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Simultaneous or staged installation with guided bone augmentation of transmucosal titanium implants

A 3-year prospective cohort study

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Date:
Accepted 20 December 2002

To cite this article:
Christensen DK, Karoussis IK, Joss A, Hämmerle CHF, Lang NP. Simultaneous or staged installation with guided bone augmentation of transmucosal titanium implants. A 3-year prospective cohort study. *Clin. Oral Impl. Res.* **14**, 2003; 680–686

Key words: transmucosal implants, bone augmentation, GBR, prospective study, peri-implant mucosal conditions, alveolar bone

Abstract: A prospective cohort study of 45 nonsmoking consecutively admitted patients was studied for the treatment outcomes following jaw bone augmentation in conjunction with installment of oral implants. Twenty-eight patients were treated for both bone augmentation and implant treatment simultaneously, while 17 patients were treated with a staged approach with the bone augmentation being performed 6–8 months prior to implant installation. Three months following this, prosthetic reconstructions were incorporated. One year thereafter, baseline data and 3 years after reconstruction, follow-up data were obtained. Moderately low mean scores for the bleeding on probing percentage were found at baseline (24%) and after 3 years of function (17%), while the corresponding values at the implant sites were 40.6% and 52.4%, respectively. However, the modified gingival index (mGI) = 2 was found in only 4.8%, and 6.9% at the baseline and 3-year examinations. Peri-implant Probing depth (PPD) and level of attachment mean values did not vary between baseline and follow-up examinations. Only a small proportion of 1.8% yielded PPD = 6.0 mm after 3 years of function. Radiographic bone level measurements showed that 18.2% of the implants lost 0.5 mm during the observation period. Seventy percent of the sites were considered completely stable. It was concluded that predictable treatment outcomes resulted for oral implant installation combined with or staged after jawbone augmentation. Only 6.5% of the sites had lost 1.5% crestal bone with the staged approach while 14% of the sites had lost 1.5 mm, when the implants were placed simultaneously. This suggests that the staged approach may have a lower risk for greater amounts of crestal bone loss as the simultaneous approach. In general, crestal bone loss encountered in the present study corresponded very well with that reported following placement of the same implant system into nonaugmented bone.

In a workshop on clinical trials staged by the American Academy of Periodontology (AAP) in cooperation with the National Institute of Dental and Craniofacial Research (NIDCR) in 1997, it was realized that the development of new clinical techniques usually occurs in three major steps (Buser & Tonetti 1977):

(a) a phase of trial and error with case reports leading to a clinical concept,
(b) cohort studies with well-defined procedures and consecutively admitted patients and
(c) randomized controlled clinical trials (RCT).

The biological principle of guided tissue regeneration (GTR) was first introduced for the regeneration of periodontal tissues with the formation of new root cementum and inserting fibers onto previously contaminated

root surfaces (Karring et al. 1980, 1985; Nyman et al. 1980, Gottlow et al. 1984). This principle has been studied extensively for various indications such as molar furcations, intrabony defects and covering of root dehiscences (for a review see Karring et al. 2003).

Approximately 10 years after the promotion of GTR in periodontal regenerative therapy, the principle of GTR for bone augmentation has first been tested experimentally in animals (Dahlin et al. 1988, 1989). This culminated in findings that, by applying barrier membranes, bone neogenesis could practically be induced on top of a flat bone surface (calvaria), into a created wound space, where bone had never been before (Schmid et al. 1991).

Consequently, patients started to benefit from guided bone regeneration techniques in conjunction with titanium oral implants (Nyman et al. 1990). Although there are a variety of case series studies (e.g. Buser et al. 1990) in the literature, only a few prospective cohort studies with long-term results have been presented (Buser et al. 1996a, b; Fugazzotto et al. 1997; Nevins et al. 1998; Von Arx et al. 1998). All these studies report between 95.8% and 100% of implant success within the observation period varying from 1 to 7 years. Unfortunately, there are no RCTs available on the treatment of bone augmentation procedures in conjunction with the placement of oral implants (for a review see Hämmerle 1999; Mayfield 1999; Simion 1999). Also, there is only a paucity of standardized prospective studies. Little evidence suggests a superiority for bone augmentation procedures being performed either simultaneously or prior to implant placement (Simion 1999). A wide variety of success rates has been reported, most probably depending on the clinical experience of researchers. Furthermore, modifying factors, such as membrane dehiscences, infections, etc, may determine the treatment outcome.

