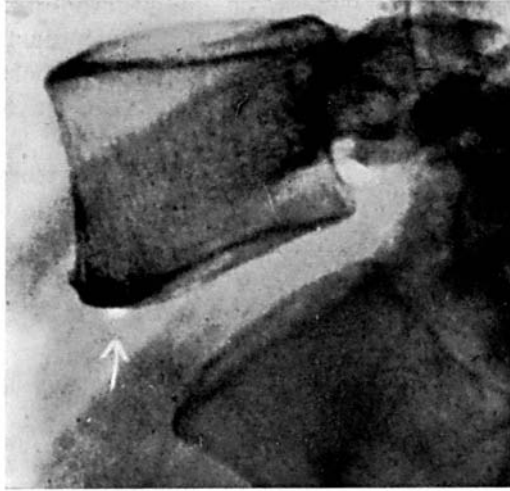


Fig. 3.

The fissuring of the annulus fibrosus that appears in spondylosis deformans can sometimes be demonstrated clinically owing to the 'vacuum phenomenon'.

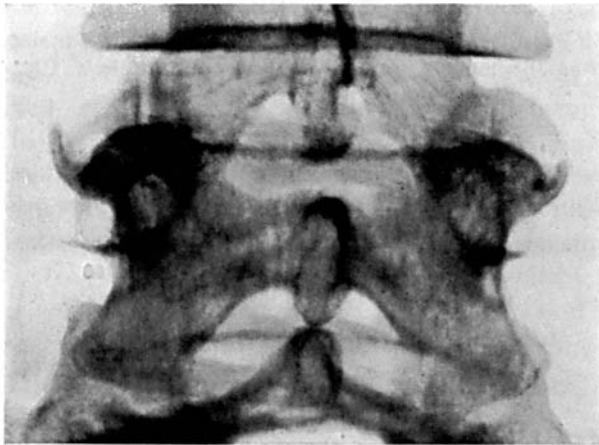


Fig. 4.

Spondylosis deformans with typical claw-like osteophytes developing from the attachments of the anterior longitudinal ligament and leaving the actual vertebral border free.

of the disk results. Pressure on the longitudinal ligament then follows, and this structure is made to take over part of the function of the annulus fibrosus. The resulting increased tension in the longitudinal ligament leads to osteophytic deposits on the vertebral body at the

site of attachment of the ligament. The longitudinal ligament is firmly attached to the vertebral body along the greater part of the curved surface, but is only loosely attached to the actual border. The osteophytes thus leave the curved surface of the body a few millimetres from the border (fig. 4).

The osteophytes are therefore bound to the vertebral-body attachments of the longitudinal ligament, so that none are to be found on the posterior surface of the body, which limits the spinal canal: on the posterior surface the ligament is firmly attached to the disk but not to the surface of the vertebral body, upon which lie structures including a venous plexus.



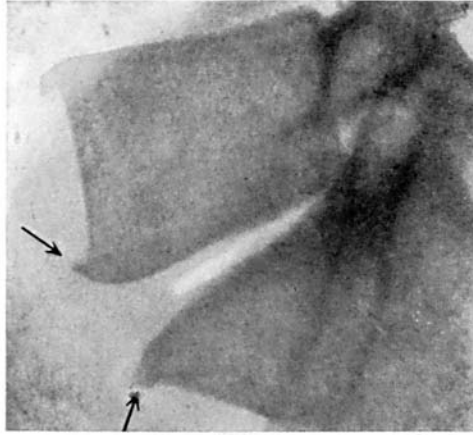
Fig. 5.

Degeneration of the disk (osteochondrosis) with fissures in the degenerated disk-substance. (After Junghanns, *Die Pathologie der Wirbelsäule*. Hb. d. spez. Path. Anat. u. Hist. 1939 (Henke-Lubarsch)).

The deposits can only appear when the turgor within the disk is maintained, and the conditions of tension leading to protrusion and increased tension of the longitudinal ligament can come into play. Detachment of the annulus does not itself result in osteophytic deposits, unless the vertebral column remains in function and constant traction is applied to the ligamentar attachments: thus heavy labouring should result in worse effects than sedentary work.

Nothing is known with certainty of the fundamental cause of peripheral detachment of the annulus, but weakening due to advancing age is thought to be responsible. Thus in spondylosis deformans the primary process is in the disk, and consists of diminished strength, viz. degeneration. Characteristic are the facts that the lesion is localized to the outer layer (annulus) and that the tension in the disk and nucleus pulposus is unaffected: the height of the intervertebral space is thus maintained.

