Instrumented Posterolateral Spinal Arthrodesis as an Effective Treatment for Single Level Symptomatic Vacuum Lumbar Disc Degeneration in Elderly Patients

Waeel Hamouda, MD.
Neurosurgery Department, Cairo University Medical School and Teaching Hospitals, Egypt.

Abstract

Background Data: Lumbar intervertebral disc vacuum phenomenon is an advanced form of spinal destabilizing degenerative changes. It is common in the elderly population and can cause refractory low back pain.

Purpose: To evaluate the efficacy and safety of instrumented posterolateral fusion in treating symptomatic lumbar single level vacuum phenomenon in elderly population.

Study Design: Retrospective descriptive clinical case series.

Patients and Methods: Twenty-one patients (16 males & 5 females), aging more than 65 years, had all their files reviewed. They were operated by instrumented posterolateral fusion to treat chronic refractory low back pain due to single level intervertebral lumbar disc vacuum phenomenon. They underwent operation after failure of adequate 6 months conservative management. Age, gender, symptoms duration, spinal level affected, surgery duration, length of hospital stay, intra or post-operative complications, visual analogue scale VAS for pain, and Lenke’s graft fusion classification at 1, 3 & 6 months postoperatively were all recorded.

Results: The results of this study showed the most affected level was L4/L5, mean age was 73±7 years, mean symptoms duration was 11 years, mean surgery duration was 137±29 minutes, and mean VAS for preoperative-postoperative pain improvement was 5.9±1.2. Good fusion (Lenke’s grades A & B) was reported in 81% of patients. No major intra or postoperative complications.

Conclusion: Instrumented posterolateral fusion in elderly population patients with mono-segmental advanced disc degeneration may yield clinical outcome with low operative risk. (2017ESJ150)

Keywords: posterolateral; arthrodesis; lumbar spine; vacuum phenomenon; elderly

Introduction

“The intervertebral vacuum phenomenon” a term first described by Magnusson in 1937, refers to a radiographic finding of gas within the intervertebral disk. It is usually correlated with advanced intervertebral disc degeneration,19 leading to instability of the affected vertebreal motion segment that usually results in chronic persistent back pains. It is most commonly encountered in lumbar spine of elderly patients.12

For patients where conservative treatments fail to control their low back pains, the affected vertebral
motion segment fusion is mandated. Surgical options include posterolateral intertransverse (PLF) or posterior lumbar interbody fusion (PLIF) approaches\(^8\).\(^1\). Although PLIF has sound biomechanical advantages,\(^29\) it is associated -if compared with the posterolateral intertransverse fusion- with relatively longer operating times and more intraoperative bleeding,\(^27\) risks which should be taken in consideration while planning surgical intervention in the vulnerable elderly patients. The PLF fusion rates improved with the help of pedicle-screw instrumentation to reach 75% fusion rate, and the clinical outcome to 80% good to excellent clinical outcome.\(^4\).\(^11\)

The purpose of this study was to report the clinical and radiological outcomes of PLF in elderly patients with low back pain due to monosegmental lumbar intervertebral disc vacuum phenomenon.

## Patients and Methods

Retrospectively, our hospital’s medical records of patients aging above 65 years, who were operated upon during the period from July 2010 till December 2015 were reviewed. We enrolled those patients who had single level lumbar posterolateral fusion augmented by transpedicular screw fixation. This approach was used as a surgical management for chronic progressive refractory low back pain, secondary to advanced degenerative intervertebral disc disease, associated with vacuum phenomenon (gas detected within the intervertebral disc space in X-rays or computed topography CT). Patients with degenerative spondylolisthesis as evident in dynamic lumbosacral spine X-ray studies, degenerative scoliosis, previous lumbar spine surgeries, those presenting mainly with sciatica or neurogenic claudication, or those who failed to comply to regular follow up visits for the first six months postoperatively were not included. All included patients should have tried conservative non-surgical managements for at least a period of 6 months without satisfactory relieve of their pain prior to considering surgery. These non-surgical managements included medications, physiotherapy and ergonomic exercises, weight reduction program if mandated, as well as trials of local spine injections. Records were analysed for age, gender, duration of symptoms, associated other less manifesting pains of spinal origin, spinal level affected, duration of surgery, length of postoperative hospital stay, and intra or postoperative complications if any.

Surgical technique involved standard transpedicular screw fixation with rods, along with intertransverse posterolateral fusion using demineralized allografts (MTF™ Company) after decortication of the posterolateral surfaces of the relevant transverse processes and pars interarticularis. (Figure 1) Neural decompression to resolve associated radiculopathy when mandated was done via either laminotomy, laminectomy, discectomy or osteophytiectomy. Patients in the series who were suffering from associated femoralgia and sciatica, had undergone interlaminar fenestration with the involved nerve root decompression and patients with neurogenic claudication undergone laminectomy.

