

ABSTRACT

The Difference in Healing Mechanism and Effectiveness of Critical Size Mandibular Defect between Bovine Bone Mineral – human Amniotic Mesenchymal Stem Cell and Autogenous Bone Graft

David B. Kamadjaja

Background: Autogenous bone graft has been gold standard for mandibular reconstruction, however, it is limited in shape, size and availability. Experimental study of bone tissue engineering, an alternative to autogenous bone graft showed promising result, however, its healing mechanisms and effectiveness has not been fully understood until today.

Purpose: The aim of this study is to describe the difference in bone healing mechanism and effectiveness between bovine bone mineral loaded with hAMSC (BBM-hAMSC) and autogenous bone graft in the reconstruction of critical size mandibular bone defect .

Methods: Forty five New Zealand white rabbit were divided into 3 groups based on the time of observation i.e. first, second, and twelfth week, each group subdivided into 3 experimental groups which were BBM-hAMSC, BBM alone (BBM), and autogenous bone graft (ABG), consisting of 5 rabbits per group. Critical size defects created in rabbits mandible were reconstructed with BBM-hAMSC, BBM alone, and ABG, respectively. Fifteen rabbits from each experimental week were sacrificed for histology and immunohistochemistry staining. Expression of VEGF, BMP2, Runx2 and amount of angiogenesis were analyzed in the first and second week groups, while expression of Runx2, osteocalcin, collagen type-I fibres, trabecular area and bone incorporation analyzed in the twelfth week groups.

Result: Expression of VEGF and angiogenesis commenced earlier in BBM-hAMSC and ABG group compared with BBM group, BMP2 and Runx2 were expressed earlier in ABG group than BBM-hAMSC and BBM group, indicating that early healing activities was higher in ABG compared with tissue engineering groups. Twelfth week analysis showed that expression of Runx2 in BBM-hAMSC and ABG were significantly higher than BBM group, amount of collagen type-I fibres was significantly higher in BBM-hAMSC and BBM than ABG group, while expression of osteocalcin was significantly higher in BBM-hAMSC than ABG and BBM group. These results indicated that in late phase of healing, the osteogenic activities were higher in BBM-hAMSC than ABG group. The result of trabecular area and bone incorporation analysis showed that there was no difference between BBM-hAMSC and ABG group with regards to osteogenic quantity and quality, respectively.

Conclusion: This study concluded that the early healing activities was higher in autogenous bone graft than BBM-hAMSC, while osteogenic activities in the late stage of healing was higher in BBM-hAMSC compared to autogenous bone graft, and the bone forming capacity of BBM-hAMSC was comparable to autogenous bone graft in the reconstruction of critical size mandibular bone defects

Keywords: human amniotic mesenchymal stem cell, bovine bone mineral, autogenous bone graft, bone healing mechanism and effectiveness, critical size mandibular bone defect