Clinical Article

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Instrumented Posterior Lumbar intervertebral bone cement Interposition: indications and results

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Abstract

Background data: The presence of osteoporosis renders the PLIF not ideal for the treatment of lumbar instability and lumbar canal stenosis. Decortication of the bony end plates weakens the weight bearing functions of the vertebrae. Avoiding decortications of the bony end plates and using bone cement to fill the intervertebral space would theoretically overcome these mechanical disadvantages.

Purpose of our study was to evaluate the results of instrumented intervertebral bone cement interposition in osteoporotic patients presented with lumbar instability and/or lumbar canal stenosis.

Study Design: Prospective study.

Material and Methods: 30 consecutive patients with a mean age of 70.3 years were operated upon using this technique. The study included 39 lumbar segments. Selective posterior decompression was done according to the extent and severity of the stenosis. The disc was removed together with the cartilaginous end plates without traumatizing the bony end plates. The disc space was filled with bone cement. The construct was augmented with transpedicular screw rod fixation of the affected segment(s). The mean follow up period was 32.07 months. The Visual Analogue Scale (VAS) for back and leg pain together with Oxford Claudication Score (OCS) were used to assess the patients pre- and post-operatively.

Results: No neurological complications were encountered. The mean operative time was 84.67 minutes and the mean blood loss was 390 ml. The VAS for back and leg pain improved from 7.1 and 3 preoperatively to 1.6 and 0.4 at the end of follow up respectively. OCS also improved from (30.3) preoperatively to (15.8) at the end of follow up.

Conclusion: Bone cement interposition after discectomy when combined with transpedicular fixation is a reasonable treatment option for elderly patients suffering from lumbar instability and/or stenosis. (2014ESJ072)

Key Words: Lumbar fusion, Bone cement, Osteoporosis and Instability.

Introduction

Since its introduction by Cloward,[6] the posterior lumbar interbody fusion (PLIF) has undergone several modifications until it reached the standard technique of posterior transpedicular instrumentation, posterior decompression, discectomy and intersomatic fusion using bone graft and cages.[3,4,7,14,16] The PLIF technique has shown higher fusion rates and better results than the posterolateral fusion particularly when discectomy is needed.[9,18] The advantages of intersomatic fusion include: elimination of potential instability, correction of disturbed sagittal and coronal profiles, preservation of the disc height, thereby reducing potential compromise of the neural foramina and lastly long lasting anterior support.[6,7,13-16]

Several studies have shown that not every pseudarthrosis is symptomatic particularly when intersomatic cages are used.[10,14,18] This is explained by the mechanical properties of the cages in maintaining the intervertebral height and providing anterior support. This means that achieving a stable construct whether through the bony fusion or through any other alternative is really what is needed to eliminate the painful instability. In other words, if any hardware or bone substitute succeeds to achieve this target, the clinical results will theoretically be comparable to that with fusion. A good example for this principle in orthopedic practice is the cemented joint replacement. Bone cement has a mechanical property which no other bone substitute can provide, namely the immediate stability. In the field of the spine surgery, bone cement has proved its benefits in the augmentation of osteoporotic fractures and replacement of the destroyed vertebrae.[2,8,12] To our best knowledge there is no previous reports in the available literature on the use of the bone cement in replacing the intervertebral disc except in the cervical spine.[1,11]

There a group of complications that may be associated with the use of bone cement including hypotension, dural tear, pulmonary cement embolism, adult respiratory distress syndrome, cerebral cement embolism, root compression due to intraforaminal cement leakage, paraplegia due to spinal cord and cauda equina compression, intravascular extension of cement, infection, and cement toxicity.[5]

The aim of this work is to introduce the bone cement in providing immediate intervertebral stability and maintaining the intervertebral height in elderly patients with lumbar instability and/or stenosis.

Material and Methods

A prospective study was done on 30 patients admitted to the spinal unit of Al-Hadra University Hospital in Alexandria. All had lumbar instability or stenosis in whom surgical decompression alone would lead to instability. The mean age at the time of surgery was 70.3 years (range: 55-80 years). Twenty two patients were females and the remaining eight patients were males. Neurogenic claudication was the main symptom encountered in 21 patients (70%) while radicular symptoms were seen in only eight patients (40%). Twenty one patients (70%) had flexion attitude of their lumbar spine which disappeared in the recumbent position. The average walking distance before surgery was 113.33 m (range: 10-500 m). The average duration of symptoms before surgery was 16.6 months (range 1-40 months). The fixation was monosegmental in 23 patients (76.67%), bisegmental in five (16.67%) and trisegmental in the remaining two patients (6.67%) The follow up period ranged between 15-42 months (average: 32.07 months).

