International Poster Journal IPJ of Dentistry and Oral Medicine

Int Poster J Dent Oral Med 2009, Vol 11 No 3, Poster 457

A finite element evaluation of stud type overdenture attachments

Language: English

Authors:
Assoc. Prof. Dr. Liliana Sandu, Asist. Prof. Florin Topala, Asist. Prof. Sorin Porojan, Prof. Dr. Cristina Maria Bortun
"Victor Babes" University of Medicine and Pharmacy Timisoara, University School of Dentistry, Timisoara, Romania

Date/Event/Venue:
15-18 June 2008
Satelite Meeting on Advanced Technologies for Advanced Characterizations of Advanced Materials
Beijing, China

Introduction

An overdenture is a restoration that covers at least one root. Anchoring an overdenture to retained roots enhances denture stability and provides numerous functional advantages. Radicular ball and socket stud type overdenture attachments are available with both rigid or resilient function. A rigid attachment allows no movement between male and female elements and the stress is directed towards the roots. The movement allowed by a resilient attachment directs stresses away from the roots and towards the tissue For this reason, resilient attachments are most frequently used. Today, a multitude of stud type overdenture attachments exist in different types and sizes. The selection of a specific attachment can seem overwhelming at first, but is basically a process of elimination. The selection process is simplified once basic considerations are evaluated.

Objectives

The aim of the study was to evaluate the influence of the stud attachments components dimensions on their strength using the finite element analysis.

Material and Methods

Color coded female inserts with various degrees of retention and a precision machined plastic burnout pattern male are most used in practice. The female inserts are retained in a metal housing allowing them to be easily replaced at chairside. Purposely designed resilient ball and socket stud type attachments were modeled (Fig. 1-5) in order to be exported for numerical simulations using ANSYS finite element analysis software (ANSYS Inc., Philadelphia, USA). The parameters like ball diameter (1.6 -2 mm), and female insert width (0.5-1 mm) were varied. The finite element models were subdivided into 4332 solid elements, connected at 8824 nodes. All nodes at the base of the ball were restrained in all directions and displacements of 0.01-0.03 mm were applied on the female part. Generated stresses and displacements were calculated numerically and plotted graphically.

