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Critical soft tissue parameters of the zygomatic implant

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Abstract

Aim: Zygomatic implants have been introduced for the rehabilitation of patients with severe bone defects of the maxilla. The soft tissue aspects of the palatal emergence situation have not been described yet. The aim of this study was to evaluate the incidence and clinical impact of possible periimplant alterations of zygomatic implants.

Materials and methods: From 1998 to 2001 all patients with zygomatic implants were included into this study (24 patients, 37 zygomatic implants). One implant was lost in the loading phase giving a survival rate of 97%. Fourteen patients with 20 zygomatic implants fulfilled the inclusion criteria and were all available for the recall examination. Thirteen zygomatic implants were inserted in cases of severe maxillary atrophy, seven in cases of tumour-resection of the maxilla. Clinical examination and microbial analysis using a DNA probe was performed. The implants had a mean time in situ of 598 days (min: 326, max: 914).

Results: Colonisation with periodontal pathogens was found at four of the 20 implants. A positive microbiologic result of the periimplant pocket and the maximum pocket probing depth were not statistically related. Nine of the 20 implants showed bleeding on probing, four of these had positive microbiologic results. At sites without bleeding on probing only negative microbiologic samples were found ($p = 0.026$). The mean palatal and mesial probing depth was 1 mm deeper than at the vestibular and distal aspect. Thus at nine out of the 20 implants both, bleeding on probing and pocket probing depth $\geqslant 5$ mm indicated soft tissue problems resulting in a success rate of only 55%. The patient's history (tumor versus atrophy) or smoking habits seemed not to have influence the situation.

Conclusion: These soft tissue problems should be taken into account if zygomatic implants are considered as an alternative therapy option in the maxilla.

Key words: dental implants; maxilla; periimplantitis; soft tissue; zygomatic implant

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Implant success in the maxilla may be critical depending on both the quality and the amount of available bone. Especially patients with a severely resorbed maxilla and patients, who underwent maxillectomia due to neoplasma, often require incriminating orofacial reconstructions (Triplett & Schow 1996; Wood & Moore 1988). The zygomatic implant, which was introduced in recent years, can offer a valuable alternative to extensive augmentation procedures. The main stability of this 45 to 55 mm self threading implant is gained by fixation in the cortical parts of the zygomatic bone. The technique in the original protocol included exposure of the inner part of the implant to the maxillary sinus. Some surgical protocols (Reichert et al. 1999) prefer a lateral sinus floor elevation to avoid exposure of the implant to the sinus cavity.

The main indications for these special type of implants have been proposed as follows: maxillectomia following neoplasia, failure of maxillary augmentation, avoiding augmentation, unloading of newly inserted anterior implants and/or bone augmentation (Higuchi 2000; Reichert et al. 1999). The surgical procedure requires a highly skilled surgeon or extensive navigation techniques for implant placement (Uchida et al. 2001). Even after strictly following the surgical protocol the mucosal penetration site of the fixture often is located medial to the alveolar crest. The anatomy of this region has been within the focus of recent studies as it is the donor site for soft tissue grafts. The thickness of the palatal mucosa is known to increase from the gingival margin toward the mid palate and from the canine to the second molar region (Wara-aswapati et al. 2001). And it is also known to be thicker in older individuals (Wara-aswapati et al. 2001).

However, in the first molar region a decreased thickness is found (Muller et al. 2000, Wara-aswapati et al. 2001). This limits soft tissue grafting from the first molar region and possibly points out a specific property of this region. In contrast to the high number of publications on thickness of the palatal mucosa, no data is found on the histological composition of the tissue especially the amount of connective tissue.

Looking at maxillary implants more recessions seem to be found on the palatal than on the vestibular side of dental implants (Jemt et al. 1994). Soft tissue problems of dental implants are also well known after flap reconstruction of tumour resections often leading to thick and mobile soft tissue, which might limit the success of endosteal implants (Chang et al. 1999).

First experiences with zygomatic implants have focused on the surgical and prothetical points of view (Reichert et al. 1999, Stevenson & Austin 2000, Higuchi 2000, Uchida et al. 2001, Bedrossian & Stumpel 2001, Parel et al. 2001, Balshi & Wolfinger 2002). Long term success however is closely related to healthy periimplant soft tissues without signs of infection. To our point of view the soft tissue situation of zygomatic implants has not yet been addressed by the scientific discussion. During the recall phase some patients with zygomatic implants presented soft tissue problems consisting of gingival hyperplasia and bleeding on probing, which seemed to occur more frequently. Based on this clinical problem the aim of this study was to study the incidence and clinical impact of the periimplant alterations.