The purpose of the present prospective cohort study was to evaluate the clinical and radiographic conditions of the peri-implant tissues as well as the implant stability in situations where one-stage transmucosal oral implants had been placed into newly generated bone or simultaneously with alveolar bone augmentation procedures.

Material and methods

From the patient pool of the University of Berne, School of Dental Medicine, Department of Periodontology and Fixed Prosthodontics, 45 nonsmoking patients, consecutively treated for bone augmentation in conjunction with installment of oral implants, were selected for the study.

The bone augmentation procedure had either been performed simultaneously with the placement of the implant ($n = 32$) in 28 patients or 6–8 months prior to implant installation ($n = 23$) in 17 patients. All implants were titanium oral implants with a TPS surface (ITI® Dental Implant System) of regular diameter (4.1 mm) and lengths between 8 and 12 mm. Implant installation was performed according to the manufacturer's recommendations (Buser et al. 1988; Sutter et al. 1988), and the implants were allowed to be integrated in a transmucosal (nonsubmerged) healing modality. Usually after 3 months, the prosthetic reconstructions were incorporated. Following 1 year of function (baseline) and after 3 years (2 years follow-up), clinical and radiographic parameters of the peri-implant conditions were assessed as well as mean scores for the patient's bleeding on probing (BOP) percentage were determined (Fig. 1).

The plaque accumulation around the implants was determined using the criteria of the modified plaque index (mPlI, Mombelli et al. 1987), and the level of mucosal health or disease was assessed using the criteria of the modified gingival index (mGI, Mombelli et al. 1987). The levels of the mucosal margin in relation to the implant shoulder (DIM) and the probing depth (PPD) were determined using a standardized periodontal probe with a point diameter of 0.45 mm and a force of 0.25 N. The 'level of attachment' (LA) was then calculated by deducting the former from the latter value (DIM−PPD). All measurements were made to the nearest millimeter. Finally, the width of the alveolar mucosa was measured on the buccal and lingual aspects of each implant. All the other clinical parameters were obtained from six sites around the implant.

At the time of the baseline examination (i.e. after 1 year of function) and 2 years later, standardized periapical radiographs were obtained using a Rinn aiming device and a long cone X-ray tube. However, no special attempts were made to obtain identical radiographs for subtraction radiography. Hence, the evaluation of the radiographs was performed in a linear fashion using a standardized computerized system to determine the mesial and distal distance from the implant shoulder to the alveolar bone level (DIB). The measurements were obtained by drawing a line through the mesial and distal aspect of the implant shoulder and measuring the DIB perpendicularly to this line at the site of the first radiographic bone contact with the implant surface.

For statistical analysis, means and standard deviations were calculated both on a patient and implant level for all clinical and radiographic analyses. *t*-tests for independent pairs were applied between the groups of patients with simultaneous vs. nonsimultaneous placement with the bone augmentation procedure. Paired *t*-tests were used for longitudinal analysis of mean scores. Furthermore, frequency analyses were performed for PPD, LA and DIB.

Results

In this prospective cohort study, 45 patients were recruited and a total of 55 ITI® implants were installed either simultaneously with a bone augmentation procedure ($n = 32$, 28 patients) or in a staged approach in which the implant installation was performed 6–8 months after the bone augmentation procedure ($n = 23$, 17 patients). For bone augmentation, the princi-

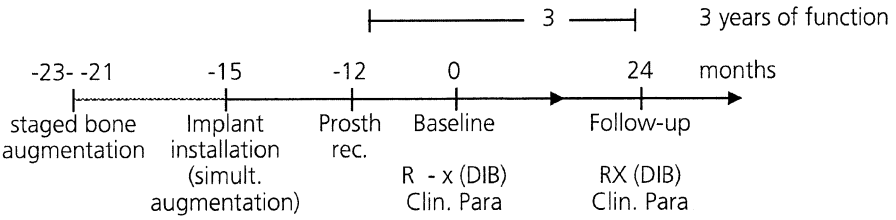

Fig. 1. Study outline. Durations in relation to the baseline that has been set after 1 year of implant function

