Two-stage IMZ implants and ITI implants inserted in a single-stage procedure
A prospective comparative study

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Abstract: The aim of this study was to evaluate the feasibility of using a two-stage implant system in a single-stage procedure and to study the impact of the microgap at crestal level and to monitor the microflora in the peri-implant area. Forty edentulous patients (Cawood & Howell class V–VI) participated in this study. After randomisation, 20 patients received two IMZ implants inserted in a single-stage procedure and 20 patients received two ITI implants. After 3 months, overdentures were fabricated, supported by a bar and clip attachment. A standardised clinical and radiographic evaluation was performed immediately after denture insertion and 6 and 12 months later. Twelve months after loading, peri-implant samples were collected with sterile paper points and analysed for the presence of putative periodontal pathogens using culture techniques. One IMZ implant was lost due to insufficient osseointegration. With regard to the clinical parameters at the 12 months evaluation, significant differences for plaque score and probing pocket depth (IMZ: mean 3.3 mm, ITI: mean 2.9 mm) were found between the two groups. The mean bone loss in the first year of functioning was 0.6 mm for both groups. Prevotella intermedia was detected more often in the ITI group (12 implants) than in the IMZ group (three implants). Porphyromonas gingivalis was found in three patients. In one of these patients an implant showed bone loss of 1.6 mm between T0 and T12. Some associations were found between clinical parameters and the target microorganisms in the ITI group. These associations were not present in the IMZ group. The short-term results indicate that two-stage implants inserted in a single-stage procedure may be as predictable as one-stage implants. The microgap at crestal level in nonsubmerged IMZ implants seems to have no adverse influence on the peri-implant microbiological colonisation and of crestal bone loss in the first year of functioning. The peri-implant sulcus can and does harbour potential periodontal pathogens without signs of peri-implantitis during the evaluation period of 1 year.

Many different endosseous implant systems are currently used in oral implantology. Most implant systems consist of two parts, i.e. the implant, which is submerged during a first surgical procedure, and the transmucosal abutment, which is connected to the implant during a second surgical procedure. For this reason, these implant systems are collectively referred to as ‘two-stage’ systems. ‘One-stage’ implant systems consist of one part, which is inserted during a single surgical procedure. Well-documented long-term clinical studies have revealed that both system types have highly predictable outcomes (Adell et al. 1990; Lindquist et al. 1996; Haas et al. 1996; Heydenrijk et al. 1998; Buser et al. 1999).

Insertion of implants in one stage has several advantages (Buser et al. 1999):
only one surgical intervention is required, which is much more convenient for the patient, especially for the medically compromised patient;
2. there is a cost-benefit advantage;
3. there is a time-benefit since the prosthetic phase can start earlier because there is no wound healing period involved related to a second surgical procedure;
4. during the osseointegration period, the implants are accessible for clinical monitoring.

However, one-stage implants are not the preferred treatment (Raynesdal et al. 1999):
1. in combination with an augmentation procedure or guided bone regeneration when the wound has to be closed tightly to prevent infection and bone or membrane exposure;
2. if the integrated abutment interferes with a functional or esthetical design of the suprastructure;
3. to prevent undesirable loading of the implants during the osseointegration period when the temporary suprastructure can not be adjusted effectively.

In several recent studies, applying two-stage implants in a single surgical procedure has been reported to be promising (Bernard et al. 1995; Ericsson et al. 1994, 1996, 1997; Becker et al. 1997; Collaert & De Bruin 1998; Abrahamsson et al. 1999; Raynesdal et al. 1999; Fiorellini et al. 1999). The reported clinical and radiological outcomes suggest that the frequently cited rationale for using a two-stage approach, i.e. to minimise the risk of infection and to prevent apical down growth of mucosal epithelium, is at least questionable.

Since one-stage implant systems and two-stage implant systems inserted in a single-stage procedure seem to have comparable results, there are some advantages to using the latter method:
1. the surgeon only needs to have a two-stage implant system in stock for executing both submerged and nonsubmerged procedures;
2. it is possible to switch from a nonsubmerged procedure to a submerged procedure during the operation when this appears to be preferable;
3. during the osseointegration period, the healing abutment can be removed if the temporary prosthesis cannot be adjusted in such a way that the implant will not be loaded;
4. the coronal part of the implant is located at the crestal level, giving the possibility for a more flexible emergence profile of the transmucosal part.

