Comparative Study of Rigid Versus Dynamic Spine Stabilization for Degenerative Lumbar Spine disorders

Ganesh Natarajan*, Manish Desai*, Muralikuttan**

* Senior House Officer (Orthopaedics and Trauma)
**Consultant, (Orthopaedics and Trauma)
Calderdale Royal Hospital, Halifax, HX3 0LF, West Yorkshire, U.K

Address for Correspondence:
Mr Ganesh Natarajan, MBBS, MS (Ortho), MRCS
Senior House Officer (Orthopaedics and Trauma)
Calderdale Royal Hospital, Halifax, HX3 0LF
West Yorkshire. U.K.
Tel: 0044-1422301726
Fax: 0044-1422222296
E-mail: gansdr@yahoo.com

Abstract:

Design: Retrospective study
Objectives: Analyze short-term effects of Rigid (Group R) Versus Dynamic (Group D) instrumentation in terms of Subjective evaluation & Patient oriented outcome.

Materials and Methods: 50 patients (Male 17; female 33), 25 in each group. Evaluation based on pre & postoperative Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) at fixed interval at 6 weeks, 6 months, 1 and 2 years.

Results: Mean preoperative VAS for LBP (Group D) was 6.9, and decreased at 24 mont postoperative to 3.4 and for Group R was 7.6 to 3.7. Mean VAS for leg pain for Group D was from 6.2 to 2.1 at 24 months and for Group R 6.9 to 3.0. Mean ODI for Group D was from 54 to 37 and for Group R it was 56 to 39, suggesting less improvement in cases operated with rigid stabilization compared to Dynesys system. ODI for Group D, follows descending pattern as scores 43.0, 38, 32.5 and 29 , whereas for Group R was 27, 30, 35 and 39 at 6 wks, 6 months, 1 and 2 yrs, respectively. There is no age related difference in outcome in both systems. Disc prolapse patients improved significantly with Rigid system, while spine instability had better outcome with Dynesys.

Discussion: Rigid fixation, there is no consistent improvement in the ODI, up to 2 yrs follow up. rigid fixation system even after fusion the instrumentation is in place, which contributes to unfavorable outcome in relation to probably loss of lumbar lordosis, and progression degenerative process at adjacent levels contributing to less favorable clinical outcome.

Conclusion: Dynesys has better outcome in older age group patients, stenosis and listhes. Dynesys can be considered as an effective option to rigid stabilization systems.

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Study Design:

Retrospective comparative clinical study on a consecutive series of 25 patients in each group.

Keywords:
Dynesys - semi rigid spinal instrumentation system; Rigid fixation - pedicle screw and rod system with fusion; VAS- Visual Analogue Score; ODI- Oswestry Disability Index

Background Data:
Lumbar spine fusion with rigid instrumentation for degenerative spinal disorders seems to increase the fusion rate. However, rigid instrumentation may be associated with some undesirable effects such as increased low back pain following decrease of lumbar lordosis, fracture of the vertebra body and pedicle, pedicle screw loosening, and adjacent segment degeneration. The use of semi-rigid and dynamic devices has been advocated to reduce such adverse effects of the rigid instrumentation and thus to achieve a more physiologic bony fusion.

Dynesys is designed to preserve intersegmental kinematics and alleviate loading of facet joints by preserving articular function. In the course of degenerative processes, during which the segment undergoes various anatomic alterations, there are significant changes in both motion characteristics of, and the load distribution across the affected segments.

This new system for treating lumbar degenerative pathology based on lumbar stabilization preserves articular function as opposed to traditional arthrodesis restrictions.

The concept of spinal fusion originally arose from the notion that a degenerated motion segment often "unstable" or shows "Movement abnormalities," and that accordingly, the elimination of motion in the affected segment would prevent it from undertaking the movements associated with the generation of pain. Recent thinking, however, suggests that the preservation of movement say may not be the most important factor accounting for the success of fusion.

By preserving flexibility of a motion segment may allow greater physiological function.

Rigid fixation system for fusion only, has to serve temporary stabilization until fusion has take place while on the other hand, the soft stabilization system has to provide stability throughout life.

