Report on two failed posterior lumbar interbody fusions

by

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Abstract

Despite X-ray and computed tomography signs of osseous stability after posterior lumbar interbody fusion (PLIF) procedures, the examination of two patients after 28 and 24 months respectively, revealed that the cages were wandering and consolidation had not taken place. Revision surgery was required in both cases.

Introduction

Fusion surgery in the region of the lumbar spine has become standard procedure during the last two decades. One of the most important indications is mono-segmental degeneration with instability and stenosis problems [1, 2, 3]. The so-called

Posterior Lumbar Interbody Fusion (PLIF) has become the preferred procedure when the dorsal osseous structures of the lumbar spine are weakened by specific decompression. Advantages are the exclusive access from the dorsal direction and the possibility of reaching and stiffening the ventral spine and avoiding the preparatory risks of ventral access [1, 2, 3, 4]. As a rule, two cages are provided for the ventral fusion. Fusion is achieved by axial load. The hollow spaces of the cages are filled with spongy bone, as is the area ventral to and between the cages. In addition, a dorso-lateral fusion is carried out.

Two types of material have become accepted, i.e. the titanium implant on the one hand, and the so-called PEEK (polyetheretherketone) implants on the other hand [11,15].

Case 1

A 63-year-old woman was suffering from an advanced degenerative vertebral canal stenosis in the area of L 4/5. In addition, she had a hypertrophic spondylarthritis and a degenerative pseudolisthesis of L 4/5. During the primary intervention, dorsal decompression and neurolysis of the nerve roots L4 and L5 on both sides were carried out. The PLIF operation was performed with two 8 x 12 mm contact fusion cages (Synthes®). The transpedicular instrumentation was carried out at L 4/5 using the USS instruments (Synthes®) (6 x 45 mm screws). The cages, the ventral space and the space in between the cages were filled with bone from the dorsal decompression and the iliac crest. In addition, a dorsolateral spondylosyndesis was carried out.

Twenty month after surgery the patient complained of backpain. X-ray revealed a broken pedicle screw at L5 left as well as dorsally dislocated cages. A revision

operation was carried out and the left pedicle screw L5 was replaced.

There were no signs of fusion ventrally. It was not possible to remove the cages from the dorsal passage so a ventral passage had to be used. The ventral spondylosyndesis was achieved by a tri-cortical bone graft. At the last consultation nine months later the patient was symptom-free.

Case 2

A 62-year-old man with advanced osteochondrosis, degenerative vertebral canal stenosis, spondylarthritis and narrowing of the intervertebral space presented with severe lumbar pain and leftsided radicular complaints. A dorsal decompression with bilateral neurolysis of the nerve roots L4 and L5 was carried out. Two PEEK 12 mm cages (Stryker) were used for PLIF and USS instruments (6 x 50 mm screws) were used for dorsal fusion. Bone from decompression and from the iliac crest was used to fill the cages, the space in front of and between the cages and the dorsolateral spondylosyndesis. Twenty-eighth month after surgery the patient had increasing complaints with bilateral radiating pain along L5 into the legs. X-ray revealed dorsally dislocated cages. A revision operation was carried out. The PEEK cages were removed through a ventral access. They were embedded in connective tissue only and could be removed without any problems. Ventral fusion was now achieved by means of a tri-cortical iliac bone graft. At the last consultation six months after the revision the patient was without symptoms.

Surgical procedure

In both cases, the implantation of the cage was carried out according to the surgical instructions. Prior to decompression, the USS titanium pedicle screws were placed

so the exact fit of the screw could be checked after decompression after which a total discectomy was performed. As spongy bone retrieved during decompression alone may reduce the fusion rate, additional spongy bone from the iliac crest was used [4, 12].

Imaging

The course of imaging was comparable in the two cases. Standardized X-rays of the lumbar spine in two planes as well as extension/flexion functional images were taken at regular intervals. In addition, thin-layer CT scans were carried out during the out-patient presentation in both cases due to the new complaints. In both cases, these CT scans were carried out some weeks prior to the plain check X-ray. The assessment of the images by the orthopedic surgeon was always accompanied by a radiological statement. In the first case, bone formation in the intervertebral space with cages was described in the plain X-ray, in the functional images as well as in the computed tomography carried out in the 19th month. The second case was similar. Increasing osseous consolidation was diagnosed in the plain X-ray as well as in the CT in the 24th month after the operation (Fig.1A & B).

Fig. 1A

Case 1:
CT-scan 19 mths postop. - X-ray 19 months postop., X-ray 20 mths postop.