In 'degeneration of the disk' (osteochondrosis) the process is confined to the central parts of the structure, and results in some fall in

*Fig. 6.*

The fissures seen in fig. 5 can sometimes be detected clinically owing to the 'vacuum phenomenon'. The deposits form at the vertebral border, in contrast to those of spondylosis deformans.

the fluid-content. Irregular fissuring from the nuclear region follows. The change may ultimately lead to total destruction of the disk. These fissures involve the central parts of the disk (fig. 5), and are thus distinguished from the fissures of spondylosis deformans which are confined to the annulus fibrosus (fig. 2). These fissures can be detected clinically owing to the 'vacuum phenomenon' (fig. 6). The peripheral part of the annulus fibrosus remains intact. When the normal resilience of the disk is lost the intervertebral space becomes narrower, and the tension in the annulus falls. The intimate, firm connexion between the vertebral bodies due to the disk is thus lost, and some gliding takes place between them. The condition has been strikingly compared to pseudo-arthritis. The gliding-movements between the vertebrae take place via the non-elastic disk and the relaxed annulus, and the surface of the bone becomes sclerosed and osteophytes develop at the border. There is no pressure on the longitudinal ligament, resulting in increased tension, as in spondylosis deformans, and there is therefore no reason for osteophytes to form at the ligamentar attachments. On the contrary, the gliding-movements lead to direct buttressing of the vertebral border, which becomes lipped. The sclerotic reaction on the surfaces of the vertebrae is a result of the mechanical stimulation of the actual gliding movements, and of course does not appear in spondylosis deformans.

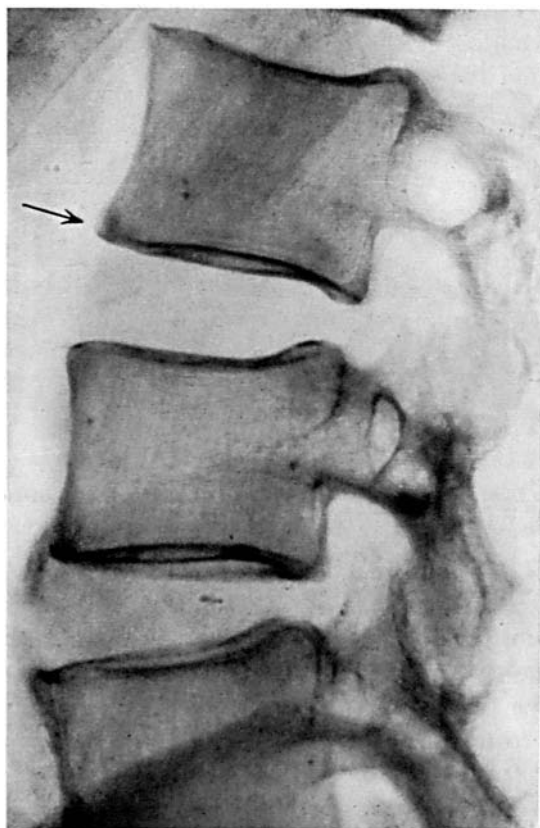


Fig. 7.

Bechterew's disease. The lower border of L.3 shows sclerosis and erosion. Calcareous deposits have been laid down in the loose connective tissue under the anterior longitudinal ligament at L.4 and L.5.

It will be clear that it is often impossible to distinguish these two forms of disk disease. Spondylosis deformans may be interpreted as a wear-and-tear phenomenon which is physiological in elderly persons and which causes impairment of function. Osteochondrosis, on the other hand, is a disease-state of uncertain aetiology which is commonly painful.

In *spondylarthritis ankylopoietica* (pelvospondylitis ossificans) the earliest changes involving the vertebral column consist of inflammation of the loose connective tissue surrounding the disk and vertebral borders. The process extends over the anterior and lateral surfaces of the vertebral body, at the upper and lower borders. Limited sclerosis

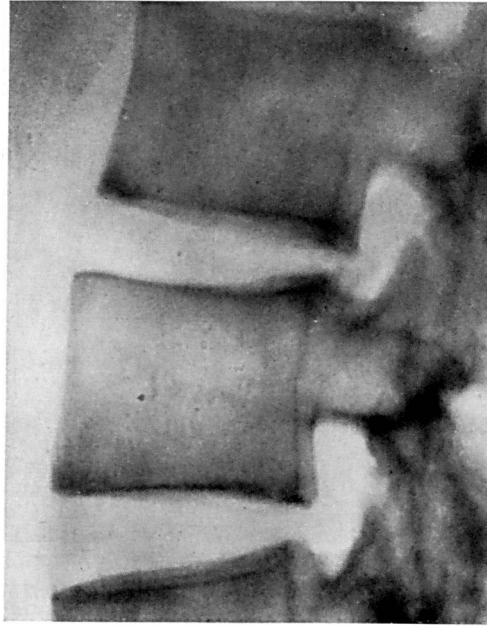


Fig. 8.

At a later stage of Bechterew's disease the anterior surface of the vertebral body becomes characteristically plane, and the borders become sharp.

develops here (the corners 'shine'), and is most obvious in lateral projections. The next stage is erosion of the surface of the vertebral body within the affected area, *anterior spondylitis* (Romanus, Ydén) (fig. 7), in which in the lateral view the anterior contour of the vertebral body loses its concavity and becomes straight (fig. 8)—the structure becomes 'planed down' or 'squared'. The inflamed tissue at the periphery of the disk becomes calcified and ossified, resulting in the formation of bony bridges between the vertebral borders (fig. 7). The character of the pathological process gives the vertebral borders a sharp appearance (fig. 8). The disease gradually spreads to the anterior longitudinal ligament and leads to its ossification.

In *injuries* to the vertebral border the surface of the vertebral body is often depressed, resulting in eversion of the border. The same mechanism probably lies behind the detachment of the vertebral border, with depression of the substance of the disk, which occurs in crack-fractures. Healing of the bone is prevented by this interposition of disk-material in the fractures, and the detached fragment persists separate from the vertebral body. The fracture itself persists and gives

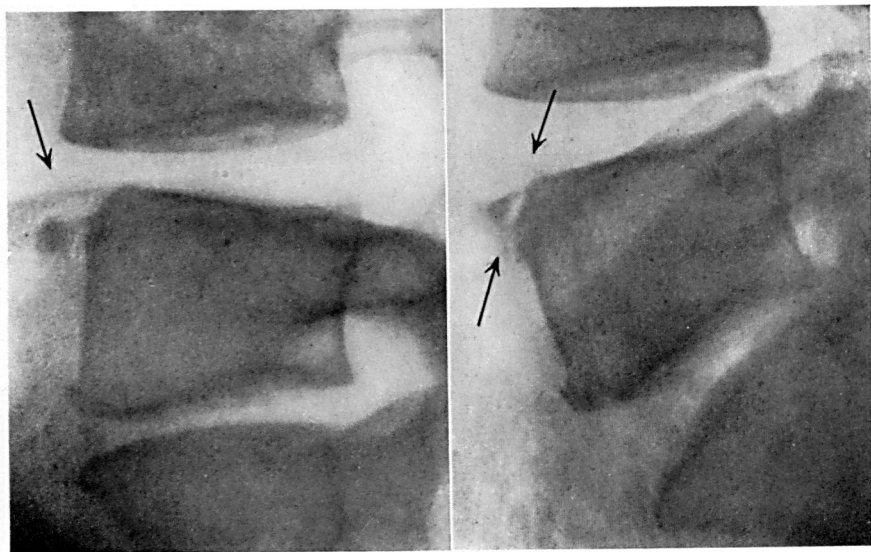


Fig. 9.

The border of the vertebral body detached by pseudarthrosis. There is considerable displacement of the detached fragment on flexion and extension of the vertebral column.



Fig. 10.

Lesion of the border of the vertebral body typical of Scheuermann's disease.

rise to pseudo-arthritis. Considerable movement of the detached fragment can be observed on movement of the vertebral column (fig. 9).

In *Scheuermann's disease* there is a characteristic disturbance in the process of ossification at the border of the vertebra.

SUMMARY

The border of the vertebral body not only forms the geometrical junction between the curved and basal surfaces but develops independently as a bony ring. In the article a description is given of certain characteristic changes of the border of the vertebral body which are of clinical significance (spondylosis deformans, degeneration of the disk, Bechterew's disease, injury, Scheuermann's disease).

RESUME

Le bord du corps vertébral ne constitue pas seulement le bord géométrique de la vertèbre, mais se développe comme une formation particulière sous forme d'anneau osseux.

Il est donné dans l'article une description de certaines des modifications caractéristiques du bord du corps vertébral qui ont une importance clinique (spondylose déformante, dégénération discale, maladie de Bechterew, fractures, maladie de Scheuermann).

ZUSAMMENFASSUNG

Die Wirbelkörper-kante stellt nicht nur die geometrische Kante des Wirbelkörpers dar, sondern entwickelt sich als ein besonderes Gebilde in Form eines Knochenringes. In der Arbeit werden gewisse charakteristische Veränderungen der Wirbelkörperkante beschrieben, die klinische Bedeutung haben. (Spondylosis deformans, Diskusdegeneration, Morbus Bechterew, Schäden und Scheuermanns Erkrankung).

REFERENCES

- Knutsson, F.*: The vacuum phenomenon in the intervertebral disc. *Acta radiol.* 23 (1942), 173.
Romanus, R. and Ydén, S.: *Pelvo-spondylitis Ossificans*. Munksgaard, Copenhagen, 1955.
Schmorl, G. and Junghanns, H.: *Die Gesunde und kranke Wirbelsäule in Röntgenbild und Klinik*, Georg Thieme Verlag, Stuttgart, 1951.