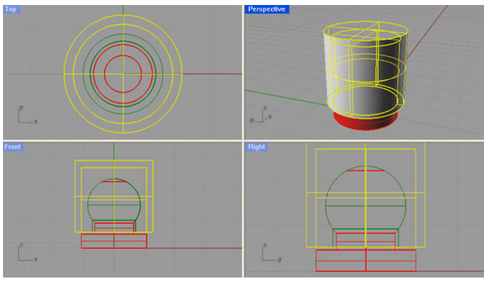


Fig. 1: Design of the resilient ball and socket stud type attachment

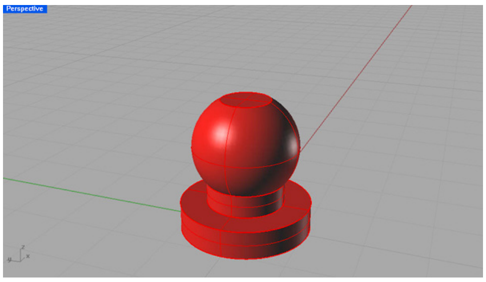


Fig. 2: Modeling of the ball

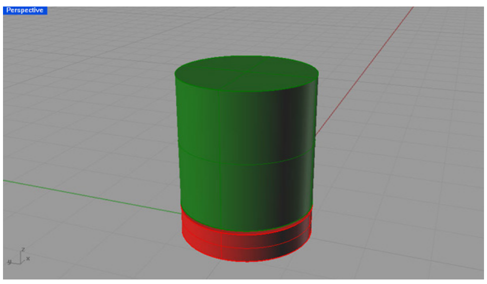


Fig. 3: Modeling of the resilient female insert

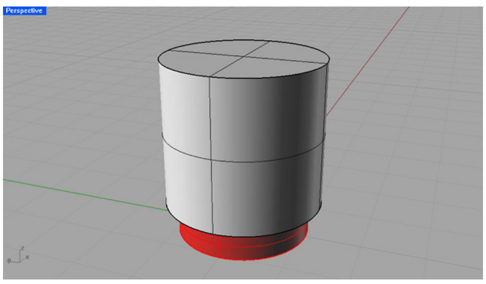


Fig. 4: Modeling of the female metal housing

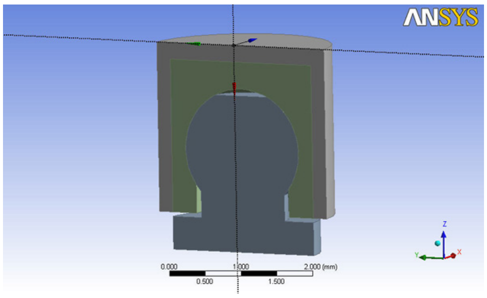


Fig. 5: Section through a resilient ball and socket stud type attachment

Results

High stresses were present on the upper surface of the resilient female insert (Fig. 6) and they increase with the increase of the displacement value, the decrease of the female insert width and the decrease of the ball diameter. The deformations of the female inserts are maximal in the same areas (Fig. 7). Regarding the stresses in the metal ball, they are present around the neck and on their top (Fig. 8). In the metal housing high stresses were located around the balls greatest circumference (Fig. 9).

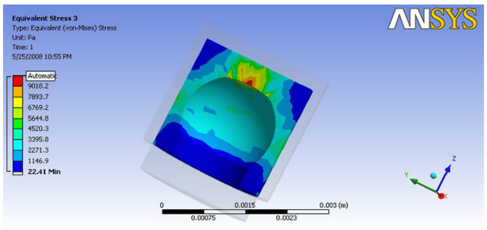


Fig. 6: Stresses in the female insert

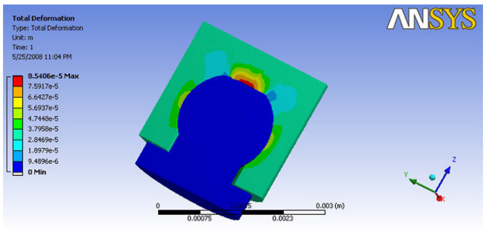


Fig. 7: Displacements in the female insert

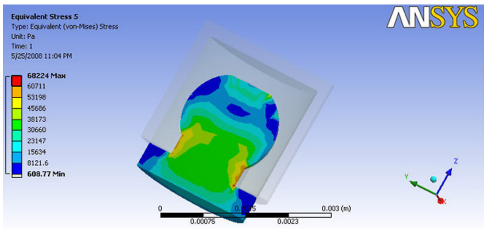


Fig. 8: Stresses in the metal ball

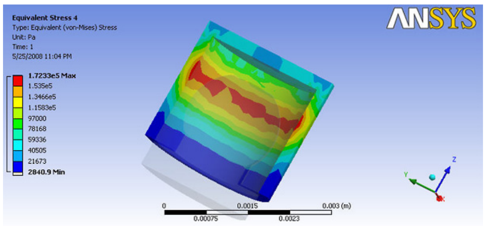


Fig. 9: Stresses in the metal housing

Conclusions

Understanding the fundamentals of stud type attachments will is essential in the selection of the appropriate attachment for each clinical case. The described methods can generate experimental models, which can be used to select the preferable attachment size.

