



Orbital prostheses anchored by dental implants

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ABSTRACT

Osseointegrated dental implants seem to be applicable for anchoring orbital prostheses in cases of previous extended ablative surgery of the orbit including excenteration of an eye. These implants are applied at stage one and connected with abutments at stage two of a two-stage surgical procedure. Nine Caucasian patients with a total of 25 osseointegrated periorbital dental implants were studied in a prospective longitudinal trial to evaluate the integrated (group A; 14 implants) and separate (group B; 11 implants) variant of step-one operation. All implants were stable and orbital prostheses were worn for an average of three years (four group A patients: 11 implants; three group B patients: nine implants). Only one implant was lost due to load stress without signs of inflammation (group B; after three years). During a mean observation time of 36 months there were only slight skin reactions around the transcutaneous abutments. Group A and group B patients did not differ with regard to their implants. The design of regular dental implants seems to be appropriate for retaining craniofacial prostheses for the above mentioned purpose. The results of this preliminary study suggest that dental implants are functional in the orbit regardless as to whether inserted in an integrated or a separate step-one operation. Future studies would have involve more patients and more implants.

Key words: Dental implant, empty orbit.

RESUMEN

Todo indica que los implantes dentales osteointegrados pueden usarse para fijar prótesis orbitarias en casos de cirugía previa de extirpación amplia de la órbita incluyendo la excenteración de un ojo. Estos implantes se aplican en el primer tiempo y se conectan con refuerzos en el segundo en los procedimientos quirúrgicos de dos etapas. Se estudiaron nueve pacientes caucásicos con un total de 25 implantes periorbitarios osteointegrados. El estudio fue prospectivo, longitudinal para evaluar las variantes integrada (grupo A: 14 implantes) y separada (grupo B: 11 implantes) de la cirugía del primer tiempo quirúrgico. Todos los implantes estuvieron estables y las prótesis orbitarias se usaron durante un promedio de tres años (cuatro pacientes del grupo A: 11 implantes; tres pacientes del grupo B: 9 implantes). Sólo se perdió un implante debido a gran carga de estrés sin signos de inflamación (grupo B; después de tres años). Durante el tiempo promedio de observación de 36 meses se observaron únicamente leves reacciones cutáneas alrededor de los refuerzos transdérmicos. No hubo diferencias respecto a los implantes entre el grupo A y el B. El diseño de los implantes dentales regulares demostraron ser apropiados para retener las prótesis craneofaciales con los propósitos antes mencionados. Los resultados de este estudio preliminar sugieren que los implantes dentales son funcionales en la órbita independiente de que sean colocados en el primer tiempo quirúrgico ya sea integrado o separado. Estudios futuros incluirán mayor número de pacientes de implantes.

Palabras clave: Implante dental, órbita vacía.

INTRODUCTION

Sufficient surgical reconstruction of the empty orbit after tumor resection and excenteration of the eye

is a difficult challenge. The use of facial prostheses should be considered a viable alternative if autologous material is not available and if the patient cannot bear a high number of successive surgical procedures associated with long-term healing. Since retention with the aid of glasses, glue, and other details entails disadvantage (*e.g.* concerning the confidence of the patient that it will stay in place during activity), osseointegrated implants with skin-penetrating abutments have been used successfully as

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retention elements for craniofacial prostheses.^{7,11,12} These implants are designed especially for craniofacial applications in contrast to dental implants for intraoral use. This led to an expensive development of a variety of novel screws, tools, accessories, and infrastructure. Craniofacial implants may, however, be highly efficient when used along with auricular or orbital prostheses even though skin-penetration sites occasionally develop reactive or inflammatory reactions perhaps attributable to interactions between with the skin and the abutment coating.¹ These complications may necessitate implant removal.

Previous studies suggested that in most regions of the face (perhaps with the exception of the mastoid region where the bone is very thin and the need of very short screws is obvious) there seems to be no need for special craniofacial implant systems.^{4,6} In the periorbital region regular dental implants can be used to support facial prostheses because **a)** the regional bone is thick enough and **b)** the manufacturers provide screws short enough.