Surgical Technique:

The operation was done in the prone position under general anesthesia. Draping was done under strict aseptic technique. Exposure of the affected segments was done using the Stagnara technique. The extent of the surgical decompression depended upon the severity of the stenosis; the parts of the facet joints not causing stenosis were not removed. The annulus was incised and discectomy was done as in the traditional PLIF but the bony end plates were not decorticated. Insertion of the transpedicular screws (Expedium system from Johnsosn & Johnson) was carried out under fluoroscopic control. High viscosity bone cement (CEMEX GENTA) was inserted in the intervertebral space using cement syringe. Care was taken to keep the cement completely inside the disc space. Any extruded cement fragments were removed before hardening of the cement. Application of the rods was done under segmental compression. Closure of the wound was done in layers.

Results

The average intraoperative blood loss was 390 ml (range 150-900 ml). Only 3 patients required blood transfusion at the immediate postoperative period. The duration of the operation ranged between 55 and 160 minutes (average: 84.67 minutes). No intraoperative complications were encountered. No postoperative neurological deficits were reported. All patients were mobilized on the first postoperative day. One patient died 18 months after surgery due to associated co-morbidity. Postoperative superficial wound infection was encountered in one patient (3.33%) and healed after local debridement and antibiotic treatment. The claudicating pains disappeared completely in 29 patients (96.66%), residual paraesthesia remained until the end of the follow up in one patient (3.33%). Those patients with preoperative radiculopathy reported immediate relief of the pain. The VAS for back and leg pain improved from 7.1 and 3 preoperatively to 1.6 and 0.4 at the end of follow up respectively. OCS also improved from (30.3) preoperatively to (15.8) at the end of follow up. The intervertebral bone cement remained in place in all patients (Figure 1). Screw loosening with displacement was reported in one patient (3.33) and necessitated revision. Presence of radiolucent lines around the caudal screws was observed in six patients (19.98%) without consequences. Spontaneous bony fusion was evident in 12 patients (40%) in whom the cement did not occupy the anterior part of the disc space (Figure 2).

