SASJournal

Is Degenerative Spondylolisthesis a Contraindication for Total Disc Replacement? Kineflex Lumbar Disc Replacement in 7 Patients With 24-Month Follow-up

Ulrich R. Hähnle, MD, FCS (Ortho),[a,b] Karen Sliwa MD, PhD,[a] Malan de Villiers, PhD,[c] Ian R. Weinberg, MD, FCS (Neuro),[b] Barry M.B.E. Sweet, MD, PhD,[a] and Geoffrey P. Candy, PhD [a]

ABSTRACT

Background
Degenerative spondylolisthesis is associated with a significant segmental kyphosis at the level of the listhesis. We treated 7 disc spaces with Grade 2 listhesis and/or kyphosis of the slipped disc level with Kineflex disc replacement.

Methods
Out of a single-center prospective registry, involving 310 lumbar disc replacement patients, 7 patients underwent a single-level Kineflex disc replacement at the level of a degenerative spondylolisthesis with either segmental kyphosis or a Grade 2 slip.

Preoperative and follow-up radiological parameters studied were: pelvic incidence, pelvic tilt, sacral slope, lumbar lordosis L1-S1, degree of segmental listhesis, segmental lordosis, and range of motion (ROM). Clinical outcome measures were Visual Analog Scale pain score (VAS), Oswestry Disability Index (ODI), and patient satisfaction.

Results
Five replacements were performed at the L4-L5 level, and 2 were performed at a L3-4 level, above a pre-existing L4-S1 posterolateral fusion. Mean age was 50 (32–62) years. Average follow-up was 23.8 ± 13.1 months. Six of 7 patients considered their outcome as good or excellent. The mean VAS score decreased from 8.4 ± 1.9 to 2.7 ± 2.2 ($P < .01$). The ODI decreased from 45.2 ± 9.9 preoperatively to 19.7 ± 12.8 ($P < .01$).

There were increases in lumbar lordosis (from 47.4o ± 10.6 to 61.3o ± 8.0 ($P < .03$)), in segmental lordosis (from 0.17° ± 7.0° to 16.4° ± 2.0° ($P < .03$)), and in sacral slope (from 34.5° ± 4.8° to 40.7° ± 4.5° ($P < .03$)). There were decreases in pelvic tilt (from 22.6° ± 6.3° to 15.5° ± 5.9° ($P < .05$)), and degree of segmental listhesis (from 24.4% ± 7.7 to 3.7% ± 3.4 ($P < .03$)). Pelvic incidence and ROM did not change.

Conclusions
Disc replacement resulted in significant improvement in clinical outcome and excellent sagittal balance and slip correction. However, the influence of improved sagittal spinal alignment on clinical outcomes needs to be investigated in larger studies including a control group.

Clinical Relevance
This study is the first focused on disc replacement in degenerative spondylolisthesis.

Key Words: Spondylolisthesis, total disc replacement, radiological outcome, clinical outcome. ***SAS Journal.*** **Spring 2008;2:92–100.** DOI: SASJ-2007-0125-NT

[a]University of the Witwatersrand, Johannesburg, South Africa; [b]Linkfield Park Clinic, Johannesburg, South Africa; [c]University of Potchefstroom, South Africa

Address correspondence to Ulrich R. Hähnle, University of the Witwatersrand, PO-Box 52040, Saxonwold 2132, Johannesburg, South Africa (e-mail: hahnleu@mdh-africa.org)

Ulrich R. Hähnle, Ian R. Weinberg, and Malan de Villiers are co-developers of the Kineflex Disc Prosthesis and shareholders in Spinal Motion (Mountainview, California)

Institutional Review Board approval was obtained from the University of the Witwatersrand Ethics Committee.