Fig. 1 b

Case 2:

CT-scan 24 mths postop, X-ray 24 mths postop., X-ray 28 mths postop

Revision surgery

In the first case, a dorsoventral approach was made. After removal of the broken screw, the dorsal instruments were completed first of all, and new iliac crest bone was placed. Subsequently, the ventral access was established; the cages were removed; tissue material was retrieved from the intervertebral space affected for histological examination, and tri-cortical iliac crest shavings were used for stabilization.

The second patient was treated through the ventral access. After cage removal and retrieval of tissue samples from the intervertebral space for histological examination, the ventral column was stabilized by tri-cortical iliac crest shavings in this case as well.

In both cases the tissue samples taken from the intervertebral space and the respective cages with tissue were submitted for cellular examination.

Pathomorphological assessment

The preparation of the removed cages was divided up into several steps. First of all, contact radiographs were made of the cages or the material in the cages

respectively. In order to answer questions with respect to calcification and

bone remodeling, half of the material was placed in low-temperature methacrylate

while the other half was gently decalcified in EDTA.

Contact radiographs

In both cases (Figs. 2 A, B), the contact radiographs revealed a focus of slightly

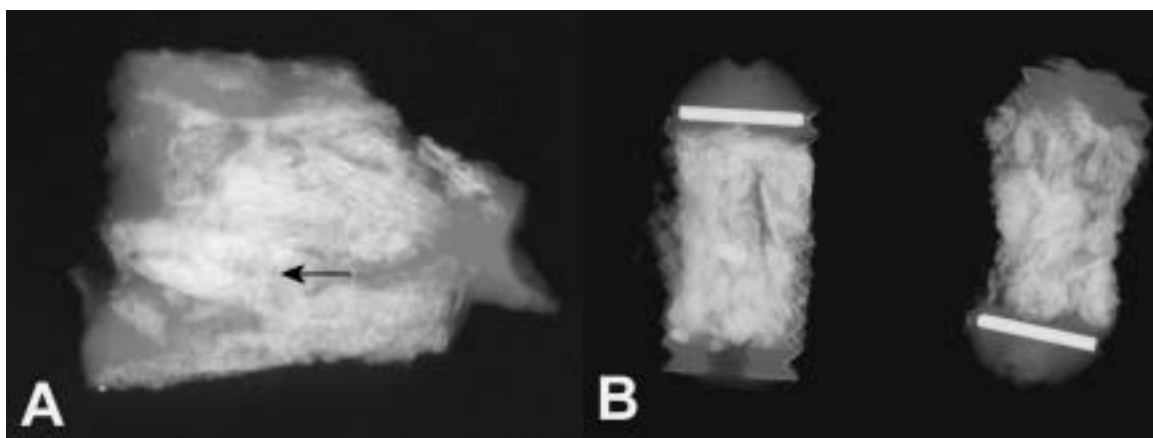increased radio density in addition to predominantly normal spongy bone structure.

Fig. 2: Contact radiographs of the interbody fusion cages e.g. the filling material: (A)
X-ray examination reveals besides predominantly normal spongiosa structure a focus
of slightly increased radio density (see arrow).
(B) Almost normal spongious bone as demonstrated by contact radiographs.

Histological sample preparation:

Case 1: Histologically, predominantly necrotic bone and fibrous tissue were revealed

with rare islands of primarily devitalized bone and callus-like cartilaginous structures

(Figs. 3 A, B).

The fragments showed only a narrow hemline of vital tissue. Intervertebral disc tissue

with matrix splintering, ruptures, mucoid matrix degeneration (increase in acidic

glycosaminoglykanes) and focal proliferation of cartilaginous cells was detected as