Table 1. **Distribution of membrane and/or scaffolding biomaterials.**

	Resorbable		Nonresorbable
n	Guidor®	Bio-Gide®	Gore™ GTAM
No scaffolding	0	3	18 (7)
Scaffolding with Bio-Oss®	3	18	4 (2)
Scaffolding with or autologous bone	5	3	2

In parentheses: titanium reinforced.

ple of GTR (Dahlin et al. 1988) was chosen. Both nonresorbable teflon membranes (ePTFE, Gore™ & Assoc., Flagstaff, AZ, USA) as well as resorbable polylactic acid (Guidor®) and collagen membranes (Bio-Gide®, Geistlich, Wolhusen, Switzerland) were used (Table 1).

Since the various biomaterials used did not yield statistically significant differences for either clinical or radiographic parameters 1 year following implant installation, the mean values for the whole patient cohort will be presented longitudinally.

Patient (subject) parameters and implant (site) parameters did not differ significantly from each other either. Hence, the data analysis presented will report on 55 oral implants and their stability over a 3-year period of function. However, the BOP percentages will be presented for both patient (subject) means and implant (site) means.

BOP

At baseline, the mean BOP for the patients was 24% (SD 15.0%). After 3 years of function, the patient mean BOP was 17% (SD 13.0%). On the other hand, the implant site mean BOP was 40.6% (SD 27.0%) and 52.4% (SD 28.0%) at the baseline and follow-up examinations, respectively (Fig. 2).

Peri-implant clinical parameters

At baseline, the mean mPlI was at 0.13 (SD 0.20). Two years later, this remained practically unchanged with mPlI = 0.16 (SD 0.29). The corresponding value for the mean mGI was at 0.40 (SD 0.39) and mGI = 0.64 (SD 0,40) at baseline and follow-up examinations, respectively. This increase, however, was not statistically significant.

Fig. 3 depicts a frequency analysis of the various mGI scores of mGI = 0, mGI = 1, mGI = 2. No mGI = 3 were given and only 4.8% and 6.9% scored with mGI = 2 at the baseline and 3-year examinations, respectively.

The mean PPD is 3.52 mm (SD 0.64 mm) at baseline and 3.58 mm (SD 0.55 mm) at the 3-year examinations. This resulted in a mean LA = 2.01 mm (SD 0.84 mm) at baseline and mean LA = 1.99 mm (SD 0.98 mm). Neither PPD nor LA values differed significantly from baseline to the follow-up examinations.

However, when the frequency distribution of various PPD was analyzed at baseline and 3 years thereafter, significant changes with increasing frequency of PPD = 4.0 mm and decreasing frequency of PPD = 2.0 mm were observed (Figure 4). A small proportion of 12.6% and 13.2% at baseline and 2 years later scored PPD = 5 mm and only 3.3% and 1.8% yielded PPD = 6.0 mm at the baseline and the 3-year examination, respectively.

Likewise, the proportion of sites with LA = 4.0, 5.0 or 6.0 mm increased significantly from 7.2% at baseline to 15.6% at the 3-year evaluation (Fig. 5). On the other hand, the proportion of LA = 0, 1.0 and 2.0 mm did not change throughout the observation period and contributed with approximately 70.0% of the sites. In contrast, sites with LA = 3.0 mm decreased in frequency from 21.9% to 13.2%.

The radiographic bone level average for mesial and distal sites was DIB = 3.61 mm (SD 1.07) at baseline and DIB = 4.10 mm (SD 1.50) 2 years later.