This study is to compare the postoperative effects of a rigid versus dynamic instrumentation for degenerative spine disease and stenosis and to investigate if a dynamic spine system can replace the commonly used rigid systems in order to avoid the above mentioned disadvantages of rigid fixation.

Objectives:

1) To analyze the short-term effects of Rigid Versus Dynamic instrumentation on lumbar spine surgery.

2) Subjective evaluation & Patient oriented outcome of the result.

3) To evaluate complications rate associated with both system.

Materials And Methods:

Patients: This study analyzes series of 50 adult patients (Male 17: female 33), 25 in Group (Rigid Fixation) and 25 patients in Group D (Dynesys System) operated at District General Hospital by same Surgeon Using Rigid and Dynesys System.

Clinical evaluation for both groups was based on pre & post-operative Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) at fixed intervals at 6 weeks, 6 months, 1 and 2 years. Mean age of the study Group R was 49 yrs (range 23-74 yrs) and 52 yrs (range 24 - 70 yrs) for group We analyzed the outcome of both Systems in different indications like Lumbar Stenosis, Di Prolapse, and Spondylolisthesis and with Degenerative Disc Disease.

In-group D, 6 patients and group R 1 patient had pedicle screw fixation of more than two levels. patients were investigated with pre & postoperative standard X-ray and MRI of Lumbar spine.

Preoperative evaluation: Preoperative evaluation included patient history, imaging, and clinical
and neurological evaluation by the treating surgeon.

**Surgery:** Both the systems consist of pedicle screws made of Ti-Al-Nb forge alloy. The screws are connected with a polyethylene terephthalate cord (Dynesys) / Ti-Al-Nb Rods. Tethering the screws and selecting the appropriate length of the spacer/rod between the screws may apply segmental distraction or compression.

The procedure was performed in prone position. A midline approach, with dissection of the erector spinae muscles, provided access to the bony anatomy of the lumbar spine. If indicated, decompression of the spinal canal was performed first. Insertion of the pedicle screws was carried out under radiologic control using a C-arm. The polycarbonate urethane spacer was cut according to the measure distance between the screws, with the length being chosen to compensate a existing lordosis or kyphosis. The central cord and the spacer were then locked within the screw heads. No postoperative brace was given, and patients were mobilized if safe to do.

**Radiologic and Clinical follow-up:** The first post op x rays were examined and any technical error, or other complications were documented.

**Results:**

All patients were evaluated up to 24 months after surgery. The results were analyzed based of the clinical Scores of VAS & ODI system and also study of complications by analyzing the X ray and MRI as indicated.

Regarding VAS scoring system we considered VAS for Low Back Pain (LBP) and Leg Pain separately for surgical outcome analysis.

![VAS SCORE - LBP FOR DYNEYSYS](image)

The mean preoperative scores of Visual Analogue Scale for low back Pain for (Group D) was 6, and decreased after surgery at end of 24 months follow up to 3.4 and for Group R same was 7 and post op score was improved to 3.7.

![VAS SCORE - LBP FOR RIGID FIXATION](image)

Similarly mean scores of Visual Analogue Scale for Leg pain for (Group D) was decreased from pre op 6.2 to 2.1 at end of 24 months follow up., and same was improved from 6.9 to 3.0 for Group R.

The final results of ODI scoring for group D were 29 at end of 24 months post operative follow up with respect to 54 score, prior to treatment and for group R it was 39 at post op follow up from pre operative score of 56, suggesting less improvement in cases operated with rigid stabilization compare to Dynesys system.

The improvement pattern for ODI score for Group D was observed at different interval, which follows a descending pattern as 43.0, 38, 32.5 and 29 at 6 wks, 6 months, 1 yr, and 2 yr respectively that represents an improvement of 20%, 29%, 40% and 46%.
The improvement pattern for ODI score for Group R was observed at different interval, which follows a different pattern from group D as 27.0, 30.5, 35, and 39 at 6 wks, 6 months, 1 yr, and yrs, respectively that represents an improvement of 51%, 46%, 37%, and 30%.

In patients operated for more than two segments of Dynesys fixation the ODI score was 52, and preop and post op respectively, which suggests less improvement in clinical outcome when compared with entire study group.

In this study we compared clinical outcome in age group more than 50 yrs, (Group A), with those the age group less than 50 yrs (Group B).

