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Wax-pattern or metallic framework investigations trough stress and deformation analysis

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Introduction

The finite element analysis is well known in dentistry. In the field of removable partial dentures were studied dental clasps, major connectors and other maintaining, support and stabilization systems [1,2,3,4,5,6,7,8,9]. The objective of the study was to test wax pattern framework optimum design of removable partial dentures [RPD], using numerical simulation. After testings, the pattern can be transformed into finite piece.

Objectives

The study aim was to utilize noninvasive experimental methods to evaluate the removable partial denture metallic framework stress and distortion areas in order to solve some conception and execution deficiencies.

Material and Methods

There were tested 30 "LiWa" (WP Dental, Beven/Hamburg Germany) wax-patterns and 30 removable partial denture metallic frameworks, and made a comparison between them. Those were 3D laser scanned with LPX 1200 (Roland) and processed with Dr. Picza program. Further processing were made using "Pixform Pro" (Roland DG Corporation) program. Imported "point clouds" are processed and transformed into one surfaces network after connection. This network was exported as DXF extension file in CAD program (Solid Work 2007 - SolidWork Corporation West) where was formed the 3D model pattern. Computer realized geometric models were meshed in finite elements and used for simulation of external forces actions on denture's component elements using Solid Work 2007 - SolidWork Corporation West program.

Fig. 1: "LiWa" Set - light curing wax

Fig. 2a: "LiWa"-Wax pattern: On model

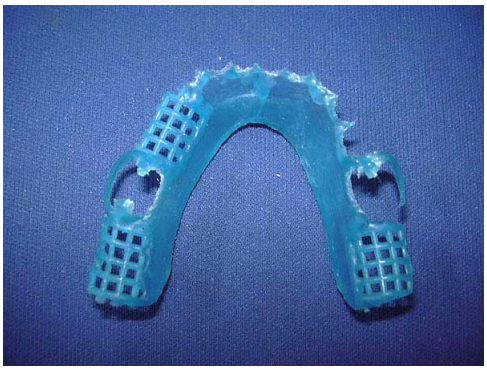


Fig. 2b: "LiWa"-Wax pattern: Light curing wax pattern prepared for scanning

Fig. 2c: "LiWa"-Wax pattern: Metallic framework

Fig. 3a and 3b: Scanning the Wax-pattern - reverse engineering method

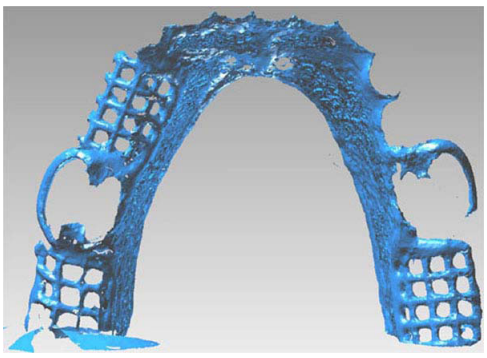


Fig. 4: Scanned Wax-pattern: program Dr. Picza (Roland DG Corporation)

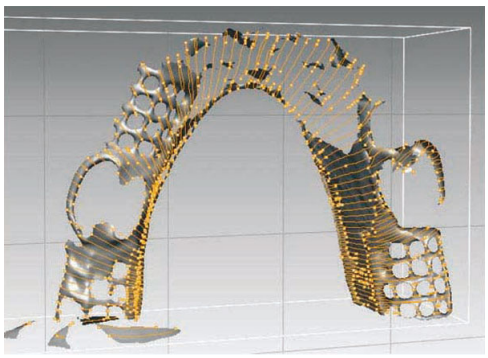
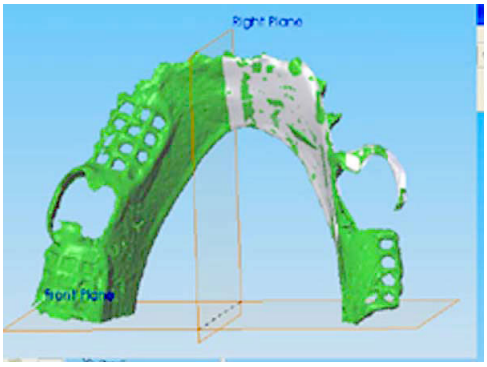