The BONE-LOCK[®] osseointegrated dental implant was designed 1975⁹ and in 1995 prosthetic rehabilitation of patients after ablative tumor surgery was successfully demonstrated by BETZ et al.¹ in a 5-year-study. However, we present the first prospective longitudinal trial to compare the implantation of BONE-LOCK[®] osseointegrated implants for anchoring orbital prostheses inserted in an integrated step-one operation with an implantation in a separate step-one operation. The small population examined in this study reflects the improvement of modern di-

agnostic and therapeutic procedures along with the (disease-associated and age-associated) high mortality of the patients. However, systematic researchs on this issue is important regardless of the small number of cases because bone anchored facial prostheses help severely mutilated patients restore facial aesthetics.⁶

PATIENTS, MATERIAL AND METHODS

Nine Caucasian patients (three females, six males; see *table*) who underwent excenteration of the orbit between 1992 and 1997 at the Department of Maxillofacial and Plastic Surgery of the Johann Wolfgang Goethe-University Medical School, Frankfurt am Main, Germany, were provided with a total of 25 BONE-LOCK[®] dental implants (HOWMEDICA LEIBINGER GMBH, Freiburg, Germany) to anchor orbital prostheses intraosseously. The application of all implants took place at stage one of a two-stage operation. The patients were randomly (but with informed consent) attributed to one of the two following groups: patients of *group A* (cases 1-5 with a total of 14 implants) had the implants inserted at the end of the ablative operation (integrated stage-one operation) whereas patients of *group B* (cases 6-9; 11 implants) underwent a secondary stage-one operation (four to six months after tumor resection). All major defects were covered by galea-periosteal or temporal muscle flaps and skin. At stage one-operation, a skin flap was prepared and pedicled extraorbitally (*group B*: in local anaesthesia). The muscle flap was raised sub-periosteally in

Table I. Synopsis of patients and orbital sites. All diagnoses leading to ablative surgery were confirmed histomorphologically.

Patient number	Age (years)	Primary disease	Number of implants	Orbital site	Side	Outcome	Function (months)
<i>Group A:</i>							
1	59	Adenocystic carcinoma	3	S, L, I	{R}	Prosthesis	36
2	66	Basal cell carcinoma	3	L, I (2)	{R}	Prosthesis	36
3	79	Squamous cell carcinoma	2	S, L	{R}	Prosthesis	36
4	57	Aspergillosis	3	S, L, I	{R}	Abutments	13
5	51	Squamous cell carcinoma	3	L, I (2)	{R}	Prosthesis	24
<i>Group B:</i>							
6	28	Rhabdomyosarcoma	2	L, I	{L}	Abutments	12
7	52	Adenocystic carcinoma	2	I	{L}	Prosthesis	36
8	47	Sebaceous gland carcinoma	3	L, I (2)	{L}	Prosthesis	48
9	39	Squamous cell carcinoma	4	S	{L}	Prosthesis	36

Abbreviations: {L} = Left orbit. {R} = Right orbit. S = Supra. I = Infra. L = Lateral.

the opposite direction by a counterincision. The lateral and infraorbital sites could be opened with the same flap and at the supraorbital rim another flap had to be prepared. The implants with a length of 9, 11 or 13 mm, 3.5 mm in diameter, were inserted as recommended for intraoral use.⁵ The musculoperiosteal flap was sutured with absorbable material, while the skin flap was sutured with silk. The mean age at implant insertion was 53.1 years (group A: 62.4 years, group B: 41.5 years). After an endosseous healing time of three to four months the implants were layed open at stage-two operation. All implants proved to be secondarily stable. Uncovering was done either by means of an incision just above the primary healing caps. In cases where the tissue covering the lesion was too thick the method described above was repeated, thinning the muscle layer. After removal of the primary healing caps the transgingival (or rather transcutaneous) abutments were fixed (the shortest length of 4.8 mm was used in all cases). The abutments were coated with a layer of titanium zirconium oxide.⁹

All implants were examined after stage-two operation for at least three months (maximum: 48 months; median: 36 months). Skin reactions were graded clinically according to the criteria proposed by Tjellström¹¹ (Grade 0: No adverse skin reaction; Grade 1: Slight reddishness; Grade 2: Reddish and moist; Grade 3: Granulated tissue; Grade 4: Removal of the implant necessary due to reactions of the soft tissue).

RESULTS

Four implants (two in each group) perforated into the infratemporal fossa without any further complications. However, healing was uneventful in all cases and both groups.

The facial prosthesis could be finished and fixed to the 19 implants in seven (out of the nine) cases. We used either ball clips, bars or telescopic devices depending on the prosthesis. The orbital prostheses were in site for three years in the majority of cases with the exception of two (*patient no. 5*) and four years (*patient no. 8*), respectively.

Group A: In patient No. 1 the axis of one implant did not fit the prosthetic application since the anatomic topography was difficult to survey. The implant was left as a submerged sleeper (accounting for the minimum observation time of three months, see above). It was stable at second stage operation and was connected to an abutment. There

was no problematic skin reaction around the abutment and the implant remained stable until we covered it again three months later. The orbital prosthesis was supported by the remaining two implants. Patient No. 4 had immunologic deficiency and died in a septic state. The implants with their abutments on top stayed in place without causing any problems until the death of the patient 13 months after the stage-two operation.

Group B: Patient No. 6 showed no problems with the implants and the subsequent prosthetic treatment the latter of which was stopped due to bad health. The patient died (due to metastatic spreading) 12 months after abutment connection. In patient No. 9 one implant (the most medial one) was lost after three years because of load stress without signs of inflammation. The four implants could be inserted only in the supraorbital rim due to the resection of the zygoma and the rest of the periorbital bone. An inferior support was lacking. The prosthesis covered the orbit and large parts of the cheek. The facial prosthesis was fixed to glasses after removal of the abutments and coverage of the implants.

Examination of skin reaction took place about one year after stage-two operation. Grade 0 was seen in three of the five implants where there was no prosthetic rehabilitation, grade 1 was found in the remaining two implants. Twelve of the 19 loaded implants showed grade 1 and the remaining seven implants were associated with grade 2 skin reaction. One year later the findings around the 18 remaining implants were different: 16 showed grade 1 reactions of the surrounding skin, while only two presented with grade 2. The same ratio we found after three years. The peri-implant skin of patient No. 8 presented with grade 1 after four years of rehabilitation. We advised the patients to clean the abutments and the surrounding skin carefully with cotton pads and hydrogen peroxide.

DISCUSSION

The statistic value of most prospective longitudinal studies on surgical reconstruction of the empty orbit after extensive ablative surgery including excenteration of the eye is limited because of the little number of appropriate patients. The body of literature on relatively small implants applied to larger facial prostheses is also little and only casual use of dental implants has been reported for osseointegrated anchorage of orbital prostheses.^{3,4,6,8,10,12,13} The

overwhelming majority of patients in these studies suffered from a loss of an ear treated with auricular prostheses; and even in the largest study only 21 patients (total: 145 patients) had orbital implant sites.¹² Seven of them became inactive during the study time of 18 to 30 months as a consequence of irradiation. In the present study (nine patients) one patient in each group died before the rehabilitation could be completed.

Success rates depend on the site of insertion and lie between 77,2 % and 95,7 % after five years of observation.^{2,3} Nasal and orbital sites seem to be associated with most complications attributed to bone volume and quality. Our series is too small for statistical evaluation but implants not loaded showed promising soft tissue compatibility perhaps due to the titanium zirconium oxide layer of the abutments and throughout the observation period there was only one implant failure in a complete prosthesis.

Jensen et al.⁴ suggested a craniofacial site classification for available sites for implant placement in the facial skeleton. The periorbital region was classified either as a so called α -site with a bone thickness of 6 mm or more, or as β -site with a bone thickness of 4 to 5 mm. Since the shortest BONE-LOCK[®] implants have a length of 9 mm the likelihood of perforation is given. The majority of our patients seemingly either presented α -sites with more than 6 mm of bone thickness or the implants perforated into adjacent muscles where they caused no harm. A screw length of about 5 mm would make the versatile BONE-LOCK[®] system perhaps even applicable in the mastoid area.

The present study is the first to show that retention of orbital prostheses is novel indication for a dental implant system that can be applied in either an integrated (group A) or separate (group B) step-one operation. The integrated step-one variant may for various reasons (personnel, medication, etc.) be more economical than the separate step-one variant. This may, however, be an important factor at times when economization has a major impact on public health. Implant systems should be applicable for as many indications as possible since development and fabrication of specific craniofacial systems is expensive. A regular use of normal dental implants for a retention of orbital prostheses seems possible. Future clinical research with other dental implants should predominantly involve implant length, abutment coating, and longer observation periods.

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