

FINITE ELEMENTS ANALYSIS OF THE STRESS DISTRIBUTION ON TEMPOROMANDIBULAR JOINT DUE TO THE USE OF MANDIBULAR ADVANCEMENT DEVICES

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Summary: Mandibular Advancement Devices (MADs) are therapeutic tools frequently used for the treatment of Obstructive Sleep Apnoea Syndrome (OSAS). Patients suffering from OSAS show repeated phenomena of oropharynx obstruction during sleep, which alter the airway volume and the breathing airflow. By advancing the mandible, MAD increases the airway volume and allows the patient to breathe better and consequently to sleep better. However, the use of MAD, forcing the mandible forward, causes the development of not negligible stresses on temporomandibular joint (TMJ).

The main goal of this study is to analyse the stress distribution on temporomandibular joint by means of finite elements simulations.

The 3D reconstruction of TMJ begins with the extraction of anatomical 3D models from the CT images of the patient's skull. The 3D meshes of the mandible and temporal bones are then smoothed, defeatured and transformed in NURBS surface models by mean of reverse engineering techniques. Soft tissues (articular disc and ligaments), which cannot be identified from CT images, are modelled according to anatomical atlas and by using geometric reconstruction tools of specific CAD software.

The roto-translation of the mandible, due to the use of MAD, is experimentally determined from the scans of the moulds of dental arches (closed mouth) with and without MAD.

The mechanical properties for each component of the mandibular system are derived from previous studies. Simulations are conducted by imposing two different displacements (by advancing the lower plate of MAD) and without imposing external loads.

Preliminary results show the qualitative stress distribution on condyle, ligaments and articular disc. Quantitative results are comparable to those obtained in literature with simulations of non-pathological normal joint. The proposed simulation model will allow to compare the stress distribution on soft and hard tissues, due to the use of different MAD. For this reason, future work will include the design of MAD and periodontal ligament, in order to study the tensile state of the anatomical parts, on the basis of different MAD's materials and fulcrum positioning.