Fig. 5: Point of clouds program "Pixform Pro" (Roland DG Corporation)



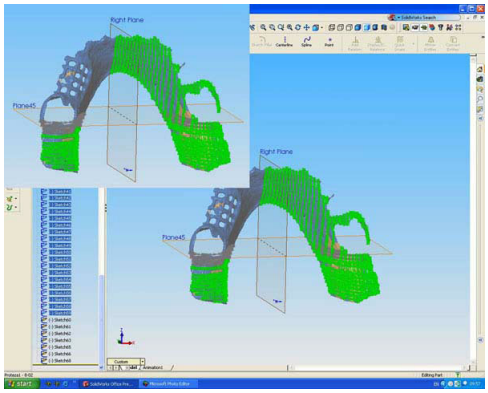


Fig. 6a and 6b: Wax-pattern processing stages programm Solid Work 2007 (SolidWork Corporation West) - sections in frontal and horizontal planes

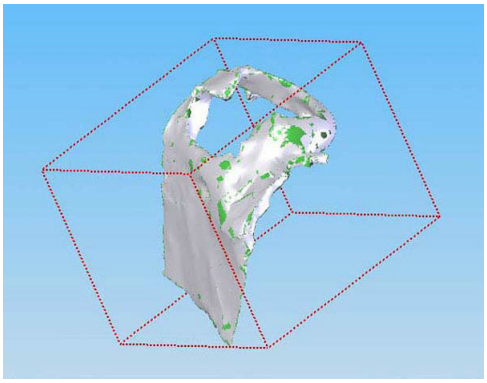


Fig. 6c: Wax-pattern processing stages programm Solid Work 2007 (SolidWork Corporation West) -Section trough major connector

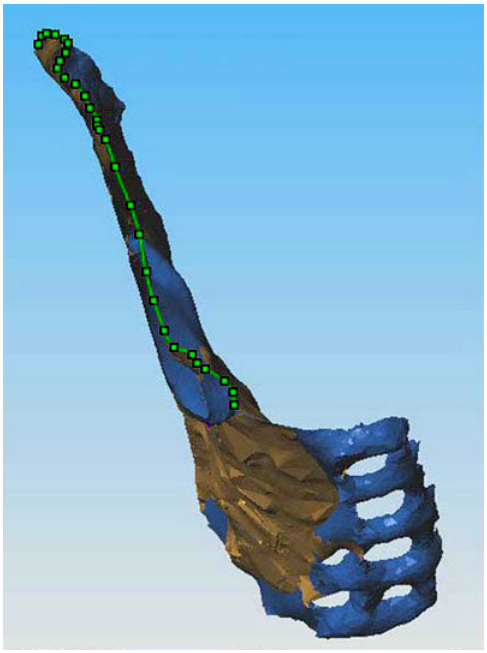


Fig. 6d: Wax-pattern processing stages programm Solid Work 2007 (SolidWork Corporation West) - Tridimesional images of circumferential clasp

Results

Scanned wax-patterns were processed through "reverse engineering" method. The load conditions and the metal characteristics were established. Wax-pattern or metallic framework stress and deformation analysis allow distinguish of minimal mechanical strength. As fragments, RPD clasps were chosen.

Conclusions

Removable partial denture testing, at wax-pattern stage is benefit for determination of the states of tensions, minimum resistance areas distinguish and appreciation the life time of future dentures. Computer experiments although allow the removable partial denture design optimization. Using light curing waxes is a novelty in the field of removable partial dentures technology. Wax pattern finite element analysis allows the design testing of future. Metallic frameworks of RPD, before achieving the prosthesis.

