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Pulsed Electromagnetic Field Stimulation Increases Multilevel Cervical Fusion Rates

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INTRODUCTION: Previous clinical series have demonstrated various factors that influence cervical spine fusion rates, including smoking, graft type (autograft vs. allograft), use of instrumentation, and number of levels fused. While high union rates have been noted for single-level cervical fusions, nonunion rates increase with the number of motion segments fused. The use of pulsed electromagnetic fields (PEMF) as an adjunct to lumbar interbody fusion has been shown to increase the fusion success rate. To our knowledge, no prior study has assessed the efficacy of PEMF for cervical fusion.

METHODS: The charts and radiographs of 45 patients who underwent multilevel cervical fusions and were treated with external PEMF postoperatively were reviewed. Cervical fusions were performed for a variety of clinical presentations, including cervical spondylotic myelopathy, previous failed fusions, and traumatic instability. The procedures performed included multilevel anterior cervical discectomies and fusions (ACDFs), multilevel corpectomies with strut-graft reconstruction, and posterior cervical fusions. Either autograft or allograft was used in these cases as well as instrumentation. Postoperatively, all patients received PEMF stimulation through an external device (Spinal-Stim, Orthofix, Dallas, TX) for four hours per day for 3 months. Follow-up radiographs were obtained monthly for the first 3 months and evaluated for the presence of fusion and hardware failure. Subsequent radiographs were obtained at 6 months and 1 year. Fusion was defined as 1) evidence of bony bridging at all levels and 2) no motion on flexion-extension views.

RESULTS: Radiographic fusion was present at all levels in 43 of the 45 patients (95.6%) with a minimum follow-up period of 12 months. There were 24 anterior fusions, 9 posterior fusions, and 12 combined procedures. The number of levels fused included: two-level (n=19), three-level (n=13), four-level (n=9), and five-level (n=4). Fusion rates for specific multilevel procedures were as follows: 91.7% for multilevel ACDFs (n=12), 66.7% for occipital-cervical fusions (n=3), 100% for multilevel corpectomies with strut-graft reconstruction (n=12), 100% for combined multilevel strut grafts with posterior fusion (n=11), and 100% for multilevel lateral mass plating (n=5). In addition to undergoing multilevel cervical fusions, other risk factors for pseudoarthrosis in this patient population included smoking (33.3%), rheumatoid arthritis (8.9%), diabetes (2.2%), and previous failed fusions (11.1%). In the two patients (4.4%) with radiographic nonunions, bony bridging was judged to be incomplete, although there was no evidence of hardware failure.

CONCLUSIONS: Utilizing external PEMF, we observed a fusion rate of 95.6% in a heterogeneous patient population undergoing multilevel cervical fusion. Reported fusion rates for similar procedures range from 59-80%. External PEMF appears to be a safe and effective adjunct for improving the rate of multilevel cervical fusion. A randomized, prospective clinical trial will be necessary to definitively assess the efficacy of this treatment modality and is currently underway.