

3D modeling and stress distribution in cast and combination dental clasps

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INTRODUCTION: Cast and combination clasps are widely used in removable partial dentures technology [1-3]. The aim of the study was to achieve 3D models in order to develop applications for basic research use, to design and optimize dental clasps.

METHODS: Enlarged plaster teeth (scale 10:1) were scanned using LPX-1200 Picza Laser Scanner (RolandDG Corporation, Japan). Resulted files were imported in LeiosMesh (Enhanced Geometry Solutions Corporations, Italy), where the point clouds from the teeth surfaces were cleaned and assembled. The collected data were used to construct three dimensional models using Rhinoceros (McNeel North America) NURBS (Nonuniform Rational B-Splines) modeling program. The models were reduced to the natural size in order to obtain a normal size of the teeth and clasps. The resulted solid was tilt in order to obtain functionally effective tooth contours. The height of contour was designed and an adjuvant plane was generated to relieve the surface located +/- 0.25 mm from the height of contour (Fig. 1).

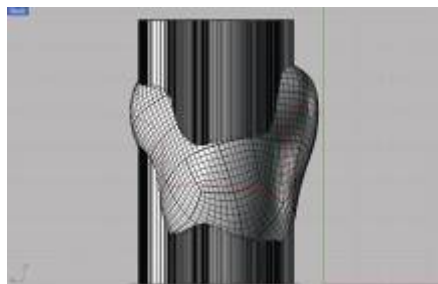


Fig. 1. Height of contour designed on the tooth surface.

The 3D models were used as a support for clasp modeling (Fig. 2).

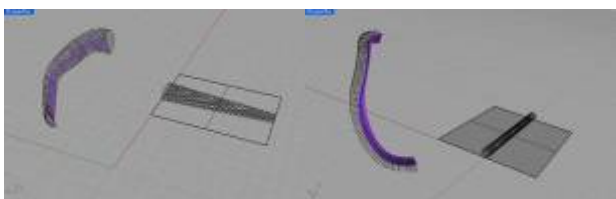


Fig. 2. 3D clasp modeling.

Purposely designed experimental three-dimensional models of the clasp arms were constructed on the teeth surface and exported in Ansys finite element analysis software (Ansys Inc., Philadelphia, USA), to be used for structural simulations. All nodes at the base of the clasp retentive arm were restrained in all directions and a concentrated load of 5 N was applied at the inner tip of the clasp arm.

RESULTS: Generated stresses and deformations were calculated numerically and plotted graphically. Results

were displayed as colored stress contour plots to identify regions of different stress concentrations. High stress values were present on the inner surface of the clasp arm, in the part located above the height of contour for the cast arm and near to the base for the wrought wire arm (Fig. 3).

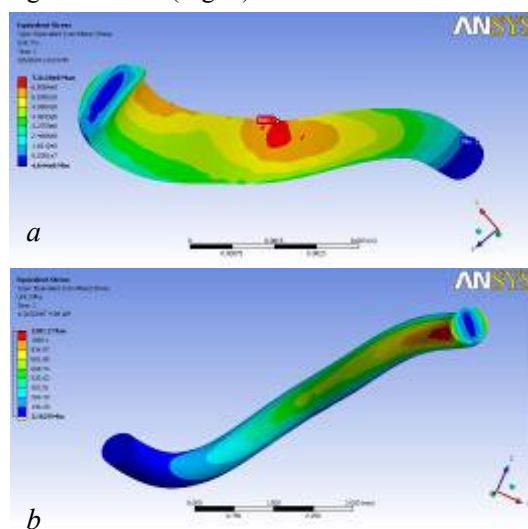


Fig. 3. Stress distribution in the retentive arm of the clasp: a. cast, b. wrought wire.

DISCUSSION & CONCLUSIONS: This in vitro study demonstrated that structural analyses of cast clasps may offer a powerful tool in order to visualize fracture risk areas. It ensures optimal performance in selection of an adequate clasp design according to each clinical case.

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