Patients and Methods

All patients with zygomatic implants inserted in our clinic which have received a prosthetic restoration for at least 12 months were included into this study. From 1998 to 2001 $n = 37$ zygomatic implants were inserted in 24 patients. One implant was lost in the loading phase giving a survival rate of 97%. At the time of this study 14 patients with 20 zygomatic implants fulfilled the inclusion criteria. All patients were totally edentulous and were available for the recall examination. Thirteen zygomatic implants were inserted in cases of severe maxillary atrophy, seven in cases of tumour-resection of the maxilla.

The examination started with a questionnaire for smoking habits and regular medication. Patients were rated as smokers, if the number of cigarettes exceeded ten per day. Clinical examination included the removal of the Dolder bars or individually fabricated bars. Implants were tested for mobility by using two opposing instruments. Mobility was rated as ''absent'' or ''not absent'' (>0.2 mm horizontal) (Lindhe 1983). The modified plaque index (Silness & Loee 1964) was assessed. Probing depth of the zygomatic implant was measured at the mesial, distal, palatal and vestibular aspect of the implant using a plastic probe (Plast-O Probe). The border between the implant and the abutment was used as a reference line. Pocket depth and bleeding on probing were recorded. The maximum probing depth of each implant was used for statistical evaluation. Subsequently a microbial sample was drawn using a sterile paper tip, which was inserted into the deepest part of the pocket. Bacterial samples were also obtained from the cheek pouch after rinsing with water for a few seconds to differentiate between localised bacterial colonisation and general bacterial colonisation of the oral cavity. The DNA Probe kit microDent (HAIN-lifescience GmbH, 72147 Nehren, Germany) was used to identify *Actinobacillus actinomycetemcomitans, Bacteroides forsythus, Treponema denticola, Porphyromonas gingivalis, Prevotella intermedia*. The paper tips were stored in a dry place and were immediately mailed to the manufacturer's laboratory for examination of periodontal pathogens using a three step technique: 1) DNA Isolation, 2) amplification with Biotin-marked primers, 3) reverse hybridisation. For each bacterial strain a semiquantitative result was obtained. For further statistical analysis we calculated a dichotome variable, which indicates ''no'' for no microbiological finding and ''yes'' for at least one positive result of the DNA probe. The implant and not the patients were defined as study unit because the clinical finding at each individual implant was to be evaluated. Implant success (Albrektsson et al. 1986) with absence of signs of pain or infection (bleeding on probing or pocket probing depth $\geqslant 5$ mm) was recorded as applicable for the special situation of the zygomatic implant. For statistical analysis SPSS 10.0 was used. As this study has a descriptive character, no adjusting of p values for multiple testing was performed. For the explorative analysis the Man Whitney test was used to test between two continuous variables. The Kruskal Wallis test was used to test for differences between more than two continuous variables. The Chi square test was used to test for differences between two dichotomous variables.

Results

At the time of examination the zygomatic implants had a mean time in situ of 598 days (min: 326, max: 914), with a mean unloaded healing time of 189 days (min: 100, max: 288). In 13 cases (65%) zygomatic implants were inserted together with an alveolar bone augmentation using autologous bone from the iliac crest. Zygomatic implants were inserted in six patients bilaterally, in eight patients unilaterally. Four implants were inserted in patients who reported severe smoking habits. None of the implants showed mobility. Only three patients with four implants reported on smoking, thus no further analysis of this subgroup was possible.

Fig. 1 illustrates the microbiologic results with respect to the sampling area. Colonisation with periodontal pathogens was found in four of the 20 implants. Colonisation of the corresponding cheek pouch was found in 3 of the 20 cases. A. actinomycetemcomitans and P. intermedia were not identified in this study. From the seven strains found in periimplant pockets, three could also bee identified in the check pouch. Two strains of T. denticola were only isolated in the cheek pouch. In Fig. 2 the relation between the microbiologic result of the periimplant pocket and the maximum pocket probing depth is given as a box plot. There is no statistical difference between the two populations ($p = 0.211$), although implants with positive colonisation tend to show lower pocket probing depth.

The relation of bleeding on probing to the microbiologic results is given in Fig. 3. Nine of the 20 implants showed bleeding on probing. Of these, four had positive microbiologic samples. Positive microbiologic samples were not found at sites without bleeding on probing. This difference was statistically significant ($p = 0.026$). In Fig. 4 the pocket probing depth in grouped by

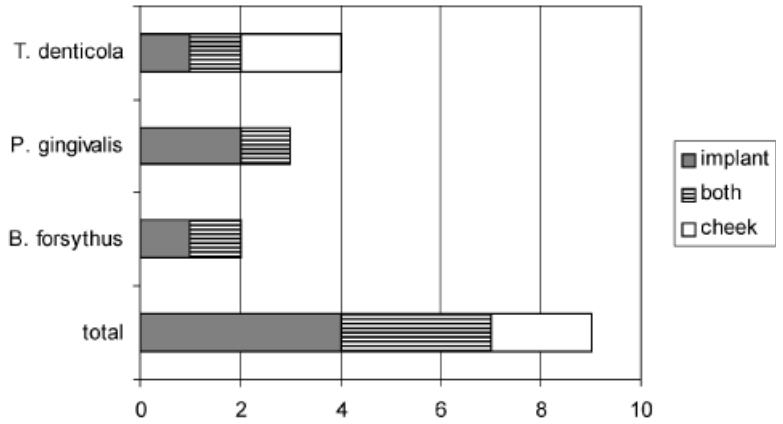

Fig. 1. Periodontal pathogens found at the zygomatic implant and the corresponding cheek pouch.

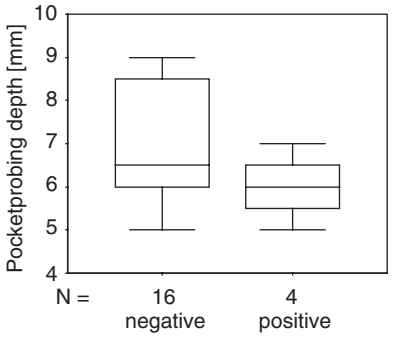

Fig. 2. Maximum pocket probing depth of zygomatic implants grouped by negative and positive results of periodontal pathogens ($p = 0.211$).

negative or positive bleeding on probing is given as a box plot. There was no statistical difference between the two groups ($p = 0.552$). The pocket probing depth of implants inserted for severe atrophy and tumour resection was 7.0 ($\pm$ 1.3) mm and 6.7 ($\pm$ 1.6) mm, respectively. This difference was not statistically significant ($p = 0.588$).

The results of the pocket probing depth at the spatial aspect of the zygomatic implant are given as a box plot in Fig. 5. The palatal and mesial probing depth show mean values which are 1 mm higher than the vestibular and distal aspect ($p = 0.003$). At nine out of the 20 implants bleeding on probing and pocket probing depth $\geqslant$5 mm indicate soft tissue problems. Thus only 55% of the implants in this study can be rated as success.

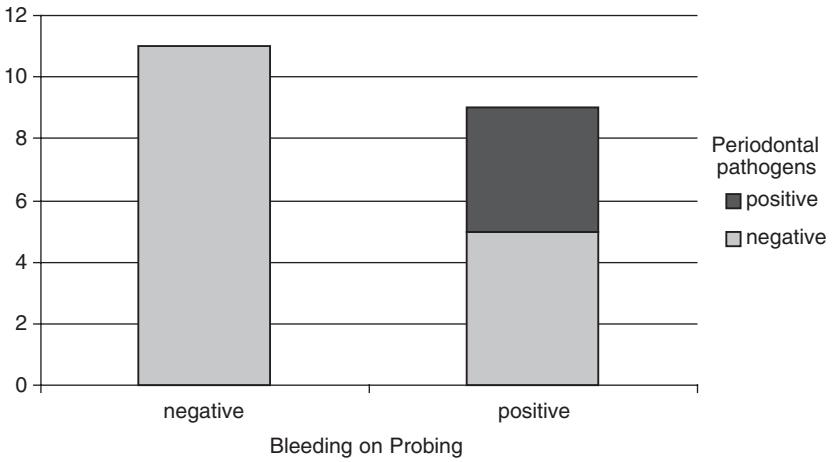

Fig. 3. Bleeding on probing at the zygomatic implants and relation to microbiologic findings ($p = 0.026$).

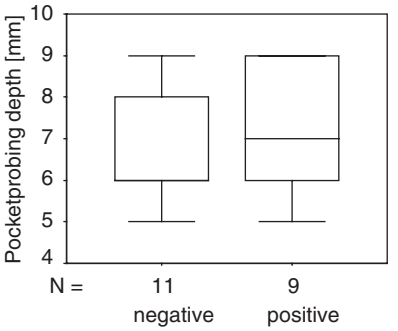

Fig. 4. Maximum pocket probing depth of zygoma implants grouped by negative and positive results of bleeding on probing ($p = 0.552$).

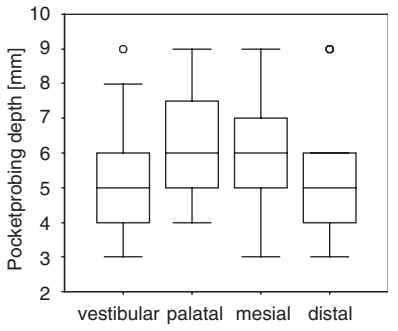

Fig. 5. Pocket probing depth of zygoma implants at different locations (vestibular, palatal, mesial, distal) ($p = 0.003$).

Discussion

This study addresses soft tissue aspects of the zygomatic implant with its special palatal emergence profile location. The large median probing depth of $>$6 mm and the high rate of 45% bleeding on probing are indicators for possible soft tissue problems of the zygomatic implant. Around normal implants a lower (mean) pocket probing depth of 4 mm is found (Rutar et al. 2001). In the periimplant region of healthy implants bacteria of the physiologic oral flora (Lactobacilli and Streptococci) are predominantly found (Mombelli 1993, Kohavi et al. 1994), whereas in peri-implant infections more Gram-negative anaerobe and facultative anaerobe bacteria are found (Mombelli 1993, Augthun & Conrads 1997). The predominant pathogens in periimplantitis are described to be *Prevotella spp.*, *Porphyromonas gingivalis*, *Fusobacterium spp*. and *Actinomyces spp.* (Passariello et al. 1993, Salcetti et al. 1997, Mombelli & Lang 1998). This is in accordance to our findings at the zygomatic implants. The group of patients who showed bleeding on probing had a higher prevalence of periodontal pathogens than those patients without bleeding on probing. The origin of this pathogenic flora in our patients can only be speculated. As some species are correspondingly found at the cheek

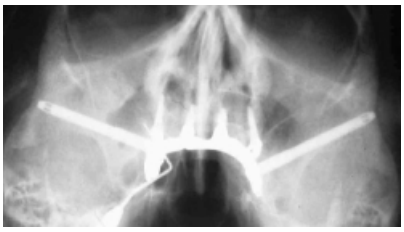

Fig. 6. Oro-antral fistula due to resorption of the thin palatal bone 12 months after restoration of two zygomatic implants in a patient with a severely resorbed maxilla.

pouch, not only the teeth (Rutar et al. 2001), but also the soft tissues may act as a reservoir. In our study the pocket probing depth is increased even in absence of bleeding and in absence of pathological microbial colonisation. This makes a non-infectious cause of the soft tissue alteration probable. The patient's history (tumor versus atrophy) did not influence the situation.

The morphological situation of the palate and the alveolar crest seem to influence probing depth as the palatal and mesial aspect showed significantly higher pocket probing depth. This is in accordance to the spatial organisation of the thickness of the palatal mucosa (Wara-aswapati et al. 2001, Muller et al. 2000). Interestingly a mean palatal thickness of 3 mm is known in this age group (Wara-aswapati et al. 2001), whereas minimal (!) probing depth in our patient group was 5 mm. If we take into account the absence of pathogens, we pose the hypothesis that mucosal hyperplasia, which seems to be more pronounced in the mesial and vestibular aspect, is seen in nearly all zygomatic implants. It should be taken into account that bone resorption in the palatal region which might follow this clinical state leads to severe problems. Resorption of the thin palatal bone rapidly leads to oro-antral fistula followed by implant loss, which already was yet observed in one case (Fig 6). A satisfying overall implant survival rate (97%) in this study stands in contrast to the clinical soft tissue problems leading to a estimated success rate of 55%.

In conclusion zygomatic implants offer an alternative therapy only in very well selected cases. Other therapeutic options such as bone augmentation and reconstruction should be considered as first choice options. If zygomatic implants are used a highly skilled surgical technique in the insertion phase and regular recall is essential to allow long term successful prosthetic rehabilitation.

References

Albrektsson, T., Zarb, G., Worthington, P. & Ericson, R. A. (1986) The long-term efficiacy of currently used dental implants: A rewiew and proposed criteria of succes. *Int J Oral Maxillofac Impl* **1**, 11.

Augthun, M. & Conrads, G. (1997) Microbial findings of deep peri-implant bone defects. *Int J Oral Maxillofac Impl* **106**.

Balshi, T. J. & Wolfinger, G. J. (2002) Treatment of congenital ectodermal dysplasia with zygomatic implants: a case report. *Int J Oral Maxillofac Implants* **17**, 277.

Bedrossian, E. & Stumpel, L. J. 3rd. (2001) Immediate stabilization at stage II of zygomatic implants: rationale and technique. *J Prosthet Dent* **86**, 10.

Chang, Y. M., Chan, C. P., Shen, Y. F. & Wei, F. C. (1999) Soft tissue management using palatal mucosa around endosteal implants in vascularized composite grafts in the mandible. *Int J Oral Maxillofac Surg* **28**, 341.

Higuchi, K. W. (2000) The zygomaticus fixture: an alternative approach for implant anchorage in the posterior maxilla. *Ann R Australas Coll Dent Surg* **15**, 28.

Jemt, T., Book, K., Lie, A. & Borjesson, T. (1994) Mucosal topography around implants in edentulous upper jaws. Photogrammetric three-dimensional measurements of the effect of replacement of a removable prosthesis with a fixed prosthesis. *Clin Oral Implants Res* **5**, 220.

Kohavi, D., Greenberg, R., Raviv, E. & Sela, M. N. (1994) Subgingival and supragingival microbial flora around healthy oeeseointegrated implants in partially edentulous patients. *Int J Oral Maxillofac Impl* **9**, 673.

Lindhe, J. (1983) *Textbook of Clinical Periodontology*. Munksgaard: Copenhagen.

Mombelli, A. (1993) Mikrobiologie und Implantate. *Deutsche Zahn* **48**, 756.

Mombelli, A. & Lang, N. P. (1998) The diagnosis and treatment of peri-implantitis. *Periodontology* **2000**, 17–63.

Muller, H. P., Schaller, N., Eger, T. & Heinecke, A. (2000) Thickness of masticatory mucosa. *J Clin Periodontol* **27**, 431.

Parel, S. M., Branemark, P. I., Ohrnell, L. O. & Svensson, B. (2001) Remote implant anchorage for the rehabilitation of maxillary defects. *J Prosthet Dent* **86**, 377.

Passariello, C., Berlutti, F., Selan, L., Amodeo, C., Comodi-Ballanti, M. R., Serafino, L. & Thaller, M. C. (1993) Microbiological and morphological analysis of dental implants removed for incomplete osseointegration. *Microbial Ecology in Health and Disease* **6**, 203.

Reichert, T. E., Kunkel, M., Wahlmann, W. & Wagner, W. (1999) Das Zygoma-Implantat: Indikationen und erste klinische Erfahrungen. *Z Zahn* **15**, 65.

Rutar, A., Lang, N. P., Buser, D., Burgin, W. & Mombelli, A. (2001) Retrospective assessment of clinical and microbiological factors affecting periimplant tissue conditions. *Clin Oral Implants Res* **12**, 189.

Salcetti, J. M., Moriarty, J. D., Cooper, L. F., Smith, F. W., Collins, J. G., Socransky, S. S. & Offenbacher, S. (1997) The clinical, microbial, and host response characteristics of the failing implant. *Int J Oral Maxillofac Impl* **32**.

Silness, J. & Loee, H. (1964) Periodontal disease in pregnancy* II* Correlation between oral hygiene and periodontal condition. *Acta Odontologica Scandinavica Vica* **22**.

Stevenson, A. R. & Austin, B. W. (2000) Zygomatic fixtures – the Sydney experience. *Ann R Australas Coll Dent Surg* **15**, 337.

Triplett, R. G. & Schow, S. R. (1996) Autologous bone grafts and endosseous implants: complementary techniques. *J Oral Maxillofac Surg* **54**, 486.

Uchida, Y., Goto, M., Katsuki, T. & Akiyoshi, T. (2001) Measurement of the maxilla and zygoma as an aid in installing zygomatic implants. *J Oral Maxillofac Surg* **59**, 1193.

Wara-aswapati, N., Pitiphat, W., Chandrapho, N., Rattanayatikul, C. & Karimbux, N. (2001) Thickness of palatal masticatory mucosa associated with age. *J Periodontol* **72**, 1407.

Wood, R. M. & Moore, D. L. (1988) Grafting of the maxillary sinus with intraorally harvested autogenous bone prior to implant placement. *Int J Oral Maxillofac Implants* **3**, 209.

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