

# Porous surface of extraoral implants: report of two cases rehabilitated with a new Brazilian extraoral implant

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## Abstract

Maxillofacial defects caused by cancer treatment are a huge problem, affecting the quality of life of patients. Some of these deformities are minimized using facial epistheses, which needs some additional retention devices, like glasses or skin adhesives. The use of extraoral fixtures as bone anchorage was introduced many years ago and since then many patients were rehabilitated with better results. Nevertheless, in many cases due to poor bone conditions (i.e. irradiated bone) the success rate of implants are not so good, causing difficulties to rehabilitate the cases. One possible cause of fixture failure could be the poor primary stability achieved in some cases, due to the small dimensions of the fixtures causing a few bone contact with the surface of the implant. Nowadays many researches are being done related to the surface of the fixture, searching for a better primary stability and for a increase of bone contact. Ordinary extraoral implants usually possess a machined surface, until now there is no published report about surface modifications in this kind of implant. This paper presents a new porous surfaced Brazilian extraoral implant (MasterExtraâ, Conexão, Sistema de Próteses, São Paulo, Brazil) that can provide optimal facial rehabilitation due to enhanced bone-to-implant contact and greater long-term stability. Two case reports are described to elucidate its use.

## Key Words:

extraoral implants, maxillofacial prostheses, facial rehabilitation.

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## Introduction

The loss of facial structures through ablative or traumatic activities may produce significant psychological trauma in the patient, aggravating the actual physical loss. Although surgical procedures, as autogenous grafting, may be able to fill in or close off large defects, the final result may be less than optimal in providing acceptable levels of function and aesthetics, hence leading to a decreased quality of life to the patient.

Prosthetic restoration of facial defects is also an option of rehabilitation, however its success depends on satisfactory retention and stability. The standard technique for retention of facial prostheses has been through the use of adhesives. Prolonged use of adhesives on the skin often leads to inflammation of the skin and associated tissues, which produces discomfort and an unnatural appearance of the junction between the prosthesis and the skin, which in turn might lead to avoidance of wearing the prosthesis. In addition, correct positioning of the prosthesis is often affected.

With the advent of osseointegration in dental rehabilitation<sup>1</sup> and recent advances in surgical and laboratory techniques, it has been possible to transfer and extend the osseointegration principle to facial rehabilitation. Retention, stability and aesthetics have been significantly improved with the use of endosseous implants, resulting in more natural appearing and functioning prostheses. In 1977, at the Sahlgrenska Hospital, University of Göteborg, Sweden, the first endosseous implants were installed in the temporal bone<sup>2</sup>. In a later stage, a percutaneous abutment was connected to the implant to support a bone conduction hearing processor. In 1979, at the same institution, the first implants were placed in the mastoid region to retain an auricular prosthesis<sup>2</sup>. Since then, endosseous implants have been internationally used for this, and other purposes.

To compensate for the lesser bone quantity in the temporal, orbital and midface regions, compared to the maxilla and the mandible, extraoral implants are shorter than intraoral implants, 3-5 mm in length vs. 10-18 mm respectively, with a peripheral flange. This flange will increase the implant surface area in contact with the bone. Perforations in the flange add additional surface area and will also provide mechanical stability. Ordinary extraoral fixtures possess a machined surface whereas in intraoral fixtures various surface modifications of the titanium implant are used to increase the mechanical interlocking, at both, microscopical and macroscopical level, between bone and implant<sup>3</sup>. Several different techniques i.e. particle blasting, plasma sprayed coatings and wet chemical etching, have been used to modify the implant surface.

In this paper we report two cases of facial rehabilitation with the use of a new Brazilian extraoral implant with a Ti-blasted and etched surface (MasterExtra®, Conexão, Sistema de

Próteses, São Paulo, Brazil). Until now extraoral implants were commercially available only with a machined surface and 3 mm or 4mm long. In the present paper we describe the first extraoral implant produced with surface modifications to enhance implant stability. In addition, this new implant is fabricated with more options of length, varying from 3 mm to 8mm.

Resonance Frequency Analysis (RFA) technique was employed to measure clinical implant stability together with clinical examinations of function and esthetics. The resonance frequency of a transducer attached to the implant abutment was measured by using a frequency response analyzer, a personal computer and dedicated software (Osstell®, Integration Diagnostics, Sweden). The measurements are expressed in Implant Stability Quotients (ISQ; range 1-100). This quotient is based on the resonance frequency of the transducer on a scale from 3.500 Hz (0 ISQ) to 8.500 Hz (100 ISQ), and, a higher ISQ value corresponds to a higher stability. It is considered optimal values those above 60<sup>4</sup>.