The DIB frequency analyses are presented in Fig. 6. It is evident that there is a significant increase of DIB levels of $\geqslant$3.0 mm on account of a decrease of DIB <3.0 mm. At baseline, the sites with

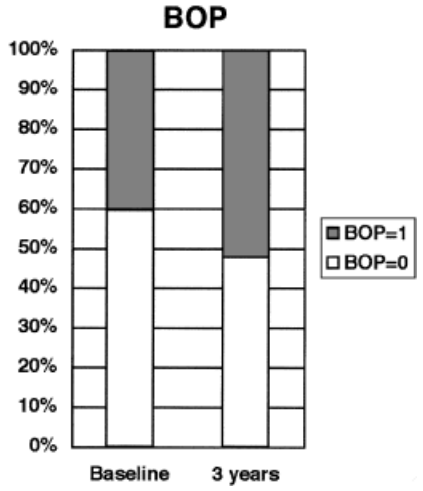

Fig. 2. Proportions of bleeding on probing (BOP) at single implant sites at baseline and after 3 years of function. BOP = 1: BOP positive; BOP = 0: BOP negative.

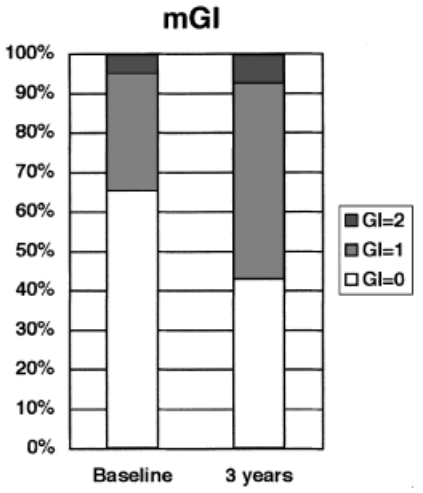

Fig. 3. Modified Gingival Index (mGI, Mombelli et al. 1987). Proportions of various scores at implant sites at baseline and at 3 years of function.

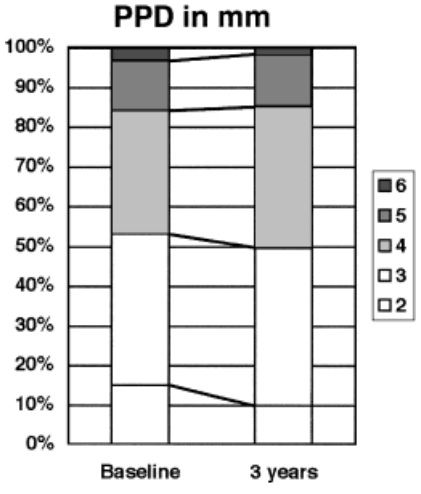

Fig. 4. Frequency distributions of various peri-implant probing depths (PPD) in millimeters at baseline and at 3 years of function.

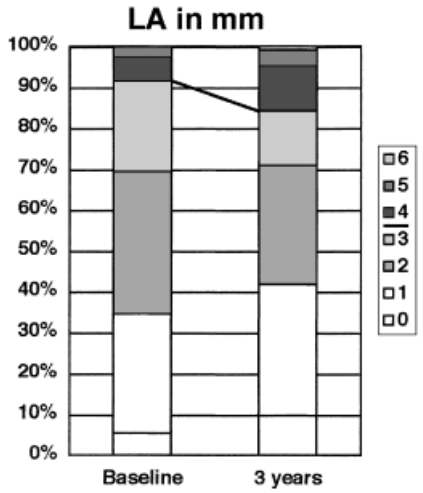

Fig. 5. Frequency of the 'level of attachment' (LA: DIM−PPD) in millimeter at baseline and at 3 years of function.

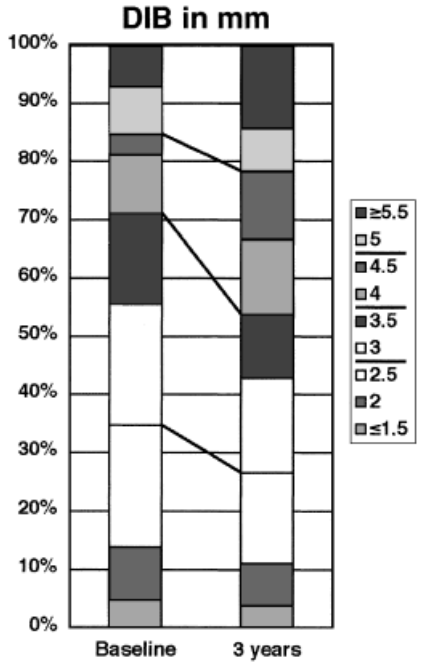

Fig. 6. Frequency distributions of radiographic bone levels at baseline and at 3 years of function. DIB: distance from the implant shoulder to the bone-to-implant contact in millimeters. transmucosal (smooth or turned) part of the ITI® implants: 2.8 mm.

