The Changes in Matrix Metalloproteinase and Collagens Expression of Rat Articular Cartilage after Continuous Mandibular Advancement: Immunohistochemical Study

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Abstract

Condylar growth modification is induced by mandibular advancement though the changes in Temporomandibular Joint (TMJ) after mandibular advancement could be permanently stable are not yet proved. Therefore, our purpose is to investigate the effects of mandibular advancement on the rat TMJ by changing in Matrix Metalloproteinases (MMPs) and Collagens (COLs) expression immunohistochemically (IHC) after retention treatment. In this study, 54 male Sprague-Dawley rats were divided to control group (n=24) and experimental group (n=30) for three months subgroups period. Only experimental sub-groups were subjected to a full-time orthodontic inclined methyl methacrylate bite plate cemented to the incisors to advance the mandible for one month and continued as a half-day-wearer (retention period) till the end of the 2nd month and stayed without appliance during whole 3rd month (post retention period). Then, the assessment of gross-morphological changes of skull and the examination of the articular cartilage for each sub-group histologically in addition to IHC examination for MMP-1, MMP 8 and MMP 13 and COL-I, II and III were done. The gross morphological changes were clear in experimental group as downward forward mandibular advancement in addition to a high significant decreased in the base mandibular length. There was also an abundant cellular proliferation at the condylar cartilage with a significant condylar ossification and higher osteoblastic activity in the experimental group obviously at retention period. Moreover, a significant increase in MMP-13 expression in both differentiation and hypertrophic layers of an experimental group during active and retention periods with reduction in the expression of COL-II in the experimental group was observed with no significant changes in other markers. These upregulation of MMP-13 in associated with significant reduction in expression of COL-II plays a significant role in cartilage collagen degradation and treatment stability, which is confirmed through the post-retention period due to endochondral ossification pattern improvement.Orthodontic appliances and their impact on the growth of

the mandibular condyles in experimental animal models have still one of the important ways to explore the real changes that could have a role in optimization of the orthodontic treatment in the last decades. Planning for the retention phase as a part of the orthodontic treatment requires knowledge for the biology of the jaw response to the treatment . The articular condylar growth modification that induced by mandibular advancement as reported by Petrovic et al. depending on histological assessment while other studies assessment were by Immunehistochemically (IHC), morphometrically, biochemically or auto-radiographically as diagnostic tools to evaluate the growth at condyle or to detect increased expression of some growth factors and biomarkers.The stability of the changes in Temporomandibular Joint (TMJ) by orthodontic appliance is not yet proved. Therefore, estimation of Collagens (COLs) with degradation enzymes as Matrix Metalloproteinase (MMPs) can give a sign for permanency and effectiveness of treatment. Mechanical overload by the appliance acts on the cartilage cells to stimulate MMPs which are involved in the degradation of collagens as well as in tissue destruction in a variety of inflammatory lesions. MMP-1 is produced by fibroblasts, synovial cells, macrophages, endothelial cells, and carcinoma cells, and degrades COL-I, II, III, VII and X collagen. MMP-8 is released by neutrophils in inflammatory tissue and degrades COL-I, II and III. Furthermore, MMP-13 is observed in tumors, osteoarthritis, rheumatism, and wounds. It degrades COL-I, II, III and X, it is considered to be the strongest for degrading COL-II specifically. MMP-13 appears to be one of the most important MMPs in cartilage remodeling and mineralization because it exhibits a substrate preference for the cartilage, specifically COL-II.

Biography

It have more than 15 years of experience in medical and Pharma (incl. targeted therapy or immunotherapy) as well as other fields.