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The value of spatial reconstructions with computed tomography (3D CT) in recognising the fissure of vertebral arch

Recognising vertebral arch fissure (VAF) by means of radiography is not infrequently difficult. This is especially the case with patients in whom accompanying spondylolisthesis does not exceed degree II. Early diagnosis of VAF enables the use of less encumbering surgery i.e. postero-lateral spondylodesis.

In the diagnostics of VAF, apart from lateral and oblique radiograms, there is emphasised the value of CT examination, mainly of multiplanar and spatial reconstructions (1, 2, 3, 4).

The aim of the study is to assess the value of 3D CT in recognising VAF on the basis of the authors' own material.

MATERIAL AND METHODS

CT examinations were performed in 20 patients with radiologically diagnosed spondylolisthesis in L5 vertebral body or with normal picture of lumbosacral spine and chronic pains in the lumbo-sacral region not subsiding after treatment. Examinations were done in 3 mm thick axial sections. From computer data of axial sections secondary spatial reconstructions 3D CT at bone threshold were performed. They were assessed in real time in optional projections. Photographic documentation was done in lateral projections for the assessment of the degree of slip as well as in posterior and posterooblique ones. In anterooblique projections intervertebral foramens were visualised. Superior projections were also performed in the axis of the vertebral canal showing epiphyses of L5 vertebral arch.

After cutting off along spinous processes part of reconstructed picture of the spine projections from the inside of the vertebral canal were done. The cut off intracanalar reconstructions were performed separately for each side.

In projections from the inside of the vertebral canal the degree of slip as well as epiphyses and vertebral arches were assessed revealing vertebral arch fissure. In posterooblique projections in the axis of intervertebral foramens their diameters were assessed by comparing the widths at individual levels.

RESULTS

In 7 patients with degree I slip arch fissure was recognised on 3D reconstructions projected from the inside of the vertebral canal. It had the form of linear clearing up (Fig. 1) or a break in arch continuity (Fig. 2). The degree of its visualisation depended on the direction of projecting the spatial picture and on ground light. In external posterooblique projection arch fissure was visible as a break in bone texture below intervertebral joint. Superior projections revealed vertebral arch fissures within the epiphysis (Fig. 3).

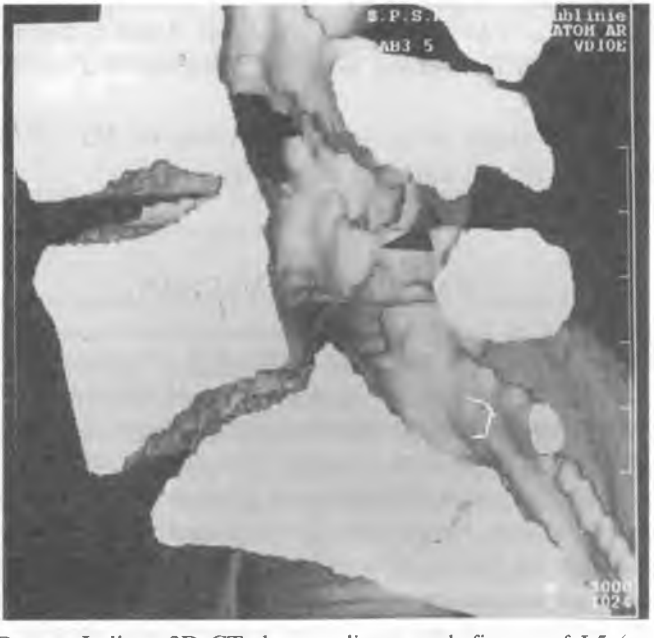

Fig. 1. Degree I slip – 3D CT shows a linear arch fissure of L5 (arrow), the degree of L5 body displacement in relation to S1 body and the width of vertebral canal and intervertebral foramens

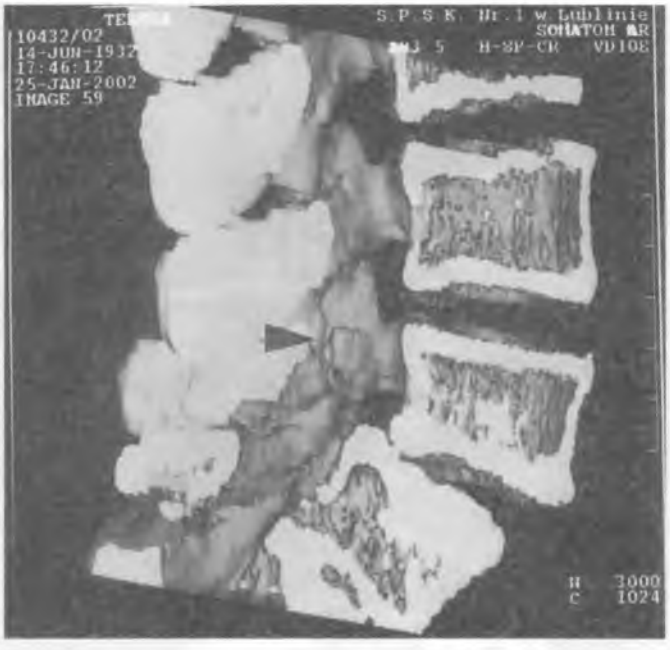

Fig. 2. Degree I slip – 3D CT shows a break in the continuity of L5 arch (arrow)

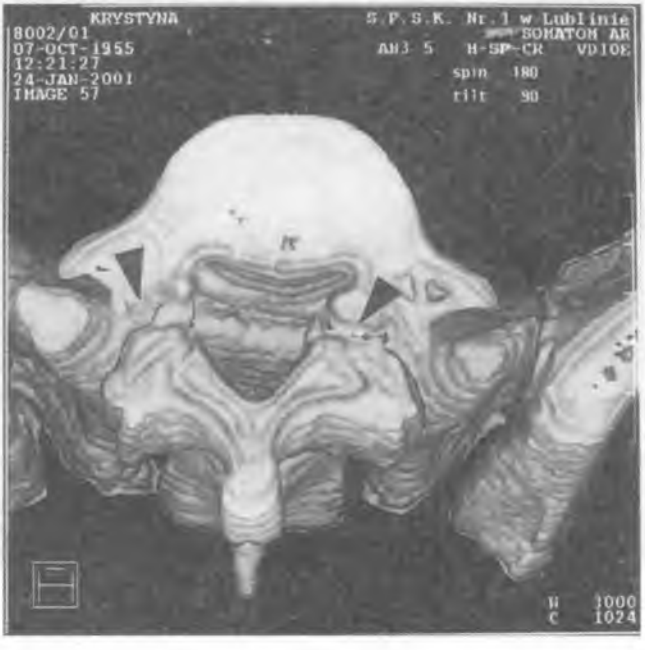

Fig. 3. 3D CT shows a bilateral arch fissure (arrows). In the lumen of vertebral canal visible posterior edge of S1 body

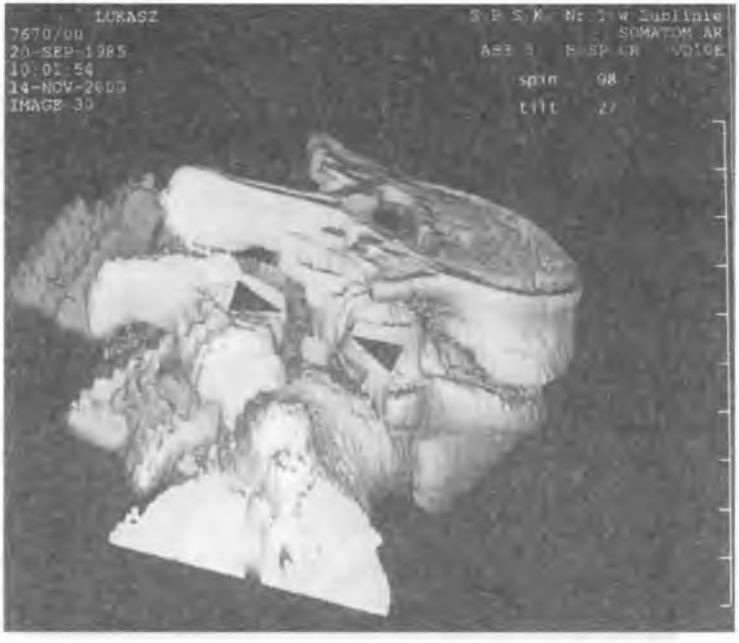

Fig. 4. 3D CT in posterooblique projection reveals fissure in degree II slip (arrows)

Fig. 5. Projection from the inside of vertebral canal after cutting off part of picture reconstructed in 3D CT shows arch fissure (arrows), degree II slip, retained width of vertebral canal, decreased width of intervertebral foramen and calcified, pulpy nucleus displaced into the canal

In 6 patients with degree II slip arch fissure had the form of different width break in the continuity of bone texture revealed in external projection (Fig. 4) and from the inside of the vertebral canal (Fig. 5).

In 5 cases of degree III slip spatial picture was similar to that in degree II.

In 2 cases of degree IV slip identification of both arch fissure and its individual elements encountered difficulties due to considerable displacements of structures and the presence of secondary osseous reparative reactions. A break in the continuity of the vertebral arch and the degree of displacement was visible only on reconstructions cut off along spinous processes in posterooblique projection from the inside of the vertebral canal (Fig. 6). This projection visualised in both cases osseogenic narrowing of the vertebral canal and intervertebral foramens.

Fig. 6. Projection from the inside of the vertebral canal of 3D CT reconstruction in degree IV slip. Wide fissure of vertebral arch (arrow) and tightening of L5-S1 intervertebral foramen. Narrowing of vertebral canal at the level L5-S1

DISCUSSION

In the majority of cases of vertebral fissure with accompanying spondylolisthesis the first symptoms are interpreted as accounting for posture defect, scoliosis or Scheuermann's disease. Further diagnostics is carried out in cases of overstrain pain complaints. Pain and symptoms of spinal radices irritation with ischias result from

intracanalar displacement of fragments of pulpy nucleus or bone stenosis of the vertebral canal and intervertebral foramens.

Radiograms of lumbosacral spine in lateral projection are sufficient for the assessment of slip degree while revealing of vertebral arch fissure requires supplementary pictures in oblique projections and layer linear ones in planes of vertebral arch epiphyses. They are not usually sufficient to make a final diagnosis and decide on surgical treatment and its technique.

CT examination should be performed as subsequent to lumbar spine lateral X-ray in patients with spondylolisthesis qualified for surgical treatment (5).

In 3D technique arch fissure was most favourably visualised in lateral and anterooblique projection from the inside of the vertebral canal after cutting off part of the reconstructed picture along spinous processes. In lateral projection the degree of slip was precisely determined while stenosis of intervertebral foramen in posterooblique projection in its axis (6).

In the assessment of arch stem the element favourably presented due to 3D rotation function is the interarticular part (isthmus). In real spondylolisthesis on axial sections no deficit of arch isthmus can be seen while 3D reconstructs them completely (7, 8).

In the assessment of the width of intervertebral foramens 3D CT reconstructions are a technique of choice. They enable a comparison of the diameter of intervertebral foramens on subsequent levels. Axial sections and planar reconstructions are less efficient then (9).

Computerised tomography supplemented with 3D reconstructions provides information enabling determination of the extent of surgical procedure (6).

In adolescents with VAF, degree I slip without neurological symptoms found on 3D CT reconstructions, normal widths of vertebral canal and intervertebral foramens the surgery of choice is still posterolateral spondylodesis. Exclusion of the function of motor segment protects from progressive slip and its complication.

CONCLUSIONS

Spatial reconstructions (3D) CT enable precise visualisation of VAF. Favourable for its assessment are latreral and anterooblique projections performed from the inside of vertebral canal after cutting off part of the reconstructed picture along spinous processes. In patients with degree I slip in recognising arch fissure 3D CT is a technique of choice. 3D CT enables the assessment of the width of vertebral canal and multilevel assessment of intervertebral foramens.

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SUMMARY

The aim of the study is to assess the value of spatial reconstructions with computed tomography (3D CT) in recognising vertebral arch fissure. The material comprises 20 patients in whom 3D CT revealed vertebral arch fissure. Spatial reconstructions at bone threshold were done from computer data of axial sections. 3D CT was assessed in real time in optional projections and lightened at a selected angle. It was found that the most favourable projections for the assessment of vertebral arch fissure are lateral and antero-oblique ones performed from the inside of the vertebral canal after cutting off part of the reconstructed picture along spinous processes. In patients with degree I slip 3D CT in recognising arch fissure is a technique of choice.

Wartość rekonstrukcji przestrzennych tomografii komputerowej (3D TK) w rozpoznawaniu szczeliny łuku kręgu

Celem pracy jest ocena wartości rekonstrukcji przestrzennych tomografii komputerowej (3D TK) w rozpoznawaniu szczeliny łuku kręgu. Materiał obejmuje 20 pacjentów u których w 3D TK uwidoczniono szczelinę łuku kręgu. Rekonstrukcje przestrzenne o progu kostnym wykonywano z danych komputerowych przekrojów osiowych. 3D TK oceniano w czasie rzeczywistym w dowolnych rzutowaniach i oświetlano pod wybranym kątem. Stwierdzono, że najbardziej korzystne dla oceny szczeliny łuku kręgu są rzutowania boczne i przednio-skośne, wykonywane od wnętrza kanału kręgowego po odcięciu części zrekonstruowanego obrazu wzdłuż wyrostków kolczystych. U chorych z ześlizgiem I° w rozpoznawaniu szczeliny łuku kręgu 3D TK jest metodą z wyboru.