DIB<3.0 mm was 34.5%. This percentage decreased to 26.4% after 3 years of function. In contrast, the sites with DIB ⩾3.0 mm increased from 65.5% at baseline to 73.6% at the 3-year evaluation. Comparing the two DIB levels of the baseline and the follow-up examinations, 18.2% of the sites lost 1.0 mm or more of

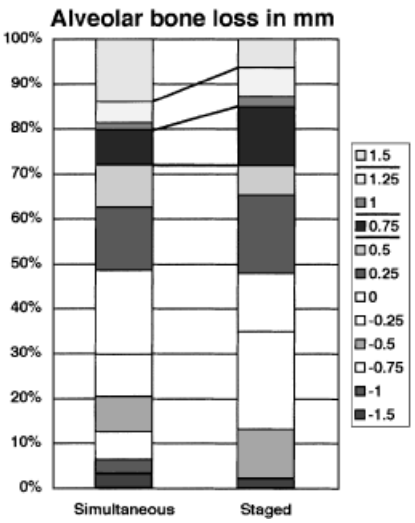

Fig. 7. Comparison of alveolar bone loss or gain in mm in implants placed simultaneously with a bone augmentation procedure ($n = 32$) or staged 6–8 months after bone augmentation ($n = 23$).

bone, while 18.2% of the sites lost 0.5 mm and 31.8% remained stable. Also 8.2% gained at least 1.0 mm and 23.6% gained 0.5 mm of alveolar bone.

In analyzing the changes in crestal bone level in the group of patients with simultaneous installation of implants with the bone augmentation procedure ($n = 32$) and comparing it with the group of patients with a staged approach ($n = 23$), approximately 70.0% of the sites in either group were considered stable (Fig. 7), i.e. 71.9% of the simultaneous group and 71.7% in the staged group showed stable alveolar bone levels within a measurement error of 0.5 mm. The remaining proportion of sites (approximately 28%) yielded some bone loss >0.5 mm. In this group with crestal bone loss, the group with simultaneous implant installation and bone augmentation showed 14.1% with a bone loss of 1.5 mm, while the group with the staged approach had only 6.5% of sites losing 1.5 mm. Conversely, this latter group demonstrated 15.2% with bone loss >0.5–1.0 mm, while 'the simultaneous group' showed 9.4% bone loss >0.5–1.0 mm.

Discussion

The present prospective study incorporated 45 patients who were in need of implant therapy. However, the bone volume available in all instances was not adequate for the installation according to the manufacturer's recommendation (Buser et al. 1988; Sutter et al. 1988). Hence, the bone volume had to be augmented either simultaneously with the implant installation or 6–8 months before. In all instances, all the 55 implants placed healed uneventfully and remained stable for the entire period of observation. In that respect, the results of the present study are in full agreement with previous reports on patient cohorts with similar indications and the use of the GBR technique for localized ridge augmentation (Buser et al., 1996c) or with immediate transmucosal implants (Lang et al., 1994).

It is evident that, in the present study, a variety of biomaterials have been used and all the procedures yielded a similar and positive treatment outcome. Although the use of nonresorbable membranes rarely leads to the application of bone or bone substitutes, the use of bioresorbable membranes almost always required autologous bone or deproteinized bovine bone mineral as a scaffold for the membrane. The choice of the biomaterials was dominated by the experience and at the discretion of the clinicians, rather than by random assignment; hence, no conclusions can be drawn as to the superiority of one or the other techniques applied. Since none of the treatment modalities presented unfavorable healing results, it may be assumed that augmentation techniques should be applied on the basis of the individual patient's needs. Basically, no difference in treatment outcomes were seen between the groups who received implants either simultaneously or in a staged approach with augmentation procedures. Also from that point of view, either one of the techniques appear to fulfil the practitioner's objective with equal predictability. It may be appropriate, therefore, to longitudinally follow the treated sites irrespective of the biomaterials used or the treatment modalities applied.

