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### **Implant treatment in completely edentulous mandible patients by means of fixed prostheses**

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#### **ABSTRACT**

*Introduction.* The aim of this study was to demonstrate the results of treatment with fixed implant-supported prostheses in completely edentulous mandible patients.

*Method.* 29 patients were treated with 190 Microdent ® implants with sandblasted surface for the fixed mandibular prostheses. The implants were loaded after a 3-month healing period. Clinical follow-up was a minimum of 12 months.

*Results.* Clinical results indicate a 97.9% implant survival and success rate. 4 implants were lost during the healing period. 58.6% of the prostheses were screw fixed, 41.4% were cemented. After a 41.4 month average period of functional loading, there were no late complications.

*Conclusions.* This study shows that treatment with fixed implant-supported prostheses in edentulous mandible patients constitutes a successful dental rehabilitation therapy.

#### **KEY WORDS**

oral implants, fixed prostheses, edentulous mandible, implant-supported prostheses, oral implantology.

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#### **INTRODUCTION**

Knowledge of the biological phenomena involved in osseointegration and the development of oral implantology has resulted in the possibility of establishing and maintaining a rigid, clinically asymptomatic union between the bone and the implant that can successfully sustain implant-supported prostheses in the long-term 1.

Treatment with osseointegrated dental implants was fundamentally designed for the rehabilitation of completely edentulous patients. The treatment has had a very positive impact on both patients and the dentistry profession as a whole; it provides a therapeutic alternative to conventional prostheses, especially on the mandible, because of the functional incapacity suffered by most patients 2.

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Volume 19 - No. 3 - December 2007

Prosthetic rehabilitation with osseointegrated implants in a completely edentulous mandible can make use of a removable option, secured by the implant (overdenture) or a fixed option (rehabilitation) which requires the professional to make a complex decision about the patient, regarding the evaluation of oral factors (e.g. the degree of bone reabsorption, occlusal study) and extra-oral factors (e.g. the patient's expectations, economic cost). Fixed mandibular implant-supported rehabilitation is a very similar alternative to natural dentures, nevertheless, in implantological treatment of the edentulous mandible patient, both prosthodontic options on implants, removable and fixed, can fully satisfy the edentulous patient's demands (functionality, appearance, self-esteem) 3.

Fixed rehabilitation of the edentulous mandible can be carried out under several different clinical protocols depending on the number of implants (4-10 implants) and the type of prostheses (e.g. resin or ceramic, cemented or screwed) 4. Following Branemark's original protocol, 6 implants are inserted between the chin foramina for screw fixed prostheses with free rear ends 5. This same protocol is used with 4 or 5 implants, although due to the stress distribution, the design of the rear free end can increase the risk of biomechanical failures 6-7.

When this strict clinical protocol is followed, implant survival is high - between 90 and 98%. However, there are some cases when it is not possible to insert 5-6 implants in the edentulous mandible; in these cases, treatment with overdentures on 2 implants may be an alternative. The other possibility is to use complex surgical implantological techniques to increase bone availability (e.g. bone grafts, osteogenic distraction) 8.

Several studies have been published on treatment with fixed rehabilitation of the mandible with osseointegrated implants 2,6-7,9-10. A Swedish retrospective study reported 10-year results with fixed prostheses on implants inserted in 2 surgical phases (submerged) in completely edentulous patients:

71 patients were fitted with 13 fixed prostheses on 4 implants and 59 on 6 mandible implants (depending on bone availability), with success rates of 88.4% and 93.2%, respectively, indicating a greater tendency to failure in patients treated with 4 implants 9. A prospective Italian study evaluated the results after 10 years in 1,286 implants inserted in a surgical phase (non-submerged) in 233 completely edentulous patients with different types of prostheses - removable (overdentures) and fixed: 40 patients were rehabilitated with fixed prostheses on 8 mandible implants with a success rate of 96.2%, indicating that this protocol is a good treatment option 10.

The aim of this study is to evaluate the clinical results of treatment with fixed rehabilitation by osseointegrated implants in completely edentulous mandible patients.

## **PATIENTS AND METHODS**

This study was undertaken by lecturers from the department of Integrated Dentistry in Adults of the Faculty of Dentistry and the Oral Implantology Postgraduate Studies course of Seville University. Before the study, any patients with serious systemic disorders that could compromise osseointegration were excluded 11. Patients were adults of both sexes. All participants in the study were completely edentulous mandible patients. All patients were informed about the surgical technique, the prosthodontic protocol, timing, clinical follow-up, the possible existence of complications and loss of implants.