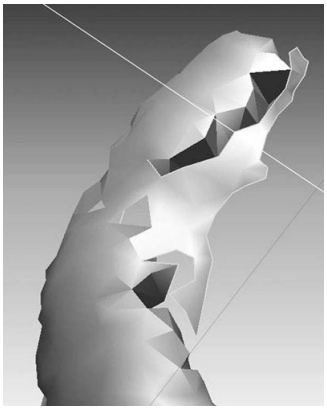


Fig. 7a: Transformation of network surfaces after their confection - brake in clasp surfaces

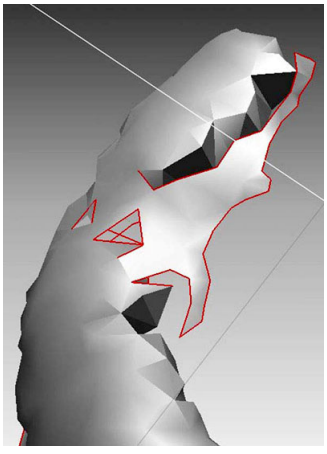


Fig. 7b: Transformation of network surfaces after their confection - red zone must be repaired

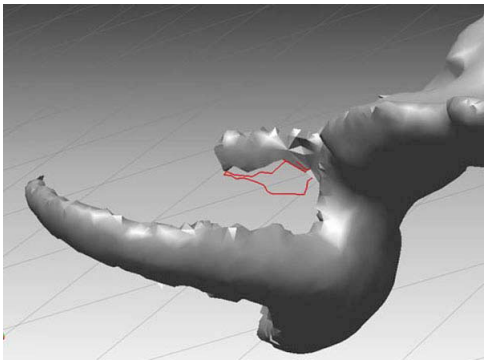


Fig. 7c: Transformation of network surfaces after their confection - red zone must be repaired

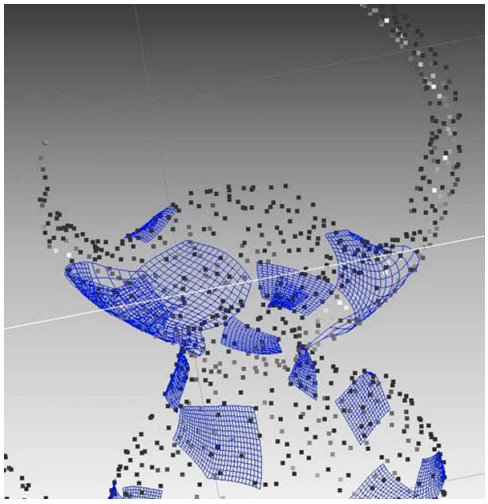


Fig. 8a: CAD program tridimensional model of wax-pattern of a clasp - details of meshing process

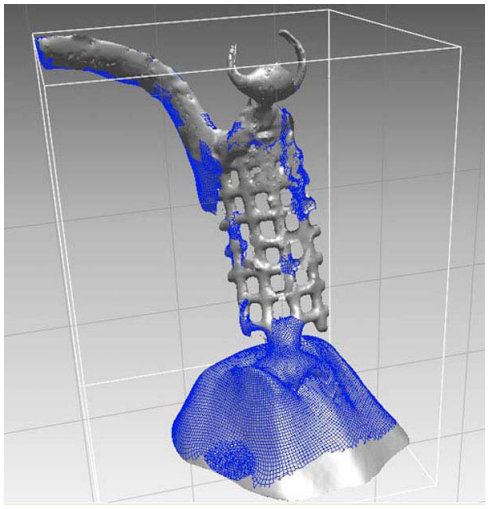
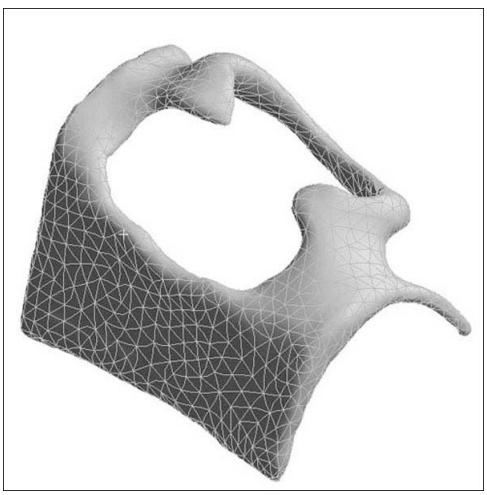


