Functionally Integrated Tissue Engineered Mandibular Condyle

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The aim of this pilot study was to evaluate the effect of therapeutic ultrasound on enhancing chondrogenic and osteogenic differentiation in vitro as well as on tissue engineering mandibular condyle in rabbits.

Materials and Methods: Eleven skeletally mature rabbits were selected and divided into four groups. Group 1 [3 rabbits] (Ultrasound with tissue engineered mandibular condyle); group 2 [3 rabbits] (tissue engineered mandibular condyle with no ultrasound); group 3 [3 rabbits] (ultrasound with empty scaffold), and group 4 [2 rabbits] (empty scaffold, no ultrasound). All rabbits had bone marrow stem cells (BMSCs) isolated from their femur bone. BMSCs were expanded and differentiated into either chondrogenic or osteogenic cells. Cell differentiation was evaluated by safranin o and von Kossa staining and by PCR. The chondrogenic and osteogenic differentiated cells were seeded into collaged sponges that were housed into a biodegradable scaffolds to form tissue engineered articular condyle. The tissue engineered condyles were implanted into the amputated temporomandibular joint (TMJ) articular condyle in groups 1 and 2. In group 3 and 4, the amputated TMJ articular condyles were replaced with empty scaffolds. Groups 1 and 3 were treated daily for twenty minutes by an ultrasound device that delivers a power of 30 mW/cm^2 with pulse frequency of 1.5 M Hz, pulse repetition frequency of 1 K Hz. Four weeks after implantation of the tissue engineered articular condyles or empty scaffolds, rabbits were euthanized and evaluated by microCT scanning as well as by histological examination.

Results: The results showed that ultrasound enhanced chondrogenic and osteogenic differentiation in vitro. Also, ultrasound treated tissue engineered articular condyles showed enhanced matrix production and integration with the original bone than the untreated condyles.

Conclusion: Therapeutic ultrasound enhances tissue engineering mandibular condyles in vitro. Also, it enhances functional integration of the tissue engineered condyles in vivo.