



Facet Wedge® Fixation in Lumbar Spine Degenerative Pathology: A New Option for Minimally-Invasive Posterior Approach?

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Abstract

In recent years spinal surgery has undergone a drastic change of course, mainly due to the increasing use of minimally invasive and percutaneous techniques for the treatment of lumbar spine degenerative pathology. This has led to the development of techniques more effective (for the pathology) and less invasive (for the patient). Recently the technological progress focused on a very specific vertebral fusion technique: the facet joint fixation. This technique has already been described in past as available with the assistance of autologous bone chips into the facet joint; nowadays it has been brought up to date by the development and use of an implantable device that promotes the bone fusion of the joint complex: the Facet-Wedge®. The employment of this device seems to offer a minimally invasive choice to the standard posterior screws fixation techniques for the treatment of selected cases of lumbar degenerative pathologies. Obviously their application has to be evaluated on the basis of a careful preoperative radiological planning. Up to date there aren't in literature clinical trials about the effective of this device and this technique. The biomechanical meaning of this device, the possibility of implanting in percutaneous technique and in combined instrumentation with anterior cages or different posterior techniques, could reveal that this technique might be an effective and feasible alternative, which needs to be addressed in further studies.

Keywords: Facet wedge; Interarticular fusion; Facet syndrome; Recurrent disc herniation

Introduction

In recent years spinal surgery has undergone a drastic change of course, mainly due to the increasing use of minimally invasive percutaneous techniques for the treatment of lumbar spine degenerative pathology. This has led to the development of techniques more effective (for the pathology) and less invasive (for the patient). Obviously the practise of spinal degenerative surgery must be done in according with the well-known degenerative cascade described by Kirkaldy-Willis that must be implied for each vertebral surgeon who makes diagnosis and treatment. Recently the technological progress focused on a very specific vertebral fusion technique: the facet joint fixation. This technique has already been described in past as available with the assistance of autologous bone chips into the facet joint; nowadays it has been brought up to date by the development and use of an implantable device that promotes the bone fusion of the joint complex: the Facet-Wedge®.

Philosophy of facet joint fusion

The biomechanical principle of facet joint fusion's treatment is strictly related with the concept of the degenerative cascade, justified as the basis of the degenerative spinal pathology: the hypermobility of one vertebral segment produces all the biomechanical, pathological and physiological alterations, which lead up to discoarthrosis. For this reason the only way to stop the degenerative process is to stop the hypermobility. The basic concept of the facet joint fusion technique is that the segmental metameric movement, understood as real articulation between two vertebrae, occurs by the action of facet joints. Indeed these structures are the only presenting themselves as structures designate for the mobility, basing on their anatomical and physiological features (like knee or shoulder). In connection to this, the need to block the segmental hypermobility is strictly tied with blocking the movement of this joint. Traditionally the technique which effectively block the facet joint's articulation used for vertebral fusion is the pedicle screws fixation, stand-alone or in combination with interbody fusion [1,2]. In the past the technique used for facet joint fusion was been performed by cruentation of the cartilage surface of the facet joint and the insertion inside itself of autologous bone chips which theoretically

might promote the fusion. Actually the segment's movement capability prevents from bone engraftment and then often the arthrodesis failed. Nowadays technical progress has developed an implantable device which solves this problem. The so-called Facet-Wedge® is properly defined as facet joint fixation system.

Device features and surgical technique

The FACET WEDGE® system may be utilized for spinal fixation via facet joint fixation technique blocking facet joints, with or without bone implantation, at single or multiple levels, from L1 to S1. This system can be inserted as by standard "open" procedure as by percutaneous route, making this procedure very adaptable. The device insertion must requires a bilaterally implantation, prone position, the use of the image intensifier to reach correctly the articular complex in AP and LL projections and the use of radiolucent surgical table. Surgical technique involves the articular complex individuation, the articular rim exposure, the insertion of a tapping inside the rim to remove the cartilage and subsequently, after size measurements by appropriate instrumentations, the device insertion within bone chips. Afterwards the device has to be fixed by some screws, with an obliged divergent orientation, to the facet joints interested. Obviously in case of percutaneous route the device implantation is performed by means of the kirschner guide-wires. Implantation technique is relatively simple and, via percutaneous route, speed up very much the vertebral fixation procedure. Moreover it may be associated with interbody fusion techniques like PLIF, XLIF e ALIF, allowing the achievement of a circumferential fixation [3,4]

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Limits and indications

This technique is considered as the first application the degenerative discopathy and the degenerative facet joints arthropathy (facet joint syndrome). In my opinion it can be so useful for the recurrent disc herniation, when the need of segmental fusion is as important as to be low invasive respecting articular integrity. All the other degenerative circumstances which involve the need of a more bone-ligamentous decompression or articular removal (central or foraminal stenosis, spondylolisthesis, synovial cysts) clearly can't be treated by this route. Furthermore the radiological finding of a clear instability (dynamic x-rays) is a contraindication for the use of this system. For these reasons the surgical indications for the use of this device are strictly selected. There are also anatomical limits for the use of this device:

1. Iliac crest positioning: Fundamental element to analyze when the idea is to implant the device at L5-S1 level. Indeed if the facet joint orientation conflicts with the iliac crest, the device cannot be used because its insertion becomes impossible. This is rare and makes infrequent the use of the device at this level.

2. Articular rim's orientation: when the articular rim, especially at L5-S1 and L4-L5 level, isn't vertical in the axial plane, but oblique (frequently when there is a degeneration of facet joint and in the lower lumbar tract) live in a latero-medial, screws positioning, especially the ones on the lateral facet joint, might be difficult; this happens because the insertion route is oriented in an oblique divergent way and not adjustable during the positioning. Just in case that the articular rim lives oblique in latero-medial, lateral facet joint develops vertically respect to the axial plane, leaving a very little thickness of bone for the screw positioning. This can result in an uncorrect fixation system, with possible mobilization in the future.

In light of this, it is necessary a careful preoperative radiological planning that must be accomplished by morpho-dynamics L/S x-rays, L/S spine CT scan and MRI in order to keep out all the possible anatomical and pathological conditions that make the use of this technique contraindicated.

In terms of biomechanical evaluations some field studies [5,6] on the effectiveness of such a system have been performed, comparing the range of motion of a vertebral segment treated by Facet-Wedge® and the same segment treated by pedicle screws and rods [7-9]; the results are encouraging because of the inter-articular fusion seems to have the same biomechanical properties of strength of the pedicle screws and rods [9-11]. Obviously in the cases of a spondylolisthesis, the shearing forces acting on the vertebral segment become stronger and the system with screws and bars gives more guarantees of sealing [12-14].

Conclusions

The inter-articular fusion technique might be an effective and feasible minimally invasive alternative to the standard posterior pedicle screws and bars for the treatment of selected cases of lumbar degenerative pathologies [9,15,16]. Obviously their application has to be evaluated on the basis of a careful preoperative radiological planning. Up to date there aren't in literature clinical trials about the effective of this technique [17-19]. The biomechanical concept of this device, the possibility of implanting in percutaneous technique and in combined instrumentation with anterior cages or different posterior fusion techniques, could reveal that this technique might be an effective and feasible alternative which needs to be addressed in further studies.

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