Duello 1: Fusion is Better Than Dynamic Fixation

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This paper is a continuation of our ongoing discussion with Dr. Fahir Ozer on fusion or dynamic fixation for lumbar degenerative diseases. We discussed the issue in different forums and we now directed our discussions to this paper.

In a recent pubmed scan I found 128 hits for the word “lumbar dynamic stabilization”, 6892 hits for “lumbar fusion” and 6415 for “lumbar spinal fusion”. In general, those numbers may reflect how vast the knowledge on fusion is, in contrast to the small number of articles on dynamic stabilization.

What is fusion?

Spinal fusion has been recommended for lumbar degenerative instability for many years. Fusion has given satisfactory outcomes in selected patients, either by noninstrumented or by instrumented techniques.

Pros: Spinal fusion is still a “gold standard” in the surgical treatment of lumbar degenerative diseases. Its results are well known and evidenced in well-selected cases. It also has reliable long term results.

Cons: There is some criticism of spinal fusion. One point is the pseudoarthrosis and nonunion, of which the clinical importance is unknown. Another problem is adjacent segment degeneration. Its clinical impact is also not well known. Adjacent level degeneration has possibly been stressed unnecessarily, and has been overemphasized by industry.

What is dynamic stabilization?

There are many different dynamic stabilization devices. They may be classified as in Table 1.

An additional classification can be used for pedicle-based implants: (a) Ligament based systems. They are considered true dynamic stabilization. Examples are Graf, Dynesys, Fulcrum-Assisted Soft Stabilization = FASS. (b) Screw-rod based systems, considered semi-rigid stabilization. Examples are Isobar, Cosmic, AccuFlex, PEEK Rod, Stabilimax. Other than descriptions such as “ligament-based systems” and “rod-based systems”, there are also differentiations such as “dynamic from screw”, “dynamic from rod” etc.

Table 1: Types of dynamic stabilization devices.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Indication</th>
<th>Trade Mark</th>
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<tbody>
<tr>
<td>Interspinous distraction devices</td>
<td>Neurogenic claudication</td>
<td>Wallis, X-Stop, Diam, Coflex, ExtendSure, CoRoent, Loop system</td>
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<tr>
<td>Pedicle screw and rod based systems</td>
<td>Reduce loading to discs and facet joints</td>
<td>Graf ligament, Dynesys, AccuFlex Rod, Medtronic PEEK rod, Scient’X Isobar, Cosmic</td>
</tr>
<tr>
<td></td>
<td>Achieve fusion</td>
<td></td>
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<td></td>
<td>Prevent adjacent level disease</td>
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<tr>
<td>Total facet replacement systems</td>
<td>Replacement device for facet disease</td>
<td>TFAS (Total facet arthroplasty), TOPS (Total posterior motion preservation)</td>
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<tr>
<td></td>
<td>Reconstruction of a functional spine unit</td>
<td>Stabilimax NZ</td>
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As you see on the lists, dynamic fixation devices are a heterogenous group. Most are new implants with evolving technology and not much experience gathered. New systems are being added in every year. This condition, however, results in a lack of experience.

Critics against dynamic stabilizations

Some dynamic implants result in fusion, some not. Biomechanical laboratory tests are usually not sufficient. There are also some logical questions on their presumed effects such as: Why do they restrict the rotation instead of flexion-extension? How much do the hydroxyapatite-coated screws prevent metal fatigue? Do they really limit the adjacent level degeneration and what percent?

What the indications are and what best patient to use them in are also not clear. Is it just disc herniation, lysthesis, or iatrogenic instability after decompression?

What will those implants replace? Will they replace fusion?

Clinical results are not well known. There are no class I or II studies comparing dynamic fixation and fusion.