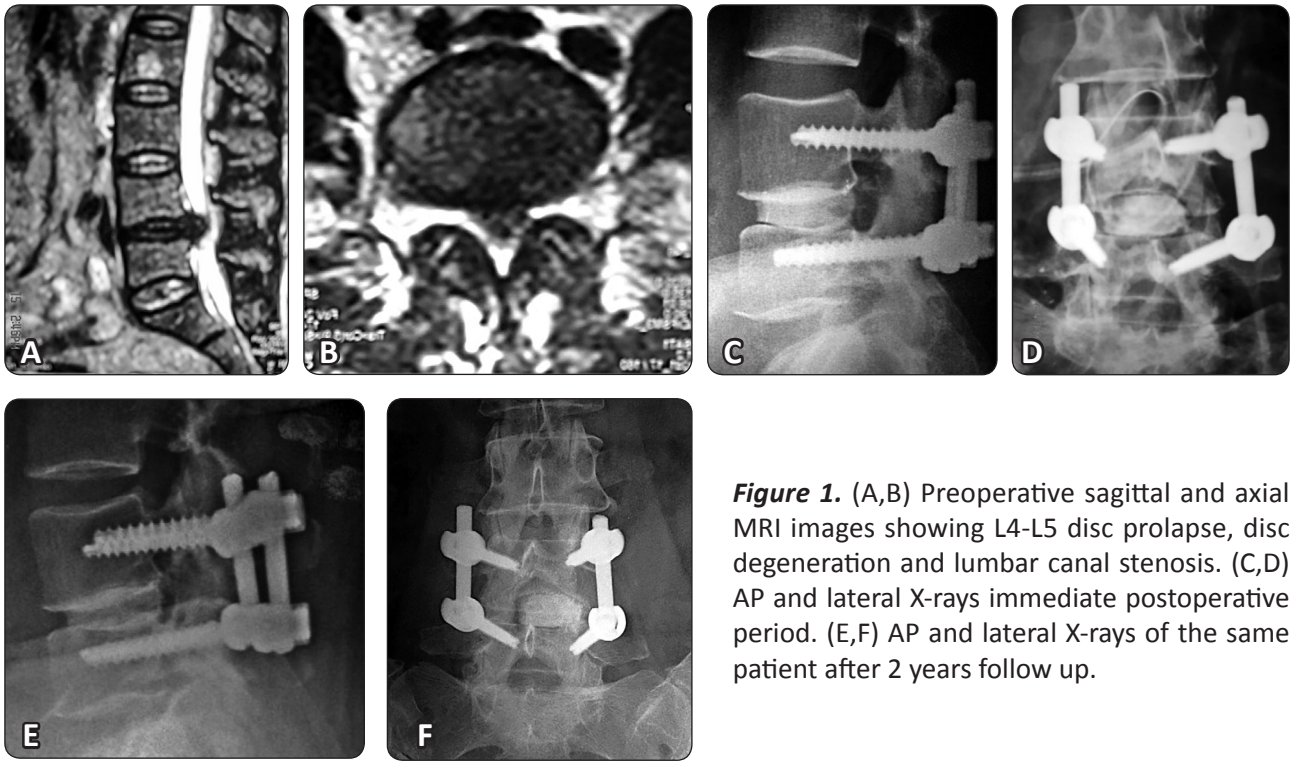

Figure 1. (A,B) Preoperative sagittal and axial MRI images showing L4-L5 disc prolapse, disc degeneration and lumbar canal stenosis. (C,D) AP and lateral X-rays immediate postoperative period. (E,F) AP and lateral X-rays of the same patient after 2 years follow up.

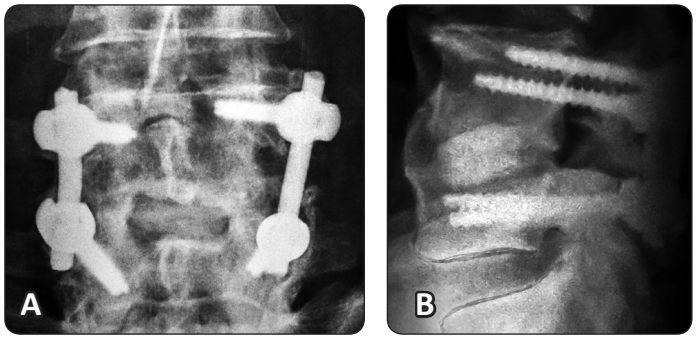

Figure 2. (A) AP and (B) lateral X-rays 3 years postoperative showing anterior bony fusion around the bone cement.

Discussion

Cloward [6] introduced the PLIF technique in 1945. He recommended vertebral fusion for most cases of surgically treated ruptured lumbar discs. Results of the original PLIF without instrumentation, encouraged the widespread use of this technique. The use of the PLIF resurged in the 1980s with the introduction of pedicle screw instrumentation. Steffee and Sitkowski[15] advocated the use of transpedicular screw fixation to enhance the rate of spinal fusion. Greiner Perth et al,[10] published the largest series of the PLIF as a treatment of a variety of lumbar stenosis and instabilities and found better results in the young healthy patients with short fusion. Osteoporosis was the main reasons for the unsatisfactory results in old people.

Elderly people do not only suffer from osteoporosis but they also do not comply to rigid instructions of avoiding bending and torsional movements until bony fusion has occurred. This together with the frequently used autogenous iliac graft (which is also osteoporotic) explains the lower fusion rate after PLIF in the elderly patients. The use of bone cement greatly overcomes these limitations. The results of this study proved that bone cement is an ideal substitute of bone in providing immediate stability and in restoring intervertebral height and normal sagittal and coronal profiles. A stable construct allowing immediate postoperative mobilization without such restrictions recommended for the PLIF was achieved and maintained in 92.2% of the cases.

Tokuhashi et al,[17] reported backing out of the screws in 7.4% of their patients treated by instrumented posterolateral fusion. In our series the rate of screw displacement was only 3.33% which might be explained by the presence of interposition bone cement adding more stability to the construct. The mean operative time in our series (84.67 minutes) and blood loss (390 ml) were lower than that reported by Tokuhashi et al.[17] Avoiding harvesting autogenous bone graft through the use of bone cement, reduced the intraoperative blood loss, the operative time, donor site morbidity, and avoided the use of osteoporotic bone graft with its mechanical disadvantages.

Although, the primary intention of using bone cement was to achieve immediate segmental stability, and maintain the disc space-height and the spinal profile, spontaneous bony fusion occurred in a relatively high percentage of the cases (40%). It seems that the degree of filling the disc space with cement played a role in this aspect because bony fusion occurred only in those cases in whom the bone cement did not completely fill the disc space. We can explain that according to the tension band principle. Leaving the anterior part of the disc space without cement makes the pedicular screws-intersomatic bone cement construct acts as a tension band when the spine is axially loaded resulting in spontaneous anterior bony fusion. This tension band principle does not work when the entire disc space is filled with bone cement.

Accordingly, we would recommend filling that anterior part of the disc space with the bone gained from the decompression and implant the cement in the rest of the disc space. In this way, one can get the immediate advantages of the bone cement and the long lasting advantage of bony fusion.

Conclusions

Polymethylmethacrylate interposition combined with transpedicular fixation seems to be a good alternative to instrumented posterior interbody fusion in treatment of lumbar instabilities in patients with osteoporosis. The immediately achieved mechanical stability of the construct makes it suitable for the elderly patients with osteoporosis.

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الملخص العربي

السمكرة الخلفية بين الفقرات القطنية باستخدام اسمنت العظام: الدواعي و النتائج

الخلفية العلمية : وجود ترقق العظام يجعل السمكرة الخلفية بين الفقرات القطنية ليست طريقه مثالية لعلاج عدم ثبات الفقرات القطنية وضيق القناة العصبيه القطنية. تقشير نهاية اللوحه العظمية يضعف تحمل الوزن للفقرات. تجنب تقشير نهاية اللوحه العظمية واستخدام الاسمنت العظمي لملء المسافه الفقرية يمكن من الناحية النظرية أن يتغلب على هذه العيوب الميكانيكية.

الغرض : الهدف من هذا العمل هو هو تقييم نتائج السمكرة الخلفية بين الفقرات القطنية باستخدام اسمنت العظام في مرضى هشاشة العظام الذين يعانون من عدم ثبات الفقرات القطنية وضيق القناة العصبيه القطنية

تصميم الدراسة: دراسة اكلينيكية

المرضى والطرق : تكونت هذه الدراسة من ٣٠ مريضا مع متوسط عمر ٧٠,٣ سنة تم علاجهم باستخدام هذه التقنية. وشملت الدراسة ٣٩ مستوى قطني. وقد تم ازالة الضغط الخلفي وفقا لمدى وشدة الضيق. تمت إزالة الغضروف جنبا إلى جنب مع لوحات نهاية الفقرة الغضروفية دون اصابة لوحات النهاية العظمية. وقد تم ملئ مكان الغضروف باسمنت العظام. وزاد من صلابة البناء استخدام المساميروالعامود لتثبيت الجزء المصاب. كان متوسط فترة المتابعة ٣٢,٠٧ أشهر. استخدم مقياس البصرية التناظرية لآلام الظهر والساق مع مقياس أكسفورد لتقييم المرضى قبل وبعد العملية.

النتائج : كان وقت العمليه للمستوى الواحد ٨٤ دقيقة. كان متوسط فقدان الدم ٣٩٠ مل. لم تكن هناك مضاعفات أثناء العملية. قبل الجراحة، كان مقياس البصرية التناظرية لآلام الظهر والساق ٧,١ و ٣ و قد تحسن الى ١,٦ و ٠,٤ فى نهاية فترة المتابعة على التوالى. كذلك تحسن مقياس أكسفورد من ٣٠,٣ قبل الجراحة الى ١٥,٨ فى نهاية فترة المتابعة.

الإستنتاج : تعتبر السمكرة الخلفية بين الفقرات القطنية باستخدام اسمنت العظام مع التثبيت استخدام المساميروالعامود حلا مقبولا لمرضى هشاشة العظام الذين يعانون من عدم ثبات الفقرات القطنية وضيق القناة العصبيه القطنية.