Fig. 8b and 8c: CAD program tridimensional model of wax-pattern of a clasp - details of meshing process



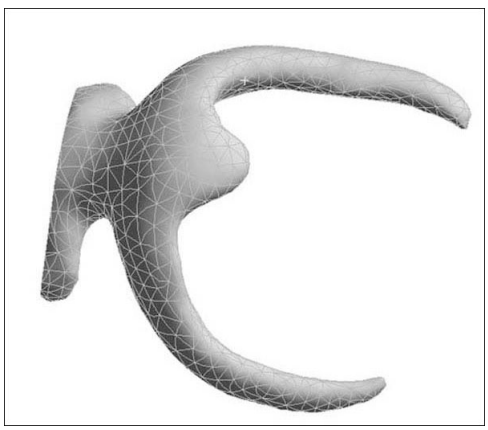
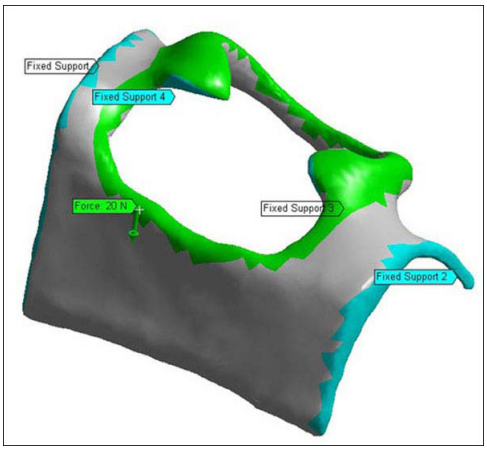


Fig. 9a and 9b: Meshed model for a circumferential clasp



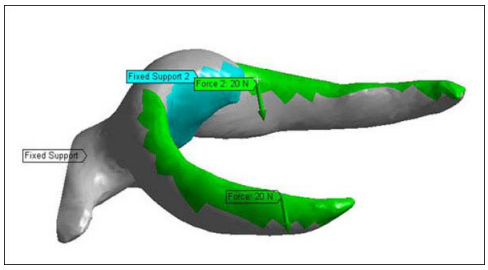
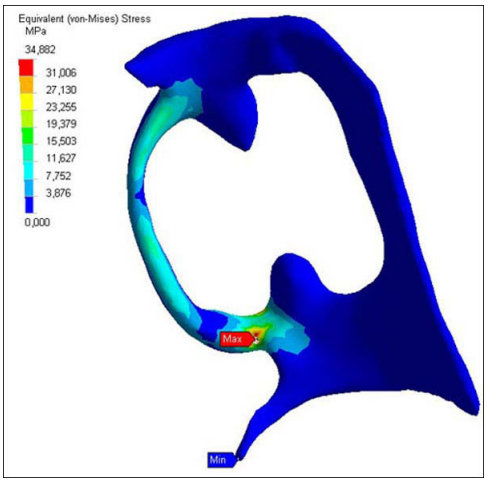


Fig. 10a and 10b: Force application and support distribution



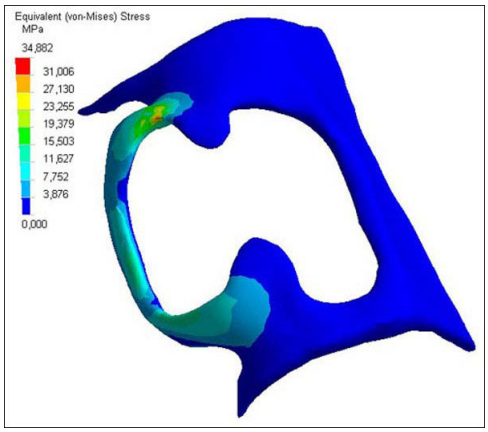


Fig. 11a and 11b: Stress of clasps of RPD

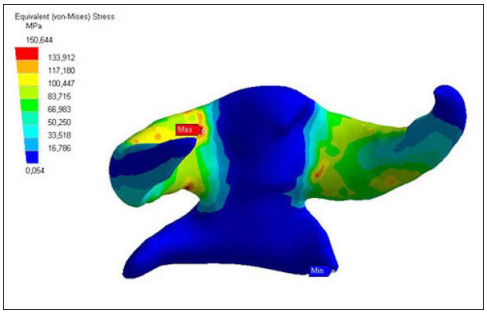


Fig. 11c: Stress of clasps of RPD

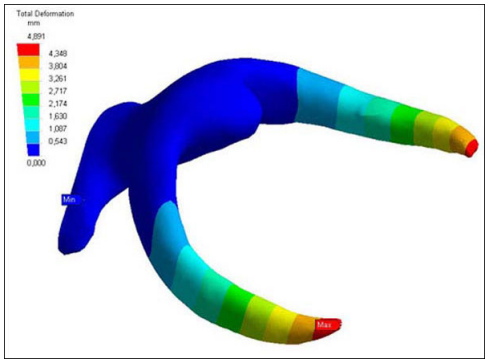


Fig. 12a: Total deformation OD clasps

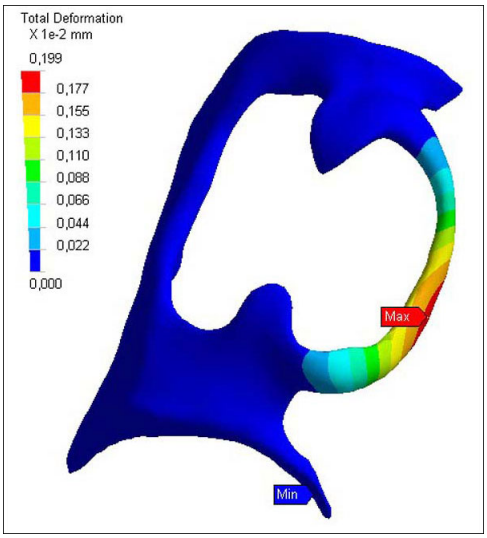


Fig. 12b: Total deformation OD clasps

Literature

1. Bortun Cristina-Informatics systems for analysis of removable partial dentures, Timisoara Medical Journal, 2006, vol.53, nr.4:73-75.
2. Eto M, Wakabayashi N, Ohyama T. Finite Element Analysis of Deflections in Major Connectors for Maxillary RPDs, Int J Proshodont, 2002, 15:433-438.
3. Faur N. Elemente finite - fundamente, 2002, Ed. Politehnica, Timişoara.
4. Saito M, Notani K, Miura Y, Kawasaki T. Stress distribution of abutments and base displacement with precision attachment- and telescopic crown - retained removable partial dentures, J Oral Rehabil, 2003, 30:482-487.
5. Sandu L, Faur N, Bortun C. Spannungsanalyse der Klammern von Modellgussprothesen durch die Methode der finiten Elemente. Quintessenz Zahntech 2006;32(4):372-381.
6. Sandu L, Faur N, Bortun C. Finite element stress analysis and fatigue of cast circumferential clasps.J. Prosthet. Dent., 2007 vol. 97, no,1: 39-44.
7. Sato Y, Yuasa Y, Akagawa Y, et al. An Investigation of Preferable Taper and Thickness Ratios for Cast Circumferential Clasp Arms Using Finite Element Analysis, Int J Proshodont, 1995, 8:392-397.
8. Sato Y, Tsuga K, Abe Y, et al. Dimensional measurement and finite element analysis of I - bar clasps in clinical use, J Oral Rehabil, 2000, 27:935-939.
9. Sato Y, Tsuga K, Abe Y, et al. Y Finite element analysis on preferable I-bar clasp shape, J Oral Rehabil, 2001, 28:413-417.

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