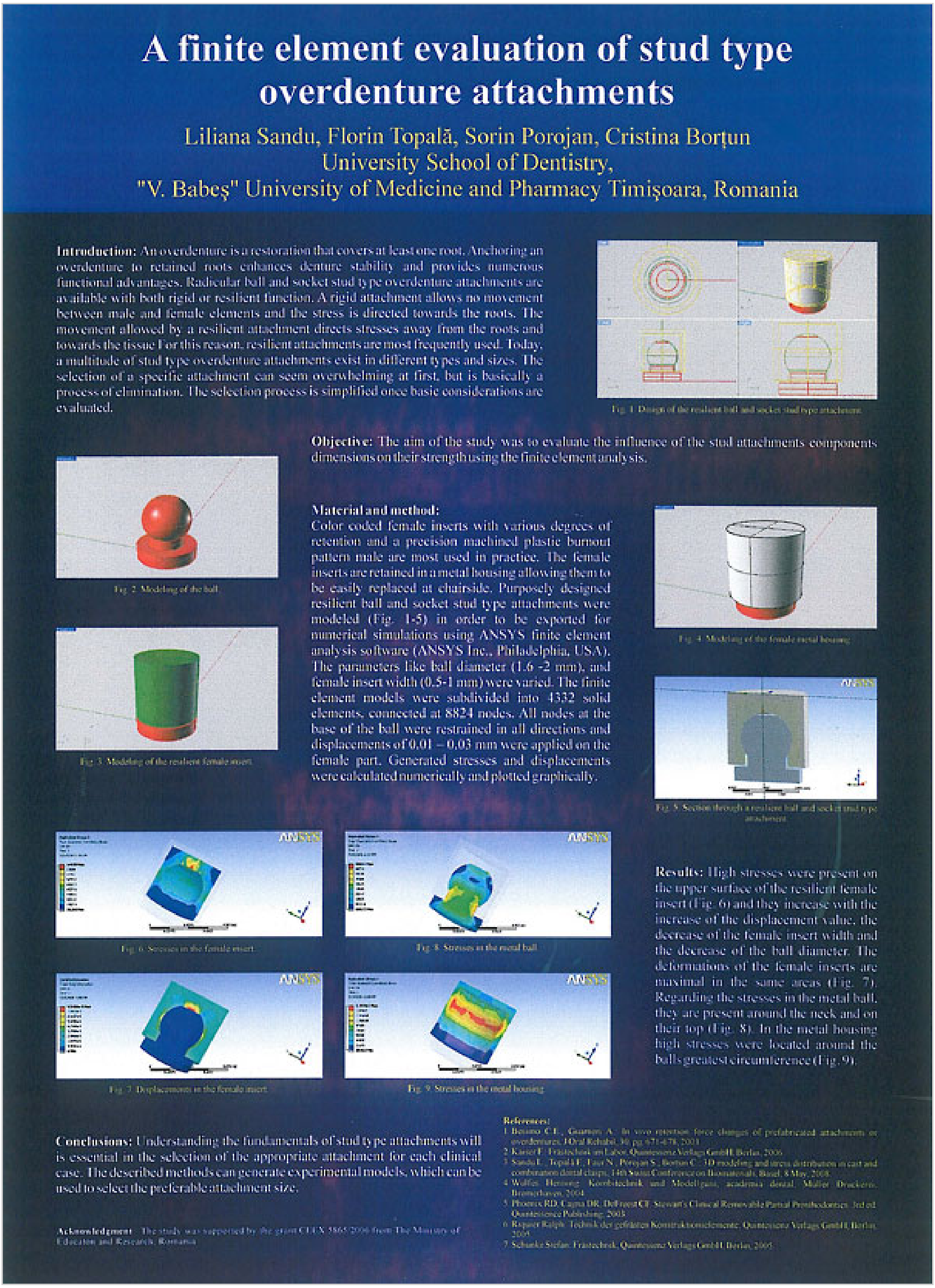
Literature

1. Besimo C.E., Guarneri A.: In vivo retention force changes of prefabricated attachments or overdentures, J Oral Rehabil, 30, pg. 671-678, 2003.
2. Kaiser F.: Frastechnik im Labor, Quintessenz Verlags-GmbH, Berlin, 2006.
3. Sandu L., Topala F., Faur N., Porojan S., Bortun C.: 3D modeling and stress distribution in cast and combination dental clasps, 14th Swiss Conference on Biomaterials, Basel, 8 May, 2008.
4. Wulfes Henning: Kombitechnik und Modellguss, academia dental, Muller Druckerei, Bremerhaven, 2004.
5. Phoenix RD, Cagna DR, DeFreest CF. Stewart's Clinical Removable Partial Prosthodontics. 3rd ed. Quintessence Publishing, 2003.
6. Riquier Ralph: Technik der gefrästen Konstruktionselemente, Quintessenz Verlags-GmbH, Berlin, 2005.
7. Schunke Stefan: Frästechnik, Quintessenz Verlags-GmbH, Berlin, 2005.

This Poster was submitted by Assoc. Prof. Dr. Liliana Sandu.