It has been proposed that marginal bone loss is more extended around two-stage implants than around one-stage implants (Buser et al. 1999). The microgap between the implant and the abutment at the crestal level has been suggested to play a prominent role in the development of this bone loss (Hermann et al. 1997). However, when measured on standardised intraoral radiographs, marginal bone loss has been observed around one-stage ITI implants as well (Weber et al. 1992; Batenburg et al. 1998a). In animal studies, comparable marginal bone levels were found around one-stage and two-stage implant systems (Abrahamsson et al. 1996; Fiorellini et al. 1999). Thus, the suggestion that the microgap is entirely responsible for marginal bone loss is questionable.

It has been suggested that bacterial infection can result in peri-implant bone loss or loss of implants (Rosenberg et al. 1991; Leonhardt et al. 1999; Van Winkelhoff & Wolf 2000). Possibly, the microflora colonising the microgap or their products is responsible for the occurrence of this bone loss (Linde et al. 1992; Quirynen & Van Steenbergen 1993, Ericsson et al. 1995; Persson et al. 1996). Putative periodontal pathogens have been implicated in the onset and progression of peri-implantitis (Ellen 1998). However, it remains unclear whether these pathogens constitute a risk factor for the maintenance of dental implants (Danser et al. 1997). Nevertheless, periodontal pathogens such as Porphyromonas gingivalis and Actinobacillus actinomycetemcomitans can cause peri-implant infections, especially in partially edentulous patients with a history of periodontitis (Van Winkelhoff et al. 2000; Van Winkelhoff & Wolf 2000). The prevalence of peri-implant infection in patients carrying these pathogens is, however, unknown.

No studies have been published comparing a one-stage implant system with two-stage implants inserted in a single-stage procedure. The aim of the present study was to compare peri-implant radiographic bone loss, clinical parameters and microbial colonisation following the insertion of nonsubmerged two-stage implants and one-stage implants in order to explore the feasibility of inserting two-stage implants in a nonsubmerged procedure. Moreover, the impact of the microgap and of the colonisation of the peri-implant area by putative periodontal pathogens was evaluated.

Material and methods

Patient selection
Forty edentulous patients, 25 women and 15 men, with a mean age of 58 years (SD = 10 years), referred to the Department of Oral and Maxillofacial Surgery and Maxillofacial Prosthetics of the University Hospital Groningen, were selected on the basis of the following inclusion criteria:
1. the presence of a severely resorbed mandible (class V–VI, Cawood & Howell 1988) with reduced stability and insufficient retention of the mandibular denture;
2. an edentulous period of at least 2 years;
3. no history of radiotherapy in the head and neck region;
4. no history of proprosthetic surgery or previously inserted oral implants.

The patients were informed about the two different treatment options and written informed consent was obtained from all participants. They were randomly assigned to a group receiving ITI implants (one-stage 4.1 mm solid screw ITI dental implants with a TPS coating, Straumann AG, Waldenburg, Switzerland), or to a group receiving IMZ implants (two-stage 4 mm IMZ cylinder implants with a TPS coating, Friedrichsfeld AG, Mannheim, Germany). Twenty patients were included in each group.

Treatment procedures
All patients received two implants in the canine region of the mandible. The implants were inserted under local anaesthesia, each about 1 cm from the midline. Implants were inserted by an experienced maxillofacial surgeon, according to a strict surgical protocol. The surgical procedure used for the ITI-implants has been de-
scribed previously (Sutter et al. 1988). The IMZ-implants were inserted as described by Kirsch (1983) but with the modification for a single-stage implantation procedure using a labial mucosa flap and connecting healing abutments as described previously (Heydenrijk et al. 2000). In none of the patients were palatal mucosa grafts placed.

Post-operatively, analgesics and chlorhexidine 0.2% mouthrinse were prescribed for 14 days. Systemic or local antibiotics were not prescribed. Patients were not allowed to wear the mandibular denture during the first two postoperative weeks.

After 2, 6 and 12 weeks following the surgical procedure, the patients were recalled. At the first recall visit, sutures were removed and the mandibular denture was adjusted by selective grinding at the implant location and reining with Coesoft (Coe laboratories, Inc. Chicago, IL, USA). At all recall visits, patients received oral hygiene instructions.

