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Clinical Paper
Implants

Extraoral implants for orbit rehabilitation: a comparison between one-stage and two-stage surgeries

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Abstract. The aim of the study was to compare the osseointegration success rate and time for delivery of the prosthesis among cases treated by two-stage or one-stage surgery for orbit rehabilitation between 2003 and 2011. Forty-five patients were included, 31 males and 14 females; 22 patients had two-stage surgery and 23 patients had one-stage surgery. A total 138 implants were installed, 42 (30.4%) on previously irradiated bone. The implant survival rate was 96.4%, with a success rate of 99.0% among non-irradiated patients and 90.5% among irradiated patients. Two-stage patients received 74 implants with a survival rate of 94.6% (four implants lost); one-stage surgery patients received 64 implants with a survival rate of 98.4% (one implant lost). The median time interval between implant fixation and delivery of the prosthesis for the two-stage group was 9.6 months and for the one-stage group was 4.0 months ($P < 0.001$). The one-stage technique proved to be reliable and was associated with few risks and complications; the rate of successful osseointegration was similar to those reported in the literature. The one-stage technique should be considered a viable procedure that shortens the time to final rehabilitation and facilitates appropriate patient follow-up treatment.

Keywords: extraoral implants; orbit rehabilitation; survival rate; surgical technique.

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Since the introduction of craniofacial implants to retain bone-anchored hearing aids, the use of this procedure as a rehabilitation method has increased worldwide.[1,2] Because of the stability of the implants, there has been an increase in the acceptance of and confidence in external prostheses, which have become an important resource for facial rehabilitation.[3–7]

The technique that was first developed to fix implants that anchor ocular prostheses comprises two surgical steps.[2] The first step consists of placing the titanium screw-shaped implants in the bone, where they must remain load-free at the subcutaneous level for 4–6 months. After this healing time, the second surgical step is performed, in which the subcutaneous tissue is reduced and the transmucosal abutment attached.[2]

This original surgical protocol was based on the waiting period required for osseointegration of the implants to occur.[8–11] This requirement existed because the risk of osseointegration failure was considered to be high based on the small sizes of the implants, the poor

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density and amount of the frontal bone, and previous radiotherapy, which many oncology patients receive.[12–15] However, the waiting time presents certain disadvantages, such as delays in making the prosthesis and the necessity of performing more than one surgical procedure, with consequent higher overall morbidity and costs.[4,8,16]

In the field of dental osseointegration, the two-stage procedure has gradually been replaced by the one-stage technique, whereby the implant placement and the attachment of the transmucosal abutment are performed in a single surgical procedure.[17,18] The major motivation for this paradigm shift is the aesthetic and functional needs of the patient. As a result of the increased reliability of implants and the surgical technique, the one-stage concept has spread worldwide, with favourable results. Consequently, the 'immediate loading' concept has been validated both clinically and scientifically within the field of dental rehabilitation.[19]

Despite its success in the dental field, the one-stage surgical concept has not yet been established as a protocol for reconstructing orbital defects. The one-stage technique has been used in the auricular area,[4,8] and in orbital defects, using dental implants.[20,21] However, no studies have compared the one-stage technique with the conventional procedures using extraoral implants. This omission might be the result of limited international experience and the increased complexity of cases (which tend to be non-standard and highly individualized), as well the less favourable characteristics of the facial bones, which exhibit worse osseointegration rates because of their thinness and poor quality.[22] Technological innovations affecting the surface and shape of the implants have been introduced to increase their integration into bone, therefore increasing the success rates, particularly in those patients with more severe local or systemic effects.[23]

To reduce the costs and risks of multiple surgeries, the one-stage surgical technique has been utilized in selected cases: placing the fixtures, reducing the subcutaneous tissue, penetrating the skin and connecting the abutments are performed together. Then, after a waiting time of 4 months, the prosthesis is made and tried on the patient. However, there have been no studies that have demonstrated whether this method is reliable over the long term with regard to the success of osseointegration or the prevalence of complications such as local infections, pain, skin reactions, and prosthetic failure.

Therefore, the aim of the present study was to compare the osseointegration success rate and the average time to prosthetic delivery in patients treated for orbit rehabilitation with the one-stage and two-stage surgical techniques.

Materials and methods

A retrospective study was conducted by examining consecutive files of all patients with orbital defects who were treated by the same team between 2003 and 2011. The study was approved by the institutional ethics committee.

Variables investigated

The following variables were investigated: gender, age, cause of deformity, previous radiotherapy, number and size of implants installed, date and type of surgery (one-stage or two-stage), date when the prosthesis was delivered, date of last follow-up visit, osseointegration success or failure, and prosthetic success or failure. Based on the study aims, the patients were divided into two groups to analyze correlations between the variables: the one-stage group and the two-stage group.

Osseointegration success was defined as the presence of functional implants without any mobility or pain, with healthy peri-implant tissue around the abutments, and no sign of infection at the final examination. Implant mobility was determined by applying lateral pressure to the implant with two opposing instruments, and recorded as positive or negative. Because it was not possible to obtain standardized radiographs in the orbit region to ascertain bone resorption, this was not used as a criterion for implant success. The condition of the peri-implant soft tissue was evaluated according to the criteria described by Holgers et al.,[24] and was defined as healthy when there was no need for abutment removal or grafting.

The total duration of implant survival was defined as the time between implant placement and implant removal, or to the last assessment of the implants that remained in use. Patients with implants but without a prosthesis were excluded from the study. Implants lost during the study were regarded as failures.

Prosthetic success or survival was defined in those patients with prostheses that remained functional and were retained by the implants at the time of the last assessment. The total duration of prosthetic survival was defined as the time between prosthetic delivery and prosthetic removal, or the last assessment of the prostheses that remained in use. Patients who required prosthetic replacement or repair but whose remained functional were considered to be prosthetic successes. Patients who declined to use their prosthesis or were unable to use it because of implant failures were regarded as prosthetic failures. Detailed information from the follow-up of prostheses will be the subject of a further study.

Surgical technique

All of the procedures were performed by the same surgeon, and the same protocols were followed. All of the patients received a clinical assessment and were prescribed rehabilitation with an implant-retained prosthesis. After obtaining approval for the procedures, preoperative clinical tests were performed, and the appropriate patients were scheduled for surgery. Imaging studies were not uniformly conducted for all patients because of differing socioeconomic conditions. Whenever possible, tomography was performed to assess the orbital rim thickness; however, only frontal and lateral orbital radiographs were usually available. Therefore, the anatomical site and implant depth were defined during surgery. All of the procedures were performed on the surgical ward at the hospital under local anaesthesia (xylocaine with adrenalin 1:200,000) and intravenous sedation, performed by an anaesthesiologist.

The areas of the upper or lower orbital rims were selected for implant placement based on the amount of bone, depth of the cavity, or prosthetic planning. All of the implants used were extraoral screw-shaped and flanged with an external hexagon, and were manufactured by Conexão Sistema de Próteses (Aruja, São Paulo, Brazil). The implants were 3.75 mm in width and 3–8 mm in length. A semilunar incision was made on the internal face of the orbital rim followed by subcutaneous dissection extending to the periosteum to expose the entire bone rim and select the areas for installation.

Between one and five implants were placed per patient depending on the extent of the defect. Once an installation site was selected, drilling began under abundant irrigation with saline solution using a 2-mm diameter spherical drill and continued at a speed of 2000 rpm to a depth of 3–8 mm based on the availability of bone. After the depth was defined, a countersink drill was utilized (under irrigation with saline solution) to broaden the bone niche and create the countersink for the

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