In recent years, after the successful introduction of the concept of osseointegration by Brånemark, implant dentistry has advanced rapidly, and with this advance, new complications have also appeared. A plethora of articles describing its successful use in oral rehabilitation have been written and reviewed. However, in the course of this rapid advance, an important challenge is faced in the rehabilitation of patients with total edentulism in the maxilla.

Edentulism is a debilitating and irreversible condition described as the “final marker of the burden of disease for oral health.” Although the prevalence of complete dental loss has declined in the last decade, it remains a major disease worldwide, especially among older adults. Many factors influence the prevalence of edentulism in different countries and regions, such as economic status, education, oral health care, lifestyle, and attitudes toward dental care. Edentulism is associated with a multitude of systemic comorbid conditions. The edentulous patient is at risk of reduced nutritional intake and obesity and is faced with an increased risk of COPD-related events. Moreover, the risk of decline in cognitive function appears to be greater in the edentulous population. Edentulism can directly lead to a change in people’s general and oral health and, therefore, in their quality of life.

Dental implant therapy is being used on a large scale to replace missing teeth to rehabilitate edentulous patients with overdentures and fixed prostheses supported by implants as a method to overcome the problem of instability and lack of retention associated with conventional removable prostheses. The improvement in the retention and stability of prosthetic

Results of Total Maxillary Edentulism Rehabilitation Protocol with Implant-Supported Prostheses in the Pterygomaxillary-Pyramidal Region as Posterior Anchorage Loci

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Purpose: To present functional and esthetic success of a well-defined protocol for rehabilitation with implant-supported complete-arch prostheses in the treatment of patients with maxillary edentulism. Materials and Methods: Medical records of patients treated from 1990 to September 2014 were reviewed. This clinic history should include clinical, anatomical-functional, and esthetic data for at least the first 5 years of follow-up. Results: Two hundred eighty-two implants were inserted into the pterygomaxillary-pyramidal region in 141 edentulous patients using cylindrical osteotomes to form bone sites and thereby minimize the use of drills in bone preparation. Also, 580 implants were inserted in the premaxilla using lyophilized bone of bovine origin as a graft material and platelet-rich plasma for repairing small bone defects around implants and as a volume-generating material to support perioral structures. Of the 282 implants placed in the pterygomaxillary-pyramidal region, 272 survived (96.1% survival rate). The 10 failures occurred after being subjected to functional load. Of the 580 implants placed in the premaxilla, 19 implants failed; thus, the survival rate was 96.7%. Moreover, from the results obtained in the study sample, it was observed that the retention and stability obtained with the implant-supported prosthesis helps improve the ability to speak, swallow, and chew, which improves patient comfort and satisfaction. Conclusion: The rehabilitation of total maxillary edentulism with an implant-supported complete-arch prosthesis achieves a high level of functional and esthetic success, which is reflected directly in oral health and patient satisfaction. Int J Oral Maxillofac Implants 2020;35:767–772. doi: 10.11607/jomi.8124

Keywords: full edentulism, platelet-rich plasma, prostheses, pterygoid implants
rehabilitation through implant-supported prostheses leads to improved speech and esthetics, a greater ability to chew and swallow and, thereby, patient comfort and satisfaction.12

Rehabilitation of the maxilla deserves special attention. It is well known that the rehabilitation of the anterior maxilla and the posterior segment present different challenges due to their anatomy.13 While in the posterior sector, the quantity and quality of bone is important to establish robust pillars for the placement of the prosthesis, the challenges have a more functional and esthetic orientation in the anterior sector, since there is usually a quantity and quality of bone appropriate for implant placement. In fact, in recent years, there have been advances in technology (rough-surface implants) and the availability of better graft materials. In this context, the great utility of platelet-rich plasma (PRP) for soft tissue healing and bone regeneration is recognized, alone or as an adjuvant in combination with lyophilized bone in regenerative therapy.14

The difficulty in placing implants in the posterior maxilla is due to factors such as a low amount of subsinusal bone, pneumatization of the maxillary sinus, and low bone density in the maxillary tuberosity. In edentulous patients, the degree of oral disability can justify aggressive techniques with general anesthesia or bone grafts (onlay, inlay, or Le Fort I).15–17 However, these techniques involve different areas and several surgical stages. In case of greater morbidity, treatment may stretch over a long period. Two less-aggressive techniques for the management of edentulism in this anatomical area are sinus augmentation18 and placement of implants in the pterygomaxillary-pyramidal junction.19

Another important consideration is that the resorption of the maxilla occurs both vertically and centripetally, which increases the prosthetic space to be restored, and in most cases, a more-or-less retractive situation arises with respect to the mandibular arch for the maxilla.20 These various considerations influence the choice of prosthetic rehabilitation that the patient needs for achieving adequate occlusion, correct facial third, and also correct support of the perioral soft tissues, mainly of the upper lip and nasogenian grooves.