Dynamic stabilization should not be used instead of fusion because of these criticisms and for the following reasons:

1- There is a philosophical mistake: The natural cascade of degeneration is described by Kirkaldy Willis (3). First is the dysfunctional phase, where annular fissures develop inside the disc, the end plate separates and the vascular circulation of the annulus ameliorates. Second is the instability phase. Multiple annular lacerations develop and the disc height decreases. Third is the stabilization phase. The intervertebral disc resorbs, and the unstable segment starts to become more stable by end plate destruction, disc fibrosis and osteophytes. To summarize, the natural cascade is degeneration, instability, and at the end fusion or restabilization. Fusion surgery is adapted to this time scale. However, dynamic fixation is against it.

An implant for fusion only has to serve as a temporary stabilization until fusion has taken place; on the other hand, a dynamic stabilization system has to provide stability throughout its life. So implant failure is a great risk with dynamic implants.

A dynamic implant becomes a very expensive fusion technique if fusion develops in time. If it does not fuse at all, then this is a biomechanical disadvantage.

2- ”The loads at the instrumented segment are shared by a dynamic implant” axiom is not proven. In a finite element analysis comparing dynamic and rigid posterior fixations, Rohlmann et al (5) has found that “A dynamic implant does not necessarily reduce axial spinal loads compared to an un-instrumented spine”. Another study has also found the effect of two implants, dynesys and rigid fixator, on intradiscal pressure at corresponding disc levels to be the same (7).

3- The “They allow controlled movement” notion is not proven. A “controlled movement” is subjective. The optimum mobility of each patient may change according to age, structure of the body, and the amount of degeneration. On the other hand, restriction of movement of each implant is different. Also each construction (spine & implant) has a different mobility.

How the surgeon will know the optimum movement of a given patient, and what kind of an implant he will choose remain to be answered.

4- The “They decrease the degeneration at the adjacent segment” axiom is not proven. Dynesys has provided satisfactory stabilization in degenerative instability (6). However, the movement at the adjacent level is not different than a rigid fixation.

Although reliable results should be evaluated after 5-10 years, most dynamic systems have shorter follow-ups. Their results are also very variable.

5- Evidence regarding the benefits is lacking (2, 4): In a study by Rigby et al., the Graf ligament showed insufficient improvement at one year and revision rates were quite high at two years (4). Mid-and long term results (mean 4 years) are also not satisfactory.

After reviewing many pedicle-based fixation devices, Bono et al. (2009) (1) have concluded that “For the spine community to draw sound conclusions that a posterior dynamic device is better than fusion, results from multiple, similarly designed, independently funded trials must be compiled, compared, and contrasted.”

6- They are more expensive

What are the indications for stabilization?

Stepwise surgical therapies were advocated for lumbar instability: Decompressive surgeries, mobility preserving surgery, and as a last resort fusion surgery. However this
line is not so straightforward. The real indications may be as in Figure 1. There are some patients who need decompression only, while some others stabilization only. However, dynamic fixation may replace only a part of the spinal fusion cases.

CONCLUSIONS

Dynamic fixation is a new technological tool for spinal fixation that is recommended for lumbar degenerative diseases. Dynamic fixation instead of spinal fusion is not a logical technique for the philosophy of the degeneration process.

The types of dynamic implants are still evolving. We cannot follow all the changes and new systems introduced to the market. We will see in time whether newly introduced implants are better than the others. The scientific evidence for benefits is still very poor. Even the claims that dynamic fixation prevents adjacent level degeneration has not been proven. They are also more expensive than fusion implants. In conclusion, dynamic fixation seems to be a legend or just experimental surgery.

REFERENCES


COMMENT

Zileli, in his ‘duello grande’ commentary has nicely outlined the pros and cons of dynamic lumbar fixation.

From a mere theoretical perspective, dynamic fixators should improve stability by stiffening the spine. If back pain were due to instability, such a maneuver should stiffen the offending motion segment and relieve back pain. Grob and others have shown that such is not the case.

I suspect that such devices are applied inappropriately and in the wrong patients. This might explain their lack of documented clinical efficacy as a management strategy for back pain.

Zileli makes many good points. At the heart of this debate, however, is that the ‘gold standard’ of lumbar fusion is a high standard. It will be difficult to do better than this tried and true technique.

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