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Maxillary "All-On-Four" treatment using zygomatic implants. A mechanical analysis

Procédure « All-On-Four » maxillaire avec implants zygomatiques. Analyse mécanique

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Summary

Objective. Zygomatic implants may be used for dental rehabilitation in atrophic maxillae. The aim of this study was to establish experimentally the areas of stress distribution using 2 kinds of "All-On-Four" maxillary procedures.

Study design. The best position to insert the implants was selected using polyurethane craniomaxillary models and surgical guides were made. Group 1 was designed with two posterior zygomatic implants and two conventional anterior implants, and group 2 with two posterior zygomatic implants and two anterior zygomatic implants. A titanium bar was built to link the 4 implants in both groups. Photoelastic replicas of these models were made and the implants were inserted using the surgical guides. An Instrom 4411 testing machine was used to perform a unilateral compressive loading at the level of the right first molar until 2 mm of displacement was obtained.

Results. Group 1 showed a high strain concentration in the right lateral orbital region at the level of the apex of the zygomatic implant. Less strain was noticed at the apical levels of the conventional implants in the anterior sector and of the contralateral zygomatic implant. Group 2 showed high strains in the lateral inferior orbital area. The load was low in the alveolar bone sector.

Discussion. Zygomatic bone and paranasal structures are loaded at high levels when zygomatic implants are used to stabilize a full maxillary prosthodontic rehabilitation on 4 implants. The use of 4 zygomatic implants loads the alveolar bone to a lower extent and

Résumé

Objectif. Les implants zygomatiques peuvent être utilisés pour la réhabilitation dentaire des maxillaires atrophiques. L'objectif de cette étude était d'établir expérimentalement la distribution des contraintes lors de l'utilisation de 2 types de procédure « All-On-Four » maxillaire.

Matériel et méthode. La position idéale des implants a été déterminée sur des modèles cranio-maxillaires en polyuréthane et des guides de pose ont été réalisés. Dans le groupe 1, deux implants zygomatiques postérieurs et 2 implants antérieurs conventionnels ont été placés. Dans le groupe 2, deux implants zygomatiques postérieurs et 2 implants zygomatiques antérieurs ont été placés. Une barre en titane reliant les 4 implants a été confectionnée dans les 2 groupes. Des répliques en résine photoélastique de ces modèles ont été réalisées et les implants ont été mis en place en utilisant les guides de pose. Une presse Instrom 4411 a été utilisée pour mettre en charge les modèles en compression au niveau de la première molaire droite jusqu'à un déplacement de 2 mm.

Résultats. Dans le groupe 1, une forte concentration de contraintes a été observée dans la région orbitaire latérale droite au contact de l'apex de l'implant zygomatique. Des contraintes moins importantes ont été observées au niveau des apex des implants conventionnels dans le secteur antérieur et de l'implant zygomatique controlatéral. Dans le groupe 2, des contraintes élevées ont été observées dans la zone orbitaire inférieure latérale. Des contraintes peu élevées ont été notées au niveau de l'os alvéolaire.

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seems better suited from a mechanical point of view than the use of 2 zygomatic implants.

Keywords: Dental implants, Zygomas, Stress, Mechanical

Discussion. Le zygoma et les structures osseuses paranasales sont soumis à de fortes contraintes lorsque des implants zygomatiques sont utilisés pour stabiliser une prothèse maxillaire complète sur 4 implants. Le montage à 4 implants zygomatiques sollicite moins l'os alvéolaire et semble donc mieux adapté sur le plan mécanique que le montage à 2 implants zygomatiques.

Mots clés : Implants dentaires, Zygomas, Stress mécanique

Introduction

Zygomatic implants have been used routinely in recent years [1]. Their use in both immediate and delayed loading has proven efficient with few complications [2,3]. Their great advantages are the short period for prosthetic rehabilitation and the uselessness of bone grafts [2,4].
Disadvantages such as the final position of the implants for the adequate installation of the prosthesis have been overcome by modifications of the abutments and of the surgical technique [5]. In this sense, one of the major disadvantages is that there is almost no choice in the type of prosthodontic rehabilitation. Biological complications like mucositis and sinusitis are still reported as potential causes of treatment failure [6].
The position and number of implants as well as the different routes towards the sinus (intra-sinusal, extra-sinusal) have been assessed [7,8]. The use of conventional implants in the anterior region has also been discussed [8].
Current trends in reducing the number of implants using only 4 anchoring units have been successful [9]. Zygomatic implants have shown favorable clinical outcomes [10].
Anatomical conditions required for insertion of zygomatic implants vary with patient's age, bone resorption increasing with edentulism duration [11].
The aim of this study was to determine the stress distribution in a photoelastic model using two kinds of "All-On-Four" implantation system.

Material and method

Design of the models

Tooth-bearing polyurethane skull and maxillae models were used (Nacional, Jaú, Sao Paulo, Brazil). From these models, ideal implant positions were determined and surgical acrylic guides were realized.
Craniomaxillary replicas of these models were then created in photoelastic resin (Polipox III®). Residual bubbles where eliminated by vacuum. Implants (INP – Sistema de Implantes Nacionais e Prótese, Sao Paulo, Brazil) were inserted in the model as planned using the surgical guides. Care was taken not to induce any strain prior to testing.
The zygomatic implants were 4.0 mm in diameter and had a length of 50.0 mm when placed in the posterior region and of 52.5 mm when placed in the anterior region. The standard implants in the anterior sector had an external hexagon connection of 3.5 mm in diameter and had a length of 10 mm.

Suprastructure design

A titanium bar of 3.0 mm in diameter was used to connect the implants. The bar was passively welded to the UCLA-type titanium implant abutments (Sistema de Implantes Nacionais e Prótese, Sao Paulo, Brazil).

Two groups were established

Group 1: two zygomatic implants in the posterior area (position of first molar) and two standard implants in the anterior area (position of canines) (*fig. 1*).
Group 2: two zygomatic implants in the posterior area (position of first molar) and two zygomatic implants in the anterior area (position between first premolar and canine) (*fig. 2*).

Mechanical assay

A compressive load was applied in the sector of the abutment corresponding to the right first molar using 2 mm displacement at a speed of 1 mm/minute by means of an Instrom 4411

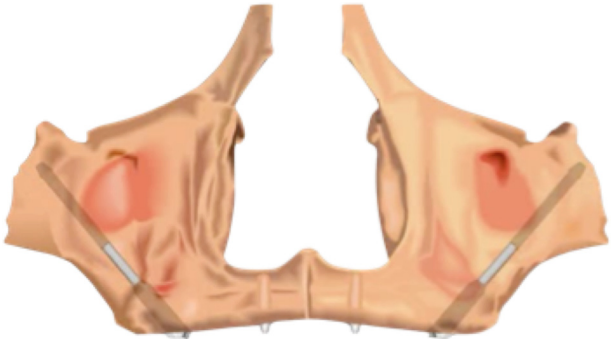

Figure 1. Group 1: model using 2 zygomatic implants posteriorly and 2 conventional alveolar implants anteriorly.