In Group A (Dynesys) mean ODI score was 50 and 25, pre and post operative respectively, which suggests >50% improvement in clinical outcome.

In Group A (Rigid) mean ODI score was 52 and 39, pre and post operative respectively, which suggests >25% improvement in clinical outcome.

Group B (Dynesys) mean ODI Score was 62, and 34, pre and post operative respectively.

Group B (Rigid) mean ODI Score was 60, and 39, pre and post operative respectively.

This suggests there is no age related difference in final clinical outcome in relation to both fixation systems.
When analyzing the final outcome for Dynesys in relation to different surgical indications, it was observed that more than 50% improvement in the ODI score, from 49 to 21, pre and postoperative respectively in lumbar instability especially spondylolisthesis and Lumbar canal Stenosis (post laminectomy).

**INDICATIONS FOR DYNESYS**


Final Outcome for rigid fixation in relation to different surgical indications was observed with different pattern, Disc prolapse ODI improved from 76 to 25, for Stenosis from 46 to 37, and in Listhesis it changed from 50 to 37.

**INDICATIONS FOR RIGID FIXATION**


**Complications:**

With regard to complications, we would like to point out total 10 (20%) cases, 3 superficial infections, 1 seroma, and 4 cases due to technical error and 2 cases had nerve root irritation.

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<tr>
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<th>Rigid fixation</th>
<th>Dynesys</th>
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<tr>
<td>Infection</td>
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<td>3</td>
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<tr>
<td>Nerve irritation</td>
<td>2</td>
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<td>Technical error</td>
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Discussion:

This study shows that Rigid instrumentation applied over a short area for Disc Prolapse pathology of lumbar spine has significant clinical improvement by 70% of both self-assessment and pain score. But in case of Dynesys instrumentation applied for indications including Stenosis and Listhesis of lumbar spine has significant clinical improvement by >50% of both self-assessment and pain score.

From this study we infer that VAS system for back pain and leg pain shows significant improvement in final assessment score at 2 yrs follow up, using Dynesys system, as a method of dynamic fixation except in some patients, in whom results are not up to expectation because of associated post operative complication like infection and screw malposition. Though our study did not show any more complications related to this system itself.

As Dynesys is not a rigid method of fixation and fusion, it has been observed that, there is gradual improvement of symptoms and score over a period of two years follow up as per the graph.

It has been observed that in using Rigid fixation, there is no consistent improvement in the ODI score, up to 2 yrs follow up. Though initial period of first 6 wks follow up shows significant improvement in ODI score, but subsequent follow up scoring shows increase in symptoms a unfavorable over all long term outcome.

Rigid fixation system is for fusion only, has to serve temporary stabilization until fusion has taken place19 while in rigid fixation system even after fusion the instrumentation is in place which contributes to unfavorable outcome in relation to probably loss of lumbar lordosis, and progression of degenerative process at adjacent levels6.
The dynamic neutralization obtained using this system, should not be considered as an arthrodesis but this device has been advocated to achieve more physiological bony fusion. With this system bone grafting is necessary therefore donor site morbidity can be avoided. Dynesys system maintains enough stability to prevent further progression of spondylolisthesis (instability).

Even some literature supports that dynesys system has limitations in elderly age group with osteoporotic bone with severe segmental macro-instability, from our results we imply that, in old age group Dynesys has better clinical outcome compare to Rigid fixation.

Conclusion:

This study supports the belief that the dynamic system can be used with the same indications with the rigid in degenerative lumbar spine because it can offer equally good short-term results regarding clinical outcome of surgery, while it has been previously mentioned as per our study Dynesys has better outcome in older age group patients, and specific indications like Stenosis and Spondylolisthesis.

Dynesys can be considered as an effective option to rigid stabilization systems, in terms of patient based clinical outcome, and avoidance of complications of rigid system like, screw loosening fractures of vertebral body, back pain because of loss of lumbar lordosis , morbidity related to bone grafting.

Because of similar clinical and radiological data and no significant rate of complications related either implant, in both groups and the relative small number of patients included in each group, is difficult for authors to make any definitive recommendation in favor of any instrumentation.

It is very essential to have prospective randomized controlled trial to support practice of evidence based medicine.

Reference:


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