All patients were radiologically evaluated, with an orthopantomography (Fig. 1) and where necessary, with computerised axial tomography (CAT). The patients authorised the implant treatment by means of informed consent.

The implant success and survival criteria were those recommended by Van Steenberghe et al 12. Survival was defined as the proportion of permanent implants in their original location even though they have no clinical value or cause adverse effects. The implant success criteria are shown in Table 1.

## **AVANCES EN PERIODONCIA /152**

**Fig. 1:** *Orthopantomography of the patient before treatment.*

### **Surgery**

One hour before surgery, patients began a week long course of preventive antibiotic treatment (amoxicillin + clavulanic). In cases of discomfort, pain or inflammation, ibuprofen was recommended for all patients. All patients received local anaesthetic. All patients were advised to use a chlorhexidine mouthwash for the first 30 days. The implants used (external connection with sand blasted surface) were Microdent ® (Microdent, Barcelona, Spain) (Figs. 2-3). Where necessary, beta-tricalcium phosphate KeraOs ® (Keramat, Coruña, Spain) was used as biomaterial.

**Fig 2:** *Radiological aspect of the inserted implants .*

**Fig 3:** *Clinical aspect of the implants after the healing phase.*

### **TABLE 1.- SUCCESS CRITERIA IN TREATMENT WITH IMPLANTS (van Steenberghe et al 12)**

1. The implant does not provoke allergic, toxic, local or systemic infectious reactions.
2. The implant offers support for a functional denture.
3. The implant shows no signs of fracturing or curving.
4. The implant shows no signs of movement when manually or electronically explored.
5. The implant shows no signs of radiolucidity with intraoral x-ray.
6. Marginal bone loss (Rx intraoral) and/or loss of the insertion (depth of drilling + recession) should not harm the anchoring function of the implant or cause discomfort for the patient for 20 years.

## **Prosthodontics**

A complete conventional prosthesis was made during the implant healing period. 3 months after insertion of the implants, functional loading took place by fitting the corresponding fixed prostheses in the mandible (Figs 4-6). Clinical follow-up from functional loading was for a period of at least 12 months.

## **Statistical analysis**

Descriptive statistics of the clinical findings of the study were prepared with reference to the demographic variables of the patients and the implants and dentures fitted.

## **AVANCES EN PERIODONCIA/153**

Volume 19 - No. 3 - December 2007

**Fig. 4:** *Protesic phase. Fitting the impression posts.*

**Fig. 5:** *Protesic phase. Fitting the pillars on the implants.*

**Fig. 6:** *Protesic phase. Fitting the lower fixed oral implant-supported rehabilitation.*

## **RESULTS**

### **Patients**

29 completely edentulous mandible patients (16 men and 13 women) with an average age of 55.8 (range: 21-74) were treated with implants for fixed prosthodontic rehabilitation. 7 patients were smokers (24.1%). 8 patients had periodontal histories (27.5%).

### **Implants**

The 29 patients were fitted with 190 Microdent® implants - an average of 6.5 implants per patient. 179 implants measured 4 mm in diameter (94.2%), 10 implants were 5 mm (5.2 %) and 1 implant was 3.3 mm (0.6%). 10 implants were 16 mm long (5.3%), 32 implants were 14 mm (16.8%), 115 implants were 12 mm (60.5%) and 33 implants were 10 mm (17.4%). There were complications with 5 implants (2.6%): 4 implants showed movement (2.1%) when clinically explored during the healing phase free from functional load and they were removed; 1 implant presented periimplantitis, which was treated with a bone regeneration technique with no subsequent loss of bone. No implants were lost after prosthodontic functional loading in the clinical follow-up phase.

### **Implant-supported dentures**

The 186 remaining implants were functionally loaded at 3 months. In total, 29 fixed mandibular implant-supported rehabilitations were carried out, 17 screwed (58.6%) and 12 cemented (41.4%). Average clinical follow-up was for 14.1 months (range: 12-98 months). Only one patient showed a prosthodontic complication due to the fracture of a prosthesis component.

## **DISCUSSION**

Treatment of completely edentulous mandible patients by fixed rehabilitation with osseointegrated implants is a modern therapeutic alternative that requires an evaluation of

the patient, integrating diagnostic, surgical, prosthodontic and maintenance aspects that represent the different sequential stages for achieving success in this type of oral implantology 4. When this integral protocol is undertaken, expectations of success are very high; in our study there was 97.9% implant survival and 100% prosthesis success.

