

## **Title: The Effect of Mesenchymal Stem Cell Allograft on Cervical and Lumbar Spinal Fusion**

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**Introduction:** A stable fusion following decompressive spine surgery is the ultimate goal for any spine surgeon and currently iliac crest bone graft is the gold standard. However, many alternatives and additives currently exist secondary to the morbidity of the grafting procedure. This retrospective chart review was performed to determine the effects of using a mesenchymal stem cell (MSC) allograft on cervical and lumbar fusions. The goal of surgery was to effect complete neural decompression followed by stabilization so that a bony fusion could occur. It is our hypothesis that fusions in both the cervical and lumbar spines performed in conjunction with MSC's will demonstrate fusion rates that are equivocal or higher than fusions done without MSC's as measured radiographically and clinically.

**Methods:** Retrospective review of one surgeons charts from March 2009 to June 2012 identified 126 patients who received mesenchymal stems cells via Osteocel during spinal fusion. Osteocel is manufactured by Nuvasive and is an immunodepleted cellular allograft bone matrix that has been processed to retain osteoprogenitor cells and mesenchymal stem cells of cancellous bone. Demineralized bone matrix (DBM) from the cortical bone of the same donor is added to the cancellous compound so that the final product has properties of osteoinductivity, osteoconductivity and osteogenesis. The patients who received MSC's to aid in their fusion were those patients whose products of decompression were minimal in volume and density secondary to prior decompressive surgeries, trauma or severe osteoporosis as well as patients whose posterior elements were unusable secondary tumor or infection. Average time of follow-up was 9 months. Fusion was assessed radiographically and clinically. CT evaluation was used in 25 patients post-operatively. The student *t* test was used for comparison of intergroup data. *P* value less than 0.05 was considered statistically significant.

**Results:** There were no significant differences in gender assignment per surgical level nor were there significant differences in age per surgical level. Commonly, single and two level ACDF's as well as single level lumbar fusions were performed. We found a 100% fusion rate in cervical group and a 97.4% fusion rate in the lumbar group. One cervical spine patient had delayed union which was treated effectively with a bone stimulator. Two lumbar spine patients had nonunions, one of which required a revision surgery. 20 patients required chronic post-operative pain management intervention in the form of epidural steroidal injections or sacroiliac joint injection. There were 2 patients with acute post-operative nerve palsies, L4 and L5 nerve roots, which resolved within 12 months. There were 4 patients with acute post-operative medical complications. Seven patients required a return to the OR; 3 for lysis of adhesions in the lumbar spine; 1 for lumbar dural tear; 1 for irrigation and debridement of surgical wound superficial infection with MRSA; 1 for pedicle screw fracture; 1 for nonunion. We found no effect of smoking on infection or fusion rate. There was a 90% rate for patients who were previously employed to remain gainfully employed post-operatively. One patient who was retired pre-operatively returned to the work force post-operatively secondary to pain relief. No patient went from disabled to employed after surgery. Overall, there was 84% relief of axial pain and 85% relief of radicular pain. The residual pain in the cervical group was more attributed to axial pain while the residual pain in the lumbar group was attributed to buttock and leg radicular pain.

**Discussion:** Although the need for long term, randomized prospective studies with regular, interval radiographic follow-up exists, this case review offers insight to one surgeons experience with mesenchymal stem cells during spinal fusion. A subgroup of patients was identified in which MSC's were placed in separate locations in vivo; i.e. left posterolateral gutter vs. right posterolateral gutter. Those patients fused clinically and radiographically, but demonstrated less opacity of their fusion mass early post-operatively which is likely due to cancellous nature of Osteocel versus the cortical nature of autologous local bone. One of two non-union patients in the lumbar spine group has end stage renal disease and has been on dialysis which started years prior to spine surgery. The other patient had already demonstrated his propensity for nonunion as he was seeking treatment for a nonunion from previous instrumentation. Our findings would suggest that the addition of mesenchymal stem cells is helpful in achieving fusion in patients at risk for poor bone healing.

### **References:**

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