INTRODUCTION

Degenerative spondylolisthesis (DSPL) is a condition where degenerative changes in disc and facet joint complex lead to vertebral displacement, resulting in spinal stenosis, recess stenosis, and segmental kyphosis.[1] Reports are mostly retrospective, and randomized studies have only compared surgical treatment consisting of posterolateral fusion with or without instrumentation and with posterior decompression alone.[2]

The influence of sagittal alignment on the generation of lower back pain (LBP) and degeneration of the lower back is not well understood. Despite existing suspicion that pre-existing differences in sagittal alignment may influence the occurrence of LBP and that outcome of fusion surgery may be dependent on restoration of lumbar lordosis during surgery,[3] only recently a classification system to measure and classify sagittal alignment has been published.[4] It has been applied to pathological conditions of the lumbar spine such as DSPL.[5]

Anterior lumbar interbody fusion (ALIF) surgery reliably corrects sagittal imbalance and listhetic slip in significant segmental kyphosis associated with DSPL.[1,6,7] Anterior column support was recommended by Sengupta and Herkowitz for patients with Grade 2 spondylolisthesis or higher or when kyphosis was present.[8]

Dynamic posterior motion preservation in DSPL renders significant clinical improvement despite minimal sagittal alignment changes[2,9-12] and despite increase in facet arthrosis.[11]

Despite the potential positive effect on spinal alignment and degree of spondylolisthesis, significant DSPL is considered a contraindication for total disc replacement (TDR). Complications from inadvertently instrumented spondylolytic disc spaces have been presented, but objective confirmation of the outcome of TDR in DSPL is missing.

The Kineflex disc prosthesis (Spinal Motion; Mountainview, California) is a chrome-cobalt-molybdenum (BioDur CCM Plus; Carpenter Technology Corp., Wyomissing, Pennsylvania), unconstrained but recentering disc prosthesis with a variable center of rotation. The mechanism comprises 2 metal endplates articulating over a sliding core, which is positioned between the endplates. It allows 12° of movement into flexion, extension, and left- and right-sided bending. The inferior endplate has a retaining ring that limits the excursion in the inferior articulation to 2 mm in all directions and prevents dislodgement of the sliding core. The mechanism therefore only allows 4 mm of translation before distraction of the disc space; a recentering force is produced that counteracts the translation. The disc is inserted as a single unit with a freely mobile mechanism during the final insertion process to facilitate placement posteriorly within the disc space. The objective in the development of this prosthesis was to facilitate reliable midline and posterior placement of the implant within the disc space in severely degenerative disc spaces, through a minimally invasive approach.[13]

The insertion technique of this disc prosthesis is unique. After the initial engagement into the disc space of the fully assembled 3-component prosthesis, the insertion tools allow independent advancement of the superior and inferior prosthetic endplates. During this process the advancing endplate pivots over the sliding core, taking pressure off the leading prosthetic endplate/bone interphase.[13] We therefore postulated that, through independent advancement of the inferior endplate, this particular disc prosthesis should be able to assist spondylolisthesis reduction during the insertion process.

We are reporting on the operative reduction technique in DSPL and on the outcome of 7 patients with either a Grade 2 spondylolisthesis and/or kyphosis of the slipped disc level and who were treated with Kineflex disc replacement.

MATERIAL AND METHODS

Out of a single-center prospective registry involving 310 lumbar disc replacement patients, 7 patients were retrieved from our databank of patients who had undergone a single-level Kineflex disc replacement at the level of a degenerative spondylolisthesis with either segmental kyphosis or a Grade 2 slip.

Operative Technique

The operations were performed through a left-sided retroperitoneal approach, followed by the creation of a wide exposure of the disc space. After a midline anuloplasty, a complete nucleotomy was performed, and the inner, desiccated layers of the annulus were removed. The disc space was mobilized, and the bony endplates were prepared. The correct-sized prosthesis was selected. As hypermobility was an anticipated complication, the disc height selected was one size larger than we would have chosen in a standard disc replacement. After initial engagement of the prosthesis, the mechanism of the prosthesis was released, and the endplates were advanced until almost flush with the posterior wall of the inferior vertebral endplate of the cephalad vertebra. Thereafter, the inferior prosthetic endplate was further advanced until almost full spondylolisthesis reduction was achieved. Additional screw fixation of the inferior endplate was performed, whenever further primary fixation was thought to be necessary, in order to absorb excessive forces through the inferior prosthetic endplate/bone interphase (Figure 1).

Radiographic Evaluation

All patients had a preoperative magnetic resonance image (MRI) or lumbar myelography followed by computer tomography (CT), or both.

Preoperatively and postoperatively at 3 months, 6 months, and yearly, anteroposterior (AP), lateral standing radiographs that included the bottom endplate of the T12 vertebra and the