Three months after implant insertion, the manufacturing of a new maxillary denture and a mandibular overdenture was initiated. A uniform prosthetic procedure (Batenburg et al. 1993) was performed for all patients by one experienced prosthodontist. In the IMZ group, the healing abutments were replaced by 5-mm-high titanium connectors. A Dolder bar with subsequent clip attachment supported the overdentures. A balanced occlusion and monoplane articulation concept with porcelain teeth was used.

Outcome measures
Data collection was performed three times during the first year (T0 = baseline assessment, 4 weeks after insertion of the new prosthesis; T6 = 6 months after T0; T12 = 12 months after T0).

Clinical outcome measures
The Mombelli index (score 0–3) was used to quantify the amount of plaque retained at four aspects of the surface of the super- mucosal part of the implant (Mombelli et al. 1987). The highest value per implant was used for data-analysis. The presence (score 1) or absence (score 0) of calculus per implant was also recorded.

The degree of peri-implant inflammation was quantified by the mucosa score, i.e. the modified Löe and Silness index (Löe & Silness 1963), yielding a 0-3 score at each of four aspects of the implants. The highest score obtained per implant was used for data-analysis. In addition, the bleeding index according to Mühlemann & Son (1971) modified by Mombelli et al. (1987) was scored per implant (score 0–3).

The depth of the peri-implant ‘sulcus’ was measured mesially and distally of each implant to the nearest millimetre using a periodental probe (Merrit B, Hu Friedy, Chicago, IL, USA) after removal of the bar (Quirynen et al. 1991). The distance between the marginal border of the mucosa and the tip of the pocket probe was scored as the probing pocket depth. The deepest pocket per implant was used for data-analysis.

The Periotest® device (Siemens, Bensheim, Germany) was used to quantify implant mobility (Teerlinck et al. 1991). Mobile implants were regarded as being lost and were removed.

Measurements were made by the same observer throughout the evaluation period after calibration.

Radiographic outcome
Standardised intraoral radiographs were made using the long cone technique with an aiming device (Meijer et al. 1992). The distance from a fixed reference point of the implants to the first bone-to-implant contact was measured with a digital calliper (Digital SI, Tesa SA, Renens, Switzerland) (Meijer et al. 1993). The measurements were made at the two approximal implant sites. The site showing most bone loss was identified on the basis of colony morphology, Gram-stain and production of specific enzymes (Heydenrijk et al. 2000, 2002). Prior to probing pocket depth measurements, supra-mucosal plaque and calculus were carefully removed with sterile Teflon curettes and cotton pellets, after which the sample site was isolated with cotton rolls and gently air-dried. Sterile paper points (Fine, UDM, West Palm Beach, FL, USA) were inserted in the peri-implant sulcus and left in place for 10 s. Per implant the approximal sites were sampled twice. Per patient the paper points were collected in four separate vials containing 1.8 ml reduced transport fluid (RTF; Syed & Loesche 1972). The presence and proportions of A. actinomycetemcomitans, P. gingivalis, P. intermedia, B. forsythus, Peptostreptococcus micros, Fusobacterium nucleatum and Campylobacter rectus were assessed. Samples were processed in the laboratory within 6 h. Ten-fold serial dilutions of all samples were prepared in RTF. Aliquots of 0.1 ml were inoculated on 5% horse blood agar plates (Oxoid no. 2, Basingstoke, UK) with haemin (5 mg/l) and menadione (1 mg/l) for isolation and growth of obligately anaerobic bacteria, and on TSBV plates for selective isolation and growth of A. actinomycetemcomitans (Slots 1982). Blood agar plates were incubated anaerobically in 80% N2, 10% H2 and 10% CO2 for up to 14 days. TSBV plates were incubated in air with 5% CO2 for 5 days (van Steenbergen et al. 1986). Blood agar plates were used for determination of the total number of colony forming units, the presence of dark-pigmented colonies, B. forsythus, F. nucleatum and P. micros. Representative dark-pigmented colonies were purified and identified using standard techniques (van Winkelhoff et al. 1988), including Gram-stain, fermentation of glucose, production of indole from tryptophan and production of specific enzