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*Degenerative changes of the vertebral column in spatial imaging
of 3D computed tomography*

The aim of the study is to assess the diagnostic value of spatial 3DCT reconstructions of degenerative pathologies in vertebral bone structures.

MATERIAL AND METHODS

The material comprised 36 patients with radicular pain syndromes. CT examination was performed with Somatom ART apparatus by Siemens with 3D software option. The obtained axial sections and planar reconstructions were assessed in a 1500/250 H.u. bone window and in a 350/50 H.u. soft tissue window. Spatial reconstructions 3D CT were done at 150H.u. threshold. The thickness of layers was 2-3 mm and table shift was the same or slightly smaller (the so-called overlapping). This let obtain continuous or overlapping layers, which improved the quality of spatial reconstructions. Magnifications of pictures and a 512 x 512 reconstruction matrix were used. Axial sections and planar reconstructions (MPR) were correlated with spatial reconstructions (3D). The spinal canal was assessed on spatial reconstructions of the spine in superior and inferior projections at different angles and jointly with intervertebral foramens in lateral projection from the inside of the vertebral canal, after cutting off along the spinous processes of part of the reconstructed picture.

RESULTS

In 12 patients osteophytic stratifications of posterior edges of vertebral bodies were revealed causing central stenosis of the vertebral canal (Fig. 1). In 3 cases they were



Fig. 1. 3D CT – vertebral canal in superior projection. Osteophytic processes of posterior edges of lumbar vertebral bodies get prominent centrally to the vertebral canal lumen

accompanied by osteophytic overgrowths within intervertebral joints. In 17 patients osteophytic stratifications of postero-lateral edges of vertebral bodies were found causing stenosis of lateral recesses while degenerative productive changes within intervertebral joints accompanied them in 12 cases (Fig. 2 and 4b). In 6 cases osteophytes occurred on both posterior and postero-lateral edges of vertebral bodies (Fig. 3 and 5). Osteophytic stratifications of intervertebral joints visualised on 3D CT reconstructions in posterior and lateral projections occurred in 18 cases (Fig. 4a). They caused narrowings of intervertebral foramens of different degree and in 2 cases stenosis of the vertebral canal (Fig. 4b). In 3 cases osteophytic stratifications of edges of spinous processes were found.

Stenosis of intervertebral foramens was caused in 6 cases exclusively by changes in intervertebral joints, in 11 cases by stratifications of edges of vertebral bodies and in 12 cases by their combined occurrence. In 4 cases 3D CT let assess the volume of thickened and calcified yellow ligaments narrowing laterally the spinal canal. Their bone attach-



Fig. 2. Osteophytic stratifications of left edges of lumbar vertebral bodies and within intervertebral joint on the left narrow the lateral recess

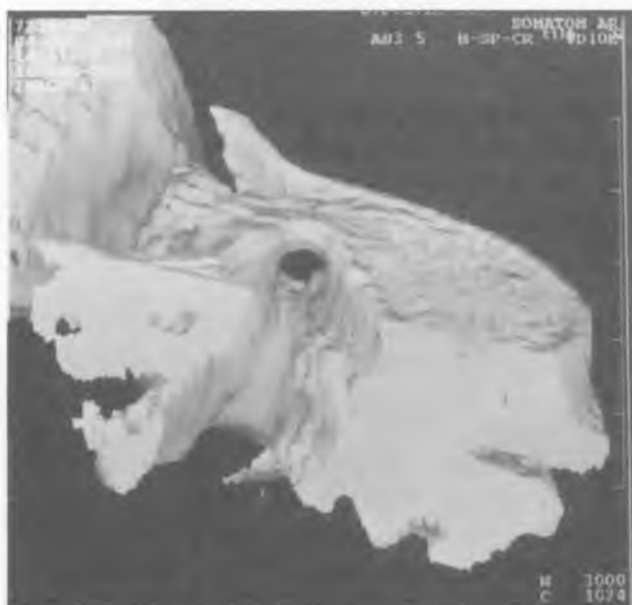


Fig. 3. 3D CT – vertebral canal in lateral projection from the inside of its lumen in the axis of intervertebral foramen. Osteophytes of posterior edges of vertebral bodies cause stenosis of the canal and intervertebral foramen

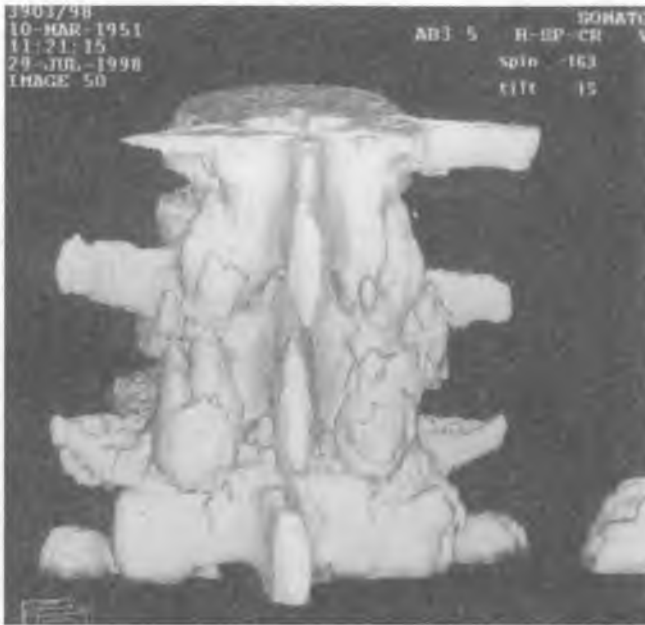


Fig. 4a. Degenerative changes of intervertebral joints

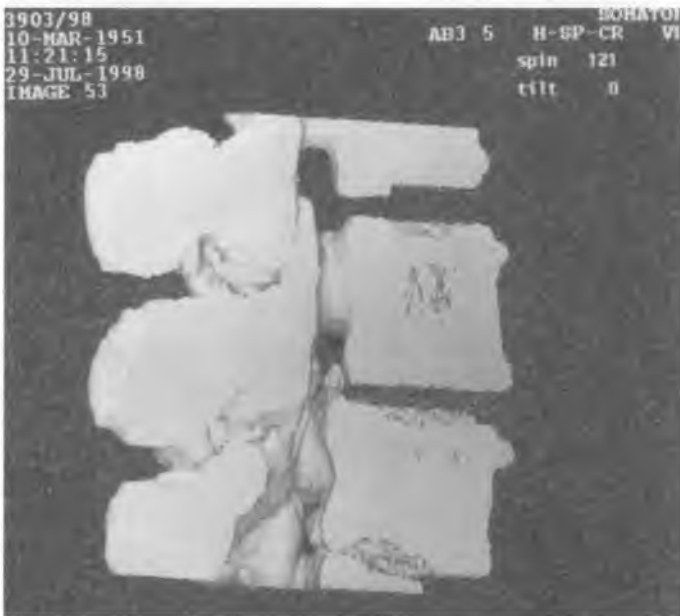


Fig. 4b. 3D CT after cutting off of part of the reconstructed picture in lateral projection from the vertebral lumen shows stenosis of the vertebral canal and intervertebral foramens

ments were privileged sites of osteophyte production and increasing fibrosis. In 5 patients 3D CT allowed to differentiate an osteophyte from calcified hernia of vertebral pulp nucleus. Multi-level changes were revealed in 9 cases (Fig. 4 and 5) and in 3 cases osteophytes jointly with degenerative slide.



Fig. 5. Two-level stenosis of the vertebral canal and intervertebral foramina in the cervical segment of the spine caused by osteophytic stratifications of posterior edges of vertebral bodies

3D CT reveals the cause of vertebral canal narrowings showing indegenerative stenosis, the presence and volume of bone spurs of vertebral body edges, thickenings and calcifications of ligaments, hypertrophies and subluxations of articular surfaces and calcified intracanal fragments of the pulp nucleus. It determines the character of narrowing and degree of filling of lateral recesses with hypertrophic bone mass (configuration of limb). Hypertrophic bone changes of the lateral recess lead to the compression of the spinal nerve root (2, 5, 7, 9). Narrowings of intervertebral foramina, asymmetry of articular surfaces resulting from deformations of articular processes and mutual rotations of neighbouring vertebral bodies are reconstructed in the dimension of spatial depth (14).

Visualisation of the internal surface of vertebral canal enables spatial assessment of bone processes penetrating its lumen and intervertebral foramina. Hypertrophic spurs intussuscept to the canal especially at the level of pulp nucleus hernia (4, 8, 13). At the site of attachment of the fibres of the fibrous ring osseous processes are usually formed

(3, 6). Narrowing, asymmetry of the intervertebral fissure and sclerotisation of limiting membranes of vertebral bodies result from degenerative changes of the intervertebral disc (10, 11, 12). The so-called 3D CT hard disc differentiates with posterior osteophyte of vertebral body by showing mutual links.

In degenerative spondylolisthesis caused by loosening of the ligament apparatus spatial option visualises shifts and static changes of vertebral bodies and arches, fibular positioning of intervertebral joints surfaces or tropism of surface (1).

CONCLUSIONS

3D CT is a technique of choice in imaging the internal surface of vertebral canal enabling the determination of the presence and location of osteophytic processes of vertebral body edges and precise assessment of the degree of degenerative stenosis of the vertebral canal. Recognition of bone narrowings in intervertebral foramens and of lateral recesses as well as determination of their cause is precise in spatial CT imaging.

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SUMMARY

In a group of 38 patients with radicular pain syndromes diagnostic value of spatial reconstructions with computed tomography (3D CT) was assessed in examinations of bone structures of the vertebral column. It was found that 3D CT is a technique of choice in the assessment of degenerative stenosis of the vertebral canal, internal surface of the vertebral canal, bone narrowings of intervertebral foramens and lateral recesses.

Zmiany zwyrodnieniowe kręgosłupa w obrazowaniu przestrzennym tomografii komputerowej 3D TK

W grupie 36 chorych z bólowymi zespołami korzeniowymi dokonano oceny wartości diagnostycznej rekonstrukcji przestrzennej tomografii komputerowej (3D TK) w badaniach struktur kostnych kręgosłupa. Stwierdzono, że 3D TK jest techniką z wyboru w ocenie stenozы zwyrodnieniowej kanału kręgowego, powierzchni wewnętrznej kanału, zwężeń kostnych otworów międzykręgowych oraz zachyłków bocznych.