The patient cohort of the present study was at moderate risk for periodontal disease and visited the dental hygienist for regular prophylaxis procedures following active periodontal therapy usually without the need for surgical intervention.

The mean BOP percentages of these patients were generally lower than 25%,

but higher than 10%, which categorized the patients into a group of moderately to well-maintained patients (Lang & Tonetti 2003). Yet, at the implant sites, the mean BOP percentage varied between 40% and 52%. This indicates that the host response to the bacterial challenge resulting in moderate mucositis was elevated at the implant sites when compared to the remaining dentition in the patients. It is unlikely to assume that the colonization of the biofilm on the implants occurred to a lesser extent than at the teeth and, yet, mucositis was evident in half of the sites. The reason for this can only be speculative and may be attributed to various probing forces, positions of probe insertion or a more delicate implanto-mucosal seal than that of the dento-gingival unit (for a review see Mombelli & Lang 1998).

Over 50% of the peri-implant sulci were 3.0 mm or less at baseline, and 31% showed a PPD of 4.0 mm. Peri-implant pockets with PPD = 5.0 mm or 6.0 mm were limited to 15.9% at baseline.

Two years later, this proportion was virtually unchanged (15.0%). However, the proportion of 4.0 mm pockets increased significantly on account of 2.0 mm peri-implant sulci. This slight change towards the 4.0 mm peri-implant pockets may reflect the formation of an edema associated with the fact that mucositis had increased by 12% during the observation period.

However, the increase in 4.0 mm probing depths occurred concomitantly with significant, yet small 1.0 mm attachment loss in a small proportion of the sites (8.4%). Nevertheless, the proportion of probing depths of 6.0 mm decreased during the observation period from 3% to 1.8%, indicating that there were practically no sites with peri-implantitis. Almost 72% of all sites presented stable crestal bone levels within a methodological error of 0.5 mm irrespective of the simultaneous or staged placement modality of the implant. Also, only 18.2% of the sites showed an alveolar bone loss of 1.0–1.5 mm, while over 80% of the sites had to be considered completely stable. These proportions are in complete agreement with previous reports on the same implant system placed into jaws without bone augmentation procedures (Weber et al. 1992).

In a staged approach, however, there were 5.2% of the sites that lost >0.5 mm but <1.0 mm. This minimal, yet significant loss at the implant sites may therefore lead to the speculation that there is a slightly elevated risk for one in 20 implants to lose some crestal bone, when placed in a staged approach following prior bone augmentation. On the other hand, the simultaneous approach showed a higher risk for a more marked bone loss of 1.5 mm, since 14.0% of the sites with simultaneous implant installation and augmentation yielded a bone loss of 1.5 mm, while only 6.5% of the 'staged approach' implants showed that amount of bone loss. Therefore, the chance for losing a significant amount of crestal bone is 1 in 14 implants, when placed simultaneously.

In conclusion, the present prospective cohort analysis showed predictable treatment outcomes for transmucosal oral implants placed in newly generated alveolar bone either simultaneously with the implant installation or 6–8 months thereafter. While 72% of the crestal bone levels remained completely stable throughout the experimental period within a measurement error of 0.5 mm, 28% of the sites showed some loss of alveolar bone as a result of remodeling rather than peri-implant infection. While there were only a few sites that lost 1.5 mm of crestal bone (6.5%) when the implants were placed 6–8 months after bone augmentation, the same amount of bone loss occurred in 14.0% of the sites when the implants were placed simultaneously with the bone augmentation procedure. In that respect, the suggestions made for this relatively new technique of guided bone regeneration (Buser & Tonetti 1997) find supportive evidence in the present study in the fact that in the sites losing bone, there may be an increased risk for greater amounts of bone loss when implants are placed simultaneously than staged with the bone augmentation procedure. This trend did not reach statistical significance, however, probably due to the relatively moderate size of the patient cohort. Nevertheless, it has to be realized that the crestal bone loss encountered in the present study corresponds very well with that reported 3 years following placement of the same implant system into nonaugmented alveolar bone (Weber et al. 1992).