Correspondence address:
Assoc. Prof. Dr. Liliana Sandu
"Victor Babes" University of Medicine and Pharmacy Timisoara
University School of Dentistry
6 Socrate Str.
code 300552 Timisoara, Romania

Poster Faksimile:



A finite element evaluation of stud type overdenture attachments

Liliana Sandu, Florin Topală, Sorin Porojan, Cristina Borţun
University School of Dentistry,
"V. Babeş" University of Medicine and Pharmacy Timişoara, Romania

Introduction: An overdenture is a restoration that covers at least one root. Anchoring an overdenture to retained roots enhances denture stability and provides numerous functional advantages. Radicular ball and socket stud type overdenture attachments are available with both rigid or resilient function. A rigid attachment allows no movement between male and female elements and the stress is directed towards the roots. The movement allowed by a resilient attachment directs stresses away from the roots and towards the tissue For this reason, resilient attachments are most frequently used. Today, a multitude of stud type overdenture attachments exist in different types and sizes. The selection of a specific attachment can seem overwhelming at first, but is basically a process of elimination. The selection process is simplified once basic considerations are evaluated.

Fig. 1 Design of the resilient ball and socket stud type attachment

Objective: The aim of the study was to evaluate the influence of the stud attachments components dimensions on their strength using the finite element analysis.

Fig. 2 Modeling of the ball

Fig. 3 Modeling of the resilient female insert

Material and method:
Color coded female inserts with various degrees of retention and a precision machined plastic burnout pattern male are most used in practice. The female inserts are retained in a metal housing allowing them to be easily replaced at chairside. Purposely designed resilient ball and socket stud type attachments were modeled (Fig. 1-5) in order to be exported for numerical simulations using ANSYS finite element analysis software (ANSYS Inc., Philadelphia, USA). The parameters like ball diameter (1.6 -2 mm), and female insert width (0.5-1 mm) were varied. The finite element models were subdivided into 4332 solid elements, connected at 8824 nodes. All nodes at the base of the ball were restrained in all directions and displacements of 0.01 – 0.03 mm were applied on the female part. Generated stresses and displacements were calculated numerically and plotted graphically.

Fig. 4 Modeling of the female metal housing

Fig. 5 Section through a resilient ball and socket stud type attachment

Fig. 6 Stresses in the female insert

Fig. 8 Stresses in the metal ball

Fig. 7 Displacements in the female insert

Fig. 9 Stresses in the metal housing

Results: High stresses were present on the upper surface of the resilient female insert (Fig. 6) and they increase with the increase of the displacement value, the decrease of the female insert width and the decrease of the ball diameter. The deformations of the female inserts are maximal in the same areas (Fig. 7). Regarding the stresses in the metal ball, they are present around the neck and on their top (Fig. 8). In the metal housing high stresses were located around the balls greatest circumference (Fig. 9).

Conclusions: Understanding the fundamentals of stud type attachments will is essential in the selection of the appropriate attachment for each clinical case. The described methods can generate experimental models, which can be used to select the preferable attachment size.

Acknowledgment: The study was supported by the grant CEEX 5865/2006 from The Ministry of Education and Research, Romania

References:
1. Besimo C.E., Guarneri A.: In vivo retention force changes of prefabricated attachments in overdentures. J Oral Rehabil. 30, pg. 671-678, 2003
2. Kaiser F. Frästechnik im Labor. Quintessenz Verlags GmbH Berlin, 2006
3. Sandu L., Topală F., Faur N., Porojan S., Borţun C.: 3D modeling and stress distribution in cast and combination dental clasps, 14th Swiss Conference on Biomaterials, Basel, 8 May, 2008
4. Wulfes Henning: Kombitechnik und Modellguss, academia dental, Müller Druckerei, Bremerhaven, 2004
5. Phoenix RD, Cagna DR, DeFreest CF. Stewart's Clinical Removable Partial Prosthodontics. 3rd ed. Quintessence Publishing, 2003
6. Rupauer Ralph: Technik der gefräßten Konstruktionselemente, Quintessenz Verlags GmbH Berlin, 2005
7. Schunke Stefan: Frästechnik, Quintessenz Verlags GmbH Berlin, 2005