3D Cone Beam Computed Tomography Volumetric Outcomes of rhBMP-2/Demineralized Bone Matrix vs. Iliac Crest Bone Graft for Alveolar Cleft Reconstruction

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INTRODUCTION: Recent studies suggest that recombinant human bone morphogenic protein (rhBMP)-2 encased in a demineralized bone matrix scaffold (MS) is a comparable alternative to iliac crest bone grafting for secondary alveolar cleft repair. Post reconstruction occlusal radiographs are used to measure bone reconstitution but cannot evaluate bony growth in three dimensions. In this study, we use Cone Beam Computed Tomography (CBCT) to provide the first volumetric comparison of bone fill between rhBMP-2/MS and iliac crest grafts.

MATERIALS AND METHODS: A prospective study was performed on 34 patients undergoing secondary alveolar cleft repair over a 2-year period. 21 patients received BMP/DBM and 13 patients underwent iliac bone grafting. Postoperatively, occlusal radiographs were obtained at 3 months and the Bergland rating scale was used to determine the degree of bone fill. CBCT scans were acquired on all the patients between 6-9 months following grafting. Specialized AMIRA® software was used to obtain volumetric data to determine the percentage of bone fill and the average density of the regenerated bone.

RESULTS: Complete closure of the oronasal fistula was attained in all patients. The most common complication from use of BMP/DBM was increased local edema. Three months following reconstruction, occlusal radiographs demonstrated that 67% of patients who received BMP/DBM had complete bone fill vs. 56% of patients in the iliac bone graft group. At 6-9 months, CBCT images showed the patients receiving BMP/DBM had the same average regenerated bone density as those who had undergone iliac bone crest grafts (Fig. 1). Measurements of percentage of alveolar cleft fill showed that patients receiving BMP/DBM had on average 31.6% bony fill vs. 32.5% in the iliac bone population (Fig. 2).

CONCLUSIONS: Here we demonstrate that BMP/DBM is equivalent at 6-9 months to iliac crest grafts, in terms of bone fill within the alveolar cleft site and overall regenerated bone density. These CBCT data contradict the conclusions that are drawn from occlusal radiographs alone; complete bony reconstitution as measured by the Bergland scale on 2D radiographs is unlikely to correlate with true obliteration of the cleft site, as the postoperative CBCT images at 6-9 months show significant bone gaps within the space. This study is the first to apply 3D imaging to understand bone regeneration in the context of secondary alveolar cleft repair.

LEGENDS:
Figure 1. Mean density of iliac bone grafts and BMP/DBM grafts at 6-9 months were identical: 1.38 g/cc (SD: 0.28). A one tailed ANOVA test comparing means showed no statistical significance (p=0.999).

Figure 2. At 6-9 months, patients with BMP/DBM grafts had an average of 31.6% bone fill (95% CI: 24.2- 38.5%) vs. 32.5% (95% CI: 22.1- 42.9%) in the iliac bone population. No difference between means (p= 0.836).

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