This study analyzed the long-term success of a strictly defined protocol for the functional and esthetic anatomical rehabilitation of patients with total maxillary edentulism through implant-supported full-arch fixed prostheses.

MATERIALS AND METHODS

For inclusion in this protocol, the patient was required to have, at the time of diagnosis: (1) posterior sectors (subsinusal areas) with 10 mm or less bone height between the sinus floor and the maxillary residual crest; (2) in the premaxillary area, sufficient bone for the insertion of at least four implants, two of them of 13 mm and the others of at least 10 mm; (3) in the preexisting bone, partial defects that affect a maximum of 25% of the implant length and no more than two bone surfaces. All patients had been treated with two implants in the posterior maxillary sectors, each in the maxillary tubers, which were inclined and had their apical anchorages in the maxillo-pterygo-pyramidal conjunction, and at least four implants in the premaxilla, and they had been rehabilitated with a full-arch implant-supported fixed prosthesis, ie, including molars.

Implants used in this protocol were MkII and MkIII Ti Unite (Brånemark System, Nobel Biocare). Medical records of the patients treated from 1990 to September 2014 were reviewed.

Study Protocol

A comprehensive evaluation of each patient was performed. From a clinical and radiographic study with orthopantomography and cone beam computed tomography scan (CBCT) with high resolution (Cranex 3D System, Soredex), the quantity, quality, and bone morphology in the coronal, sagittal, and horizontal planes were inferred to establish the exact location of the implants and occlusion. The antagonistic arch determines the material to be used in the maxillary prosthesis only if the loss of spatial relationship in different planes is relevant between the maxilla and antagonistic arch. The number of pieces of the prosthesis is determined by the analysis conducted; in any case, one molar has always been restored per quadrant and a minimum of 12 pieces per arch. A study of the prosthetic space and the fabrication of template for radiography and surgical positioning was also carried out.

Implant placement in the pterygo-pyramidal region was performed according to the technique described by Fernández Valerón and Fernández Velázquez.21 In the premaxilla, all patients had received at least four implants (≥ 10 mm). Until 2000, the graft material used was lyophilized bone of bovine origin (OCS-B Xenomatrix, Nibec) with physiologic serum. Since then, the use of PRP has been incorporated as an adjuvant to lyophilized bone in implants in the premaxilla, always with the purposes of repairing small bone defects around implants and as a volume-generating material to support perioral structures (upper lip), and never as primary support material for implants.

Post-surgical Protocol

This protocol included the administration of an oral antibiotic (amoxicillin 500 mg every 8 hours) and an oral nonsteroidal anti-inflammatory analgesic (ibuprofen 400 to 600 mg every 8 hours) for 3 days after...
surgery. The first exam was done 24 hours after surgery. Seven days after surgery, the suture was removed and a provisional complete prosthesis with soft material was adapted. Patients were examined monthly over 6 months following the treatment.

The clinical and radiologic criteria followed in this protocol are those described by Albrektsson et al. In addition, the patient’s medical history includes the patient’s condition for functional factors (speech, chewing, and swallowing), esthetics (symmetry of the lower facial third, vertical dimension, nasogenial grooves, and labial folds), and quality of life (diet, habits, support of perioral tissues, satisfaction, and social security) before treatment. Each of these aspects was reviewed in the follow-up of the patients.

All implants had been functionally loaded after 9 weeks postsurgery, based on the biologic criteria of bone healing. After the placement of the prosthesis, the clinical and radiologic examinations took place at 3 and 6 months and annually thereafter.

During the 5 years of follow-up, annual dental hygiene and a periodontogram were performed. Additionally, a radiographic review was done every 2 years.

In this protocol, the failures between surgery and delivery of the prosthesis were considered as early failures, and subsequent failures have been considered late failures. All cases collected in this study have been under functional load for a minimum of 5 years.

**Statistical Analysis**

For the statistical analysis, all continuous variables were reported as means (SD). Implant survival rates were estimated using the Kaplan-Meier method (GraphPad Software). Multivariate Cox risk models (SPSS for Windows, SPSS) were performed to assess the independent contributions of variables such as age, sex, and smoking in the patient outcome. In addition, the cumulative success rate was calculated using the life-table analysis described by Cutler and Edeler.

**RESULTS**

From September 1990 to August 2014, 282 implants were placed in the pterygomaxillary-pyramidal region, and 580 implants were placed in the premaxilla in 141 patients who showed total edentulism in the maxilla (Fig 1). The sample comprised 81 women and 60 men between 45 and 75 years of age. Eleven patients from the initial group of 153 were excluded, two patients died, and nine patients withdrew for various reasons. However, the reasons for these exclusions were not related to the protocol.

For the remaining 141 patients in this study, the age at the time of implant placement ranged from 45 to 75 years. The mean age was 62.88 ± 6.9 years.

There were 10 failures among the 282 implants placed in the pterygoid and 19 failures among the 580 implants placed in the premaxilla. All these were late failures because they occurred after being subjected to functional load. There was no statistical association between implant survival and patient age ($P = .8$) or sex ($P = .55$). However, it will be highlighted that approximately 60% of the failures occurred among the patients who smoked ($P = .2$). All patients were followed up for 60 months after surgery (Table 1).

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<th>Table 1</th>
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<td>Implants placed in the premaxilla</td>
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The overall success rate of implants in the pterygoid (96.45%) and premaxilla (96.72%), and actual survival at 5 years according to the Kaplan-Meier method for the pterygoid (n = 141; 97.37% ± 0.8%) and premaxilla (n = 580; 96.96% ± 0.4%) turned out to be very satisfactory (Fig 2). The cumulative success rate was similarly satisfactory (Table 2).

Moreover, the treatment leads to achieving adequate occlusion; correct facial third; and correct support of the perioral soft tissues, mainly of the upper lip, nasogenian grooves, and lip folds. In the first year of follow-up, patients gave an exhaustive interview to assess their level of satisfaction in general. All patients showed improvements in chewing, swallowing, and speaking. Most patients have improved their diet and have shown greater security in their social skills. Some smokers have quit tobacco.

DISCUSSION

It is well known that despite the advances in dental implant therapy, the process of osseointegration of implants sometimes produces surprising results. For example, when a clinician places a certain number of implants in the same anatomical region of a patient, it is not uncommon for some of them to fail, while the rest prove to be absolutely successful.

It is the responsibility of the clinician to predict and control all possible variables in order to bring the patient to a successful rehabilitation through a well-defined protocol. Thus, when the patient meets the aforesaid criteria, the treatment plan must be based on three pillars: an exhaustive analysis of the comprehensive study performed for each patient, the choice of a suitable posterior anchorage for the prosthesis, and the choice of the most favorable technique in implants in the premaxillary area to correct small defects and provide volume.

Complete prosthetic therapy has become the conventional and most-prescribed treatment option for edentulous patients for providing improved esthetics and function. However, bone resorption of the alveolar ridge, as a consequence of edentulism, can cause a lack of stability and denture retention, which reduces the patient’s mastication, phonetics, and esthetics. Lack of stability and rejection of the implant causes a feeling of insecurity, inefficient chewing, and general dissatisfaction with the prosthesis in the patient. The placement of endosseous dental implants to retain and support overdentures or fixed full dentures has been developed as a solution to these problems. The improvement in retention and stability of prosthetic rehabilitation through implant-supported prostheses leads to a greater ability to speak, chew, and swallow; therefore, this method improves patient comfort and satisfaction (Fig 3). The placement of implants in the pterygomaxillary-pyramidal junction as posterior anchorage loci precludes the use of graft material and can be carried out under local anesthesia and using the patient’s preexisting bone. This technique entails using cylindrical osteotomes of increasing diameter prior to the use of drills in order to ensure the implant length and direction, therefore conserving bone and diminishing surgical risks, as there is no need to enter the retropterygoid space or the pterygomaxillary fossa with drills.

In addition, based on results and the existing literature, two other aspects deserve special attention. Failures of implants have a direct relationship with smoking. More than 60% of failures occurred among patients who smoked. Due to the promise of an improvement in general health, in addition to esthetics, many of these patients committed themselves to the demanding recommendation of the tobacco cessation protocol at
least during the osseointegration period, and approximately 40% of them abandoned it completely.

Finally, there are many articles that refer to the benefits of the use of PRP for tissue regeneration or healing. Without going into deep discussion, what can be said based on the results of this study is that this mixture of lyophilized bone that acts as an osteoconductor and the PRP that provides the growth factors act together, contributing to the filling, repair of small bone defects, and volume to support the perioral structures (upper lip). In addition, it was found that implants in the anterior maxillary sector of patients treated before 2000 both clinically and radiologically showed high resorption of the graft material, while in patients treated with lyophilized bone and PRP mixture, the resorption of the graft material had slowed from 50% to only 25% at least in the first year of follow-up (Fig 4).

CONCLUSIONS

The analysis of the study presented led to the following conclusions. The rehabilitation of total maxillary edentulism with full-arch prosthesis with implant in the pterygomaxillary-pyramidal region achieves satisfactory levels of success. This success is not only anatomical, functional, and esthetic, but also contributes to improving the patient’s overall health and, therefore, quality of life. The predictability and durability of these implants as a place of anchorage in the posterior maxilla is also very high, at least during the first 5 years.

ACKNOWLEDGMENTS

The authors reported no conflicts of interest related to this study.

REFERENCES