*From a diagnostic point of view*, fixed rehabilitation with osseointegrated implants in the edentulous mandible requires a full clinical history and a complete patient examination and exploration that includes preparation of study models and articulator fitting 13. Image diagnosis is also recommended as it provides vital information on the bone structure of the edentulous mandible 14. All patients participating in this study were diagnosed by means of a panoramic x-ray; in the most severe cases of bone reabsorption, computerised axial tomography (CAT) image diagnosis was also employed: .

In implant treatment on completely edentulous patients, the use of a splint is recommended in the radiological diagnosis and as a surgical guide for optimum location of the implants 15.

In this study, a radiological-surgical splint was used in all cases and this enabled better implant distribution, improved functional and aesthetic perspectives (load and stress distribution) with greater prosthetic restoration emergence.

*From a surgical point of view*, the insertion of implants in an edentulous mandible is a simple technique for an implantologist with sufficient clinical experience. The surgical implantological material (e.g. burs) is of excellent quality and the self-threading design of the implants enables correct insertion in most clinical situations 10.

However, oral factors (e.g. bad bone quality, incorrect drilling) and extra-oral factors (e.g. smoking) may very occasionally result in acute or immediate complications that compromise the primary stability of the implant, causing movement and loss 9-10. In this study, 4 implants (2.1%) showed clinical mobility during the healing phase and were removed.

Intense mandibular alveolar reabsorption with narrow alveolar crests as a consequence of complete edentulism over a long period of time and the existence of anatomical structures such as the dental nerve can increase the complexity of treatment with osseointegrated implants and require surgery to enable the insertion of implants with a sufficient guarantee of success. In these conditions, different techniques have been recommended, such as bone grafts, alveolar distraction and the lateralization of the dental nerve 8,16.

The quantity and morphology of the severely atrophied mandibular bone may necessitate the use of autologous bone grafting surgical techniques as well as the use of biomaterials to increase bone volume and facilitate implant treatment 16. Depending on the clinical conditions, implants can be inserted in the same surgical session or after a 3-4 month period 8.

No complex techniques for implant insertion (e.g. bone grafts) were used in this study as the selection of patients did not include clinical situations of extreme mandibular atrophy, except the use of biomaterials (beta-tricalcium phosphate) as a filling material in some cases of implant insertion, post-extraction or in bone defects produced during surgery.

The length of the implants can be an important factor in the success of the treatment - a direct relationship between greater length and the possibility of long-term success has been shown in cases of completely edentulous patients 10. 100% of the implants used in this study were more than 10 mm long, and 82.6% were of 12 mm or more.

Studies have been carried out on the insertion of short implants in cases of severe mandibular reabsorption as there is the advantage that there is a relatively simple surgical procedure with very little morbidity 17-18. However, insertion of short implants in cases

of extreme mandibular reabsorption has the fundamental disadvantage of negatively compromising the ratio between the length of the implant and the distance to the occlusal plane which causes unfavourable biomechanics 8,19.

In terms of number of implants, in this study an average of 6.5 implants were inserted per patient. The number of implants varies according to the individual study 5-7,10,20. When considering numbers of implants, in addition to the mandibular bone structure, biomechanical factors must also be taken into account: If the patient is 100% edentulous and the upper area is complete, rehabilitation of the mandible with a removable screwed resin prostheses will require less implants (4-6) inserted between the chin foramina 5-7,20; However, in cases of patients with natural upper teeth or partially edentulous maxillaries, lower fixed rehabilitation requires a wider distribution of implants towards the rear sections and the number of implants is usually greater (8-10) 4,10.

Implant diameter is another important factor as greater diameter can increase the contact surface between the bone and the implant. In other words, for implants of the same length, those of wider diameter have a greater area of bone contact 21. In this study, 99.4% of the implants inserted in had a diameter of 4 mm or more.

*From a prosthodontic point of view*, it is important to evaluate the interocclusal space, especially in patients that are also edentulous in the upper maxillary, as a wide discrepancy between both maxillaries may require a removable-fixed restoration with resin, rather than a fixed rehabilitation with porcelain, and, in very unfavourable cases, an overdenture 22. Functional loading with the corresponding prosthesis is the culmination of the treatment by fixed rehabilitation on mandible implants and should be established according to the integral evaluation of the patient, and, as far as possible, with advanced rehabilitation planning. This study carried out conventional functional loading at 3 months. However, in other clinical situations, when evaluation of the patient demonstrates favourable surgical and prosthodontic conditions, implant-supported mandibular rehabilitation can be carried out with early and even immediate loading protocols 23-25. In this respect, the importance of the of the latest, more anatomic designs and the new, rougher implant surfaces can be a decisive factor in early and even immediate loading, as greater primary stability and osseointegration that improves the implant to jawbone union can be achieved 23-25.

The type of connection used between the fixed rehabilitation and the osseointegrated implants (cemented or screwed) in the treatment of the edentulous mandible patient is a case by case decision that is made in accordance with professional experience. It is a decision that should be made during the treatment planning process, before surgery, to avoid adverse clinical situations that could compromise the functionality and aesthetics of the prosthetic rehabilitation 22,26-27.

In this study, of the 29 fixed mandibular rehabilitations on implants, 17 were screwed (58.6%) and 12 were cemented (41.4%). Screwed fixed mandibular rehabilitation on implants has the advantage easy removal (if necessary). However, a passive adjustment of the prosthetic structure with the implants is needed, as a consequence of a more complex laboratory process, which is always more difficult to achieve 14,26.

Cemented prostheses on implants offer an excellent appearance, the adjustment between the prostheses and the prosthetic pillars on the implants is easier and it is similar to conventional cemented restorations with drilled natural teeth 14,27.

The different types of implant prostheses can present complications, although, in terms of frequency, there is usually not much difference between cemented and screwed implants. Rear sectors present more complications than front and free ends should be avoided 28.

*From the point of view of maintenance*, fixed rehabilitation with osseointegrated implants in the edentulous mandible requires regular patient revision throughout the years. Regular controls are essential to avoid

complications and to achieve success rates of over 95% 10,20,29-31. Annual or six-monthly checkups (if there are complications) using clinical and radiological evaluation, enable control of the evolution of the periimplant tissues that are the permanent union of the implants to the mandibular bone 10.

Marginal bone loss is a frequent occurrence in long-term results as indicated in a 15-year Swedish study of 47 edentulous patients rehabilitated with fixed prostheses with a 98.9% global success rate (of 273 implants inserted with 2 surgeries, 3 implants failed) and a marginal bone loss of 0.5 mm in the first year, and 0.05 mm in successive years. This loss was greater in the frontal implants and was related to tobacco consumption and poor oral hygiene. None of the prostheses failed 29.

Although there are long-term studies indicating a 100% success rate for fixed prostheses in edentulous mandible implant patients 29, some prosthodontic maintenance is always necessary for patients treated with fixed mandibular rehabilitation implants, as demonstrated by a Canadian study with 33 completely edentulous patients with 29 fixed rehabilitations on the mandible, 4 in the upper maxillary and an average follow-up of 20 years - 31: In the first 7 years, the success of the implant prostheses was 97.8%. 6 fixed prostheses were later changed to overdentures due to implant loss (3 prostheses) and unfavourable biomechanical functioning (3 prostheses), which gave a success rate of 84.3% 31.

In the current study, there was a case of periimplantitis in 1 implant, which was successfully treated by bone regeneration. More general factors, such as tobacco consumption, a medical history of periodontal disease and poor oral hygiene may constitute a higher risk in some patients treated with implant prostheses 32. Poor oral implant hygiene could lead, in the long term, to greater marginal bone loss and this may compromise the success of the implantological treatment 29,31.

## **CONCLUSIONS**

Treatment of completely edentulous mandible patients by fixed rehabilitation, osseointegrated implants can be a good odontological option. It is a treatment that requires a case by case evaluation of each patient and it must consider the different diagnostic, surgical, prosthodontic and maintenance aspects as successive phases for achieving positive results.

## **ABSTRACT**

**Introduction.** The aim of this study was to demonstrate the results of treatment with fixed implant-supported prostheses in completely edentulous mandible patients.

**Methods.** 29 patients were treated with 190 Microdent ® sandblasted surface implants for fixed mandible rehabilitation. Implants were loaded after a healing free-loading period of 3 months. The follow-up period was a minimum of 12 months.

**Results.** Clinical results indicate an implant survival and success rate of 98.3%. 4 implants were lost during the healing period. 58.6% of patients were fitted with screw fixed

cemented prostheses, 41.4% with fixed prostheses. After a mean functioning period of 14.1 months, no late complications were reported.

*Conclusions.* This study indicates that treatment with fixed prostheses dental implants in completely edentulous mandible patients constitutes a successful dental rehabilitation therapy.

#### **KEY WORDS**

Dental implants, fixed prostheses, edentulous mandible, implant-support prostheses, implant dentistry.

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