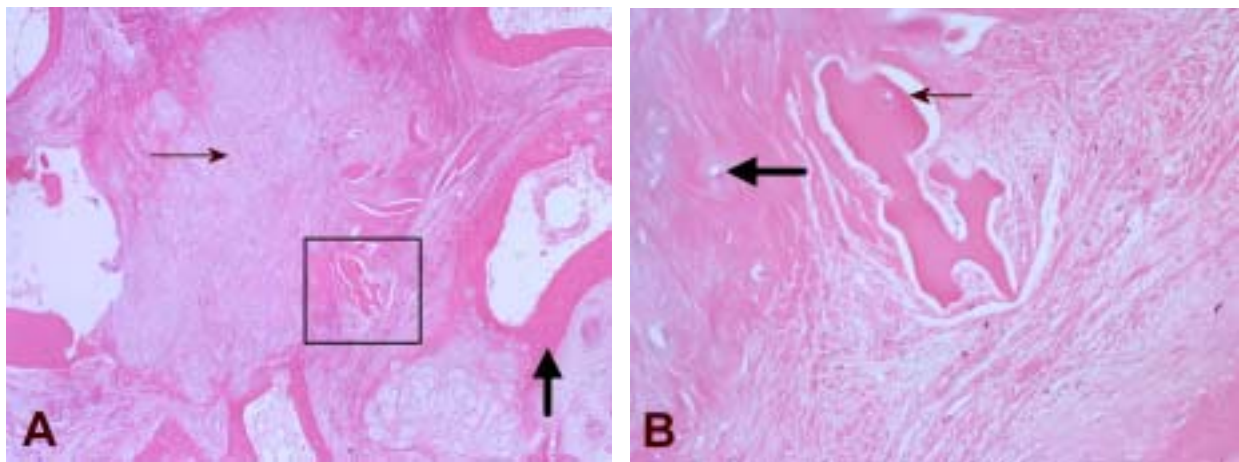well. Von Kossa staining indicated mainly mineralized bone matrix in keeping with the contact radiographs.

Fig. 3: Photomicrographs demonstrating necrotic bone and fibrous tissue
(A) Routine staining shows pallor bone (big arrow) and connective tissue (small arrow) with nearly complete loss of nuclear detail.
(B) Higher magnification (see rectangle in A) reveals the microscopic details of bone necrosis with loss of osteocytic nuclei (small arrow) and callus-like connective tissue without any nuclear staining.
(A and B hematoxiline-eosin staining, original magnification A: x 100; B: x 300).

Case 2

In the small-scale structure, largely necrotic spongy bone with transition to largely devitalized cartilage as well as callus-like tissue were found. Islands of granulation tissue reaction (Fig. 4 A) with narrow appositional bone growth (Fig. 4 B) were revealed. The spongy and compact bone was calcified primarily (Fig. 5 A). Numerous parts of disc tissue with deep tears, splicing, chondrocyte clusters and increased deposition of acidic mucopolysaccharides were also found (Fig. 5 B).

To summarize, the examination of the small-scale structure revealed almost identical results in both cases. The material corresponded largely to necrotic avital mineralized bone and cartilage tissue with foci of accentuated callus formation, with minimal

appositional bone growth in case 2. In both cases, the intervertebral disc

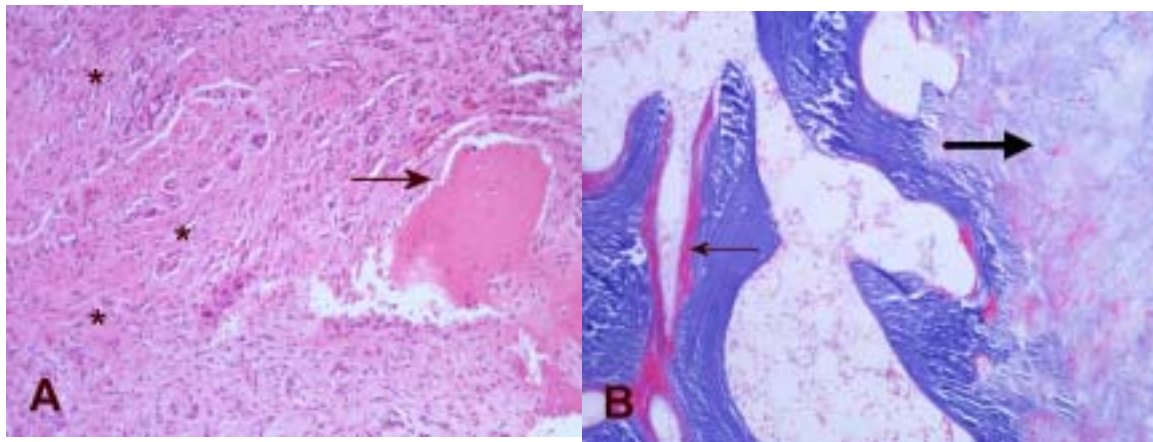tissue revealed distinct regenerative and reparative changes.

Fig. 4: *Histomorphological signs of tissue remodelling*
(A) Seldom spare islands of granulation tissue with a marked proliferation of
fibroblasts and histiocytes (asterisk) and little viable bone fragments (small arrow)
are detectable at the interface between the cage and the surrounding disc tissue.
(B) Initial attempts of bone remodelling with callus-like fibrous tissue (big arrow) and
a small hemline of undecalcified osteoid (small arrow).
(A: hematoxiline-eosin staining, B: Ladewig's trichrome; original magnification A: x
300; B: x 150).

Discussion

In a number of PLIF operations, the results of which will be described in greater detail

later, some complications were encountered. These complications were comparable

to cases already reported in publications [6, 10,13,14]. With respect to the indication

as well as the surgical method, the procedures prescribed in the current literature [1,

2, 3, 4, 5, 7, 8, 9] were strictly observed. The symptom-free interval of several

months in both cases described here was surprising, in particular because most

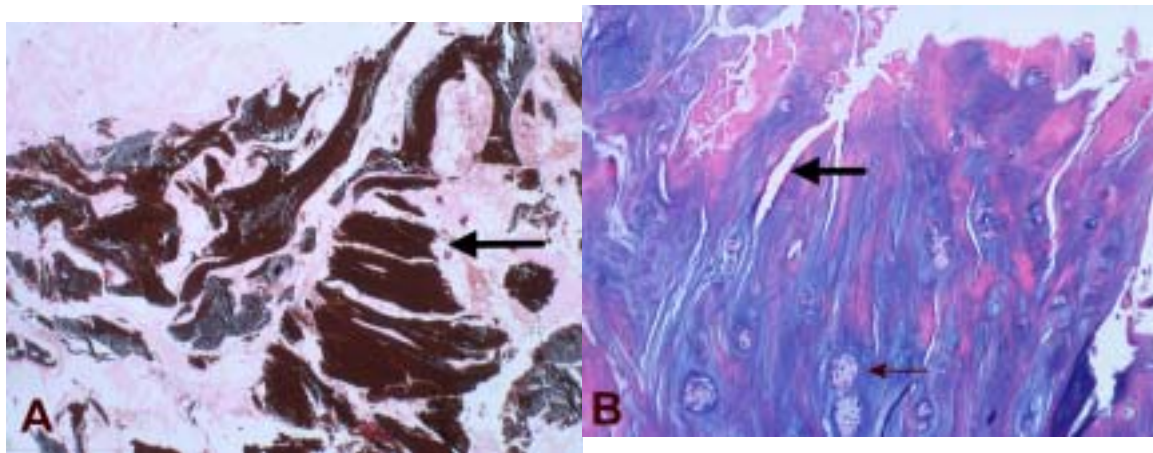authors report early complications [6, 13, 14].

Fig. 5: Bone mineralisation and histomorphological signs for disc degeneration

(A) Von Kossa staining shows large amounts of mineralised trabecular bone (big arrow).

(B) Advanced signs of disc degeneration reveal tear formation (big arrow), focal cell proliferation as chondrocytes clones (small arrow) and mucoid disc degeneration.

(A: von Kossa staining, B: Alcian blue-PAS staining; original magnification A: x 50; B: x 250).

In view of the known difficulties described in the literature with respect to the interpretation of potential osseous consolidation reactions in the affected segment of the vertebral column in the case of titanium cages, the PEEK cage was used as an alternative. The supplier maintains that with this cage variant one can better assess whether osseous fusion has taken place. The patients treated with these PEEK cages were comparable to the patient group treated with titanium cages with regard to symptoms, age structure and indications. The fact that loosening did not occur early in the cases described here but only after several months is not really surprising. Implants can loosen at any time. The course is surprising. The interpretation of the images by radiologists as well as the clinical and radiological assessment by the operating surgeons describes the course of a consolidated fusion

of the vertebral column; this being at the point of the implant rupture or implant migration. Following the assessment of leading surgeons [10] as to when fusion can be assumed to have taken place, the clinical and radiological course was documented. As there is no agreement on the importance of the isolated interpretation of CT, functional images in plain X-rays and clinical examinations [10], functional images as well as thin-layer CT images were made in the cases described. No more than 3° suggested motoric play in the flexion/extension images was seen in the two cases. The thin-layer CT in the sagittal levels suggested an osseous bridge between the PLIF cages in both cases, i.e. in titanium cages as well as in PEEK cages. The histological examination (see above) describes no stable bone in either case, neither in the cages nor in the ventrally and intermediately retrieved tissue material.

To summarize, we can state after evaluating these two cases that at present perhaps only surgical exploration with retrieval of tissue for histological examination when titanium cages and PEEK cages are used will show with certainty whether fusion has taken place or not. Another variant that would provide certainty about the quality of the ventral fusion is the isolated removal of the dorsal instruments.

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