Recorded Visual Analogue Scale (VAS) was used to assess low back pain one day preoperatively, as well as at one, three and six months postoperatively. Lumbar spine standing anteroposterior and lateral view radiographs at the three and six months follow-up visits were used to determine the bone graft fusion state using the Lenke’s\(^25\) classification based on the size, discontinuity, and resorption of the fusion mass created between the upper and lower transverse processes, where grades A and B are defined as the union state, and grades C and D are defined as the non-union state.

Data were analysed using the SPSS version 13.0 statistical software package (SPSS Inc., Chicago, IL, USA). The continuous variables are presented as mean ± standard deviation.

## Results

Twenty-one patients were identified. Sixteen were males and five were females. Mean age was 73±7 (Range, 65-86) years. Average duration of symptoms was 11 years. Main presenting pain was chronic low back pain which manifests more at waking up in the morning, after prolonged standing or walking for few meters. Three patients suffered from symptoms other than low back pain including; one femoralgia, one sciatica, and one neurogenic claudication. All three patients reported -during history recording-
that although theses pains were initially the leading complains but later became less prominent with progression of their significant low back pain and eventually limitation of ambulation.

Most lumbar spinal levels affected was L4/5 (10 patients), L5/S1 (6 patients), L3/4 (4 patients) and L1/2 (1 patient). Mean duration of surgery was 137±29 (Range,102-185) minutes, and mean postoperative stay was 4±2 (Range, 2-7) days. One patient needed intraoperative blood transfusion as he was maintained perioperatively on Clopidogrel for recent coronary stenting, and another patient had a dural tear during performing discectomy, which was sutured and sealed primarily with no postoperative sequelae.

The mean preoperative VAS for back pain was 7.8±0.8, at 3 months postoperatively was 3.6±0.5, and at the six months’ final follow-up it improved to 1.9±0.6. Radiologic fusion (Lenke’s grades A & B) was observed in 17 patients by the 6th month postoperatively (81%), incomplete fusion (Lenke’s grades C & D) was noted in two male and two female patients with no implication on VAS pain improvement. Results are summarized and presented in Table 1.

Table 1. Data Summary of 21 Patients Reported in this Study.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Gender</th>
<th>Age/ years</th>
<th>Duration of Symptoms/ years</th>
<th>Spinal level affected</th>
<th>Associated symptoms other than back pain</th>
<th>Operative Time/ minutes</th>
<th>Operative events</th>
<th>Hospital stay/ days</th>
<th>3 months postoperative VAS</th>
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<th>Lenke’s fusion grade 6 months postoperative</th>
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(M: male, F: female, VAS: visual analogue scale)
“The intervertebral vacuum phenomenon” as described, refers to visualizing gas within the intervertebral disk space on radiographic images. Its presence correlates with end stage intervertebral disc degeneration, where disc dehydration and shrinkage leads to clefts formation within the nucleus pulposus, which accumulate gas from the surrounding tissues. Because of the lack of material inside the vacuum disc, it doesn’t contribute to the support of the involved motion segment. It has also demonstrated a close relationship with pathological sagittal translation. Both these factors are important signs of vertebral motion segment instability that results in prominent back pain.

Vacuum phenomenon is a common finding especially in the lumbar spine. Although it is observed in about 1–3% of all lumbar radiographs, about 50% of the patients with this condition are older than 40 years of age. With further age advancement it becomes much more common and reaches a much higher prevalence of almost 25% in the elderly. So it is not uncommon to see vacuum discs in x-rays of elderly patients seen in clinics complaining of longstanding significant low back pain. In this study the mean age of the included patients was 73 years.

For patients where non-surgical treatments failed to alleviate their persistent low back pains, fusion of the affected motion segment is recommended. Surgical approaches may include those that employs interbody fusion (e.g. anterior lumbar interbody fusion ALIF, posterior lumbar interbody fusion PLIF, and transforaminal lumbar interbody fusion TLIF) and those that don’t (posterolateral “intertransverse” fusion PLF), or a combination of both, with all approaches usually accompanied by transpedicular screw instrumented fixation to enhance fusion rates.

Theoretically, the degenerated vacuum disc would continue to move persistently if an interbody fusion was not performed, resulting in a less favourable surgical outcome. posterior lumbar interbody fusion techniques is expected to achieve better clinical results than posterolateral fusion (PLF) as it support the anterior column, regain disc height, correct sagittal alignment, and can maintain lordosis. PLIF also presumed to have better bone graft fusion after debridement of the degenerated lumbar disc endplates.