Randomly selected extraoral fixtures were also examined by scanning electron microscopy (SEM) in order to verify the microscopical structure of the surface. These examinations were performed in a LEO Gemini 982 analytical SEM.

## Case Reports

**Patient 1.** A 23-year-old male was referred for evaluation of definitive prosthetic rehabilitation with a bone-anchored auricular prosthesis (Figure 1a). He had lost his right ear 3 years ago in a car accident. Until this clinical evaluation he had been using a hat to hide his defect since the accident. At the time of referral he attended a course at the university but due to psychological difficulties of facing his colleagues at school he stopped studying.

Using standard technique for fixture placement, 2 extraoral implants (MasterExtra®, Conexão, Sistema de Próteses, São Paulo, Brazil) were placed in the mastoid process (Figure 1b). The implants were left unloaded for 3 months (Figure 1c). After impression, a metallic bar was fabricated and connected to the abutments. For the next step, magnets were retained to the bar (Figure 1d). Magnets were sealed into place with acrylic resin; corresponding magnets were placed within the silicone prosthesis to permit automatic correct positioning of the prosthesis (Figure 1e). As the prosthesis was finalized, the patient was able to return to school to finish his studies (Figure 1f).

At the 1-year follow-up RFA was performed. The RFA measurements were performed at the fixture level. The ISQ values were 76 for both fixtures indicating an optimal healing in of the extraoral fixtures. These values correspond to values found in this region by Heo *et al.*<sup>4</sup> or actually somewhat higher ISQ values.

There were no signs of skin irritation or ongoing infections around the implants.



**Fig. 1a.** Close-up photograph of the auricular defect.



**Fig. 1d.** Construction of a bar with magnets for retention of the prosthesis.



**Fig. 1b.** Insertion of the fixtures in the mastoid area.



**Fig. 1c.** Incision closed and the implants left unloaded.



**Fig. 1e.** The auricular prosthesis in place.



**Fig. 1f.** Final aesthetic result.

**Patient 2.** A 28-year-old female with an orbital defect due to tumor surgery was referred for evaluation of prosthetic rehabilitation with a bone-anchored orbital prosthesis (Figure 2a). She had a history of retinoblastoma of the right eye, which was treated by surgical eradication and radiotherapy when she was 5 years old.

Using standard technique 4 extra-oral implants (MasterExtra®, Conexão, Sistema de Próteses, São Paulo, Brazil) were placed in the frontal bone (Figure 2b, 2c). In the orbit, usually three implants are used to retain the prosthesis, but due to a higher rate of implant loss in the frontal bone, and in particular in irradiated patients, one implant was placed additionally to compensate for potential implant loss.

After a healing-in time of 6 months the implants were exposed. At this time, all implants were clinically well integrated but only three implants were chosen to be exposed for retention of the prosthesis. As in Case 1, the same type of metallic bar with magnets was fabricated for prosthesis retention (Figure 2d, 2e).

Resonance frequency analysis, RFA, was in this case performed 1 month after prosthesis placement. Also in this case all measurements were performed at the fixture level. The ISQ was 68 (Figure 2f) for the medial and lateral fixtures and 76 for the central fixture, corresponding to well incorporated and integrated fixtures. There were no signs of

skin irritation or ongoing infections around the implants. Before the rehabilitation with extraoral implants the patient used an adhesive retained prosthesis. The use and required daily removal of the adhesive removed her right eyebrow. She was forced to compensate it with make-up. Today she is very satisfied with her new implant supported prosthesis and she has her eyebrow back.



**Fig. 2a.** Orbital defect.



**Fig. 2b.** Preparation of the holes in the orbit and implant close-up.



**Fig. 2c.** Insertion of 4 fixtures.



Fig. 2d. Bar with magnets for retention of the prosthesis.