Résumé

Une étude prospective chez 45 non-fumeurs a été menée pour étudier le traitement suivant l'épaississement de l'os de la mâchoire en association avec le placement d'implants buccaux. Vingt-huit patients ont été traités pour un épaississement osseux et un traitement implantaire simultané tandis que 17 patients ont été traités par une approche de l'épaississement osseux effectuée six à huit mois avant le placement des implants. Trois mois après, les reconstructions prothétiques ont été placées. Une année plus tard les données de l'examen initial, et trois années après la reconstruction les données du suivi, ont été obtenues. Un pourcentage de BOP moyen modérément bas a été constaté lors de l'examen de départ (24%) et après trois années de mise en fonction (17%), tandis que les valeurs correspondantes au niveau des implants étaient respectivement de 41 et 52 %. Cependant, le mGI = 2 était constaté seulement dans 5% et 7% lors des examens de départ et après trois ans. Les valeurs moyennes PPD et LA ne variaient pas entre l'examen de départ et les suivis. Seul une petite proportion de 2% avaient un PPD de 6,0 mm après trois années de mise en fonction. Les mesures du niveau osseux radiographique ont montré que 18% des implants perdaient 0,5 mm durant la période d'observation. Septante pour cent des sites étaient considérés complètement stables. Un traitement prévisible se produisait donc pour les implants osseux qu'ils aient été installés en une ou deux étapes. Seul 6,5% des sites avaient perdu 1,5% d'os crestal avec l'approche chirurgicale en une étape tandis que 14% des sites avaient perdu 1,5 mm lorsque les implants étaient placés en même temps que l'épaississement. L'approche en deux étapes pourrait s'accompagner d'un risque inférieur de perte osseuse importante au niveau crestal comparée à l'approche en une étape. En général, la perte osseuse crestale rencontrée dans l'étude présente correspondait très bien avec celle rapportée suivant le placement du même système d'implants dans l'os non-épaissi.

Zusammenfassung

In dieser prospektiven Kohortenstudie an 45 nichtrauchenden Patienten wurden die Behandlungsresultate nach Kieferkammaugmentation in Zusammenhang mit der Platzierung von oralen Implantaten untersucht. Bei 28 Patienten wurde die Knochenaugmentation und die Implantation in einem Eingriff durchgeführt, während bei 17 Patienten ein gestaffeltes Verfahren angewendet wurde, bei welchem die Knochenaugmentation 6–8 Monate vor der Implantatplatzierung stattfand. Drei Monate nach Implantation wurden die prothetischen Rekonstruktionen eingesetzt. Ein Jahr später wurden die Daten für die Ausgangsuntersuchung erhoben und drei Jahre nach Rekonstruktion wurden die Daten für die Nachuntersuchung aufgenommen. Bei der Ausgangsuntersuchung (24%) und nach drei Jahren in Funktion (17%) wurden relativ tiefe mittlere BOP % Werte gefunden, während die entsprechenden Werte bei den Implantatstellen 40.6% bzw. 52.4% betrugen. Jedoch wurde ein

mGI = 2 nur bei 4.8% anlässlich der Ausgangsuntersuchung und bei 6.9% bei der Nachuntersuchung gefunden. Die mittleren PPD und LA Werte variierten nicht zwischen der Ausgangs- und Nachuntersuchung. Nur ein kleiner Anteil von 1.8% zeigte eine PPD = 6 mm nach drei Jahren in Funktion. Die Messung des radiologischen Knochenniveaus ergab, dass 18.2% der Implantate während der Beobachtungszeit einen Knochenverlust von 0.5 mm zeigten. 70% der Stellen wurde als komplett stabil angesehen. Es wurde die Schlussfolgerung gezogen, dass für die Eingliederung von oralen Implantaten zusammen mit Knochenaugmentation oder in einem gestaffelten Verfahren zu voraussagbaren Behandlungsresultaten führt. Nur 6.5% der Stellen im gestaffelten Vorgehen zeigten einen Knochenverlust von 1.5 mm während bei den gleichzeitig gesetzten Implantaten bei 14% der Stellen ein Knochenverlust von 1.5 mm auftrat. Dies lässt vermuten, dass das gestaffelte Vorgehen ein kleineres Risiko für grössere Knochenverluste haben könnte als das gleichzeitige Vorgehen. Generell betrachtet korrespondierte der in der vorliegenden Studie gesehene Knochenverlust sehr gut mit den Werten, die für das gleiche Implantatsystem nach dem Setzten in nichtaugmentierten Knochen berichtet werden.

Resumen

Se realizó un estudio prospectivo en serie sobre 45 pacientes no fumadores admitidos consecutivamente acerca de los resultados del tratamiento tras el aumento del hueso mandibular en conjunción con la instalación de implantes orales. Se trataron 28 pacientes para aumento del hueso y tratamiento de implantes simultáneamente mientras que 17 pacientes se trataron con un enfoque por fases con el aumento óseo realizado 6–8 meses antes de la instalación del implante. A los tres meses de esto, se incorporaron las reconstrucciones protésicas. Un año después, se obtuvieron datos de seguimiento, momento inicial y tres años tras la reconstrucción. Se encontró un % de BOP medio moderadamente bajo al inicio (24%) y tras tres años en función (17%), mientras que los valores correspondientes para los lugares de implante fueron 40.6% y 52.4%, respectivamente. De todos modos, el mGI = 2 se encontró en solo 4.8%, y 6.9% al inicio y en el examen de los tres años. Los valores medios de PPD y LA no variaron entre el inicio y los exámenes de seguimiento. Solo una pequeña proporción del 1.8% produjo un PPD = 6.0 mm tras tres años en función. Las mediciones del nivel radiográfico del hueso mostraron que el 18.2% de los implantes perdieron 0.5 mm durante el periodo de observación. El 70% de los lugares se consideraron completamente estables. Se concluyó que se obtuvieron unos resultados predecibles para instalación de implantes orales combinados con o en fases tras el aumento del hueso mandibular. Solo el 6.5% de los lugares perdió el 1.5% del hueso crestal con el enfoque por fases mientras que el 14% de los lugares perdieron 1.5 mm cuando los implantes se colocaron simultáneamente. Esto sugiere que el enfoque por fases puede tener un menor riesgo para mayores cantidades de perdida de hueso crestal que el enfoque simultaneo. En general, la perdida de hueso crestal encontrada en el presente estudio correspondió con muy buen con aquella informada tras la colocación del mismo sistema de implantes en hueso no aumentado.

要旨

口腔インプラント埋入と顎骨造成術を行った後の治療結果に関して、連続４５名の非喫煙連続患者を対象に前向きコホート研究を行った。患者２８名では、顎骨造成術とインプラント治療を同時に行い、１７名では骨造成術後６－８ヵ月後にインプラントを埋入するという段階的アプローチを採用した。この後３ヶ月後に、補綴治療を行った。１年後にベースライン・データ、補綴治療３年後に追跡データを得た。かなり低い平均ＢＯＰ％がベースライン時（２４％）と、機能開始３年後（１７％）に得られた。インプラント部位での値は、各々４０．６％と５２．４％であった。しかしベースライン時及び３年後の追跡調査で、ｍＧＩ＝２は、わずか４．８％と６．９％において得られた。ＰＰＤとＬＡの平均値は、ベースライン時と追跡調査時で変化はなかった。わずか１．８％のみが、機能開始３年後にＰＰＤ＝６．０ｍｍを示した。レントゲン像による骨レベルの測定は、インプラントの１８．２％で観察期間中に０．５ｍｍの骨喪失が生じたことを示した。７０％の部位は、完全に安定しているとみなされた。結論として、口腔インプラントの埋入と顎骨造成術を同時あるいは段階的アプローチで行うことで予知性のある治療結果が得られた。段階的アプローチではわずか６．５％の部位で１．５％の骨が失われ、インプラント同時埋入では１４％の部位で１．５ｍｍの骨が失われた。この事は、段階的アプローチは同時法より骨の喪失量のリスクが少ないと思われる。全体として本研究で経験された骨頂の喪失量は、同じインプラント・システムを造成していない既存骨に埋入した場合に報告されている値に匹敵するものであった。

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