However, interbody fusion approaches involve more neural tissues manipulation and retraction (e.g. PLIF & TLIF), higher risk for dural tears, more postoperative tissue scarring, requires a longer...
operating time, and can be associated with greater blood loss.\textsuperscript{2,10,27} The latter two drawbacks can be of utmost importance when planning to operate on and elderly patient. Although some surgeon have advocated minimally invasive interbody fusion techniques to overcome these drawbacks,\textsuperscript{3} there are concerns that even if utilized, these minimally invasive techniques might escalate the risk of nerve roots injury\textsuperscript{9} with seemingly no -at least- obvious added benefits in other studies.\textsuperscript{13}

In this study, the most commonly affected spinal levels were L4/5 followed by L5/S1, similar to incidence reported by Deukmedjian et al.,\textsuperscript{6} and D’Anastasi et al.,\textsuperscript{5} but opposite to Ki-Chan et al.,\textsuperscript{2} where incidence of L5/S1 affection level was higher. The Mean duration of the instrumented PLF surgeries was 137±29 minutes, shorter than reported in other instrumented PLF series, as reported by An et al.,\textsuperscript{3} in their series of 46 patients where mean operative time was 163±42, and significantly shorter than time reported for single level open TLIF or PLIF surgeries in other studies\textsuperscript{7,28} with mean operative time 237 and 198 minutes respectively.

Adequate radiologic bone fusion (Lenke’s A & B) was observed in 81 % of the patients after six months. Similar percentages were mentioned in meta-analysis studies conducted by Jacobs et al.,\textsuperscript{16} and Kwon et al.,\textsuperscript{22} for instrumentation-augmented PLF, where good clinical outcome was documented with this rate of PLF fusion. Although lumbar interbody fusion techniques might yields higher fusion rates, still the clinical outcome with PLF is not compromised.\textsuperscript{2,21,32}

In the studied patients, the reduction of the mean VAS for back pain after six months postoperatively was 5.9±0.2. This is comparable to similar improvement in other instrumented PLF or PLIF/TLIF/ALIF series,\textsuperscript{3,2,4,32} with mean VAS reduction of 4.8±1.2, 5.2±1.1, 3.6±0.9, and 4.4±1.2 respectively.

The study excluded patients with degenerative spondylolisthesis and similarly scoliosis, as these patients usually harbour other instability-related degenerative changes other than those solely attributed to the intervertebral discs, i.e. increases ligamentous laxity and chronic facet joint arthropathy. So, results and recommendations driven from this study shouldn’t be reproduced with confidence to these groups of patients.

The study has some limitations; it was retrospective and had a narrow spectrum of inclusion criteria, which might lead to selection bias. The number of patients reviewed was relatively small, and some of the operated patients missed few or all of the follow-up visits. Also, patient characteristics like smoking, disease, and bone mineral density were not investigated.

### Conclusion

Instrumented posterolateral fusion in elderly population patients with mono-segmental advanced disc degeneration may yield clinical outcome with low operative risk.

### References


الملخص العربي
الاتحاد الفقري الخلفي الجانبي باستخدام البراغي كعاج فعّال لأعراض التدهور الفارغ للقرص القطني أحادي المستوى لدى المرضى المسنين

البيانات الخلفية: ظاهرة القرص القطني الفارغ هيئته متقدمة للتغيرات الفقرية المتدهورة غير مثبتة بالمصرين المتسببة

الغرض: دراسة فاعلية وسلامة الاتحاد الفقري الخلفي الجانبي بمساندة الآلات لأعراض التدهور الفارغ للقرص القطني أحادي المستوى

تصميم الدراسة: دراسة أثر رجعي

المريض والطريق: 21 مريض (16 ذكر و5 إناث) بعمر أكبر من 65 سنة أجرىوا جراحة للإلتثام الفقري الخلفي الجانبي بمساندة الآلات كعلاج للألم وأفضل الظهر المزمنة العنيفة نتيجة التدهور الفارغ للقرص القطني اللذين فشل علاجهم بدون جراحة لمدة 6 أشهر، تم مراجعة ملفاتهم، تم تسجيل السن، الجنس، مدة الأعراض، المستوى الفقري المتأثر، مدة الجراحة، مدة الإبقاء بالمستشفى، المضاعفات أثناء أو بعد الجراحة، مقياس الألم البصري، و تصنيف Lenke’s للاختلافات عند 1و0 و6 أشهر بعد الجراحة.

النتائج: متوسط العمر 73±7 سنوات ومدة الأعراض 11 سنة. مدة الجراحة 137±2 دقيقة، و مقياس الألم 5.9±1.

المستوى الأكثر تأثراً 81% . النتائج جيدة لاتزال مرضي بعد الجراحة.

الاستنتاج: الإلتثام الفقري الخلفي الجانبي بمساندة البراغي كعاج فعّال لأعراض التدهور الفارغ للقرص القطني، بقيت مرضية بعد 6 أشهر، وتقدمت في الانتشار والعلاج الفعّال.

Waeel Hamouda, MD.
Neurosurgery Department, Cairo University Medical School and Teaching Hospitals, Egypt - Email: wohamouda@outlook.com

المصدر: Egy Spine J - Volume 25 - January 2018