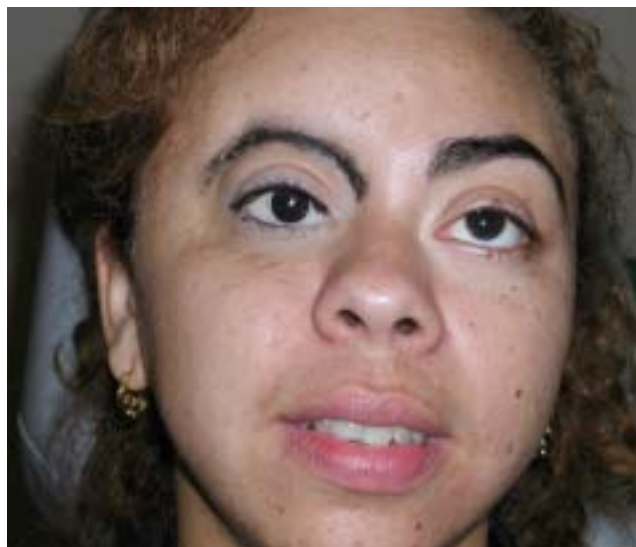


Fig. 2e. Orbital prosthesis in place.



Fig. 2f. Resonance Frequency Analysis measurement.

## Discussion

A facial defect due to congenital or acquired deficits often has a significant psychological impact<sup>5-6</sup>. Some methods for facial rehabilitation have been described, but the great majority does not restore patient's self-confidence. Facial rehabilitation with prostheses retained by implants has provided a new horizon for these patients because it offers adequate mechanical retention and accurate positioning of the prostheses<sup>7</sup>. The use of implants improve patient's quality of life, making possible participation in routine activities and function in society with confidence that their defect will be less noticeable. This has also been proved in patients receiving intraoral implants for treating total edentulousness<sup>8</sup>.

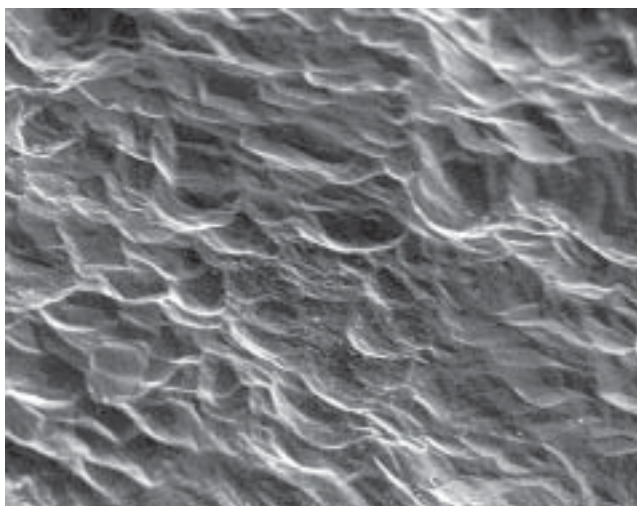
It has been reported that the bone integration of titanium implants is modulated by its surface characteristics. Based on this concept, various titanium implants with different types of surface roughness or morphology have been developed to optimize bone integration. The percentage of direct bone-implant interface of a rough titanium implant is greater than that of a smooth implant<sup>9-10</sup>.

From the scanning electron microscopical investigations performed in the present study, it is obvious that the surface is greatly enhanced by the blasting and etching procedures used (Figure 3a, 3b).

Long-term function of osseointegrated implants is dependent on implant stability as the implant is subjected to stresses associated with supporting, retaining and stabilizing prosthetic restorations. The use of porous-surfaced implants in facial rehabilitation may offer an increased implant stability and load bearing capacity. Furthermore, it may also shorten the healing-in time of the implants, i.e. a decreased period between fixture installation and abutment connection (prosthetic reconstruction).

By means of the resonance frequency analysis technique, implant stability can be clinically measured and followed with time. Bone loss will be detected as a decrease of the resonance frequency, which is expressed in Implant Stability Quotients (ISQ) varying from 1 to 100. In the present paper, both cases revealed high ISQ values. It was measured 76 in each fixture inserted in the auricular case. In the orbital case the ISQ was 68 for the medial and lateral fixtures and 76 for the central fixture. ISQ values higher than 60 indicated a high stability at the timepoints measured<sup>4</sup>. However, RFA measurements must be accompanied by clinical testing and evaluation for each individual fixture in each patient.

In conclusion, the extraoral porous implant presented and used in this study, is an excellent and promising alternative in facial rehabilitation by means of osseointegrated implants. New studies must be performed analyzing both experimental and clinical long-term results.



**Fig. 3a** - Scanning electron micrograph of the implant surface.



**Fig. 3b** - Scanning electron micrograph of the implant used in the study

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