

Transplantation of Decellularized Zygomatic Bone Augmented with BMP-2 as an Allogeneic Bone Graft Alternative for Maxillofacial Defects: A Pilot Study in Rabbits

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INTRODUCTION: Autologous bone grafts are the current gold standard for reconstruction of osteochondral defects but are limited in availability and donor site morbidity. Current literature demonstrates that bone morphogenetic protein (BMP-2) induces new bone formation and is currently used for the treatment of bony defects, delayed union, and non-union healing within orthopedics. Currently, there is no evident research that investigates the use of BMP-2 as a method to promote osteogenesis in allogeneic bone grafts for maxillary reconstruction. The aim of this study is to investigate the use of decellularized bone grafts augmented with acellular collagen matrix (ACM) infused with BMP-2.

MATERIALS AND METHODS: Adult, female New Zealand white rabbits (n=12, ~4 kg) underwent surgical removal of one zygomatic bone. Defects (2.5mm in size) were created within the extracted zygomas before decellularization of the bone. Rabbits were divided into three bone graft groups: (1) non-decellularized, (2), decellularized, and (3) decellularized graft augmented with ACM infused with BMP-2. Twelve weeks post-operatively, skulls were harvested and underwent micro-CT imaging (20µm resolution) and analyses. The contralateral face, which did not undergo surgery, served as a control for each animal. The extent of re-ossification, osteogenesis, and evidence of bone resorption were observed from the micro-CT images and preliminary bone mineral density (BMD) measures were made.

RESULTS: Qualitatively, CT images demonstrated that BMP-2 augmented collagen sponges had a strong osteoinductive effect on the decellularized bone scaffold. Defects contained large amounts of radio-dense material that was comparable to the contralateral zygomatic bone density. Furthermore, complete bridging within the bone defects was achieved. In contrast, groups 1 and 2 showed no new bone accumulation within the defects, and moderate to significant resorption was evident. BMD values were measured: Control= 500 ± 102 , Group 1= 536 ± 92 , Group 2 = 652 ± 203 , Group 3 = 460 ± 169 .

CONCLUSION: This study investigates the use of BMP-2 in a model for mid-facial maxillary defect reconstruction. The current data indicates that decellularized zygomas augmented with BMP-2 and transplanted into a recipient rabbit resulted in reconstructed bone comparable to the original zygoma. Initial findings indicate that this allograft alternative has merit as a viable reconstructive method for human subjects with maxillary defects by providing a method for non-immunogenically reconstructing a large three-dimensional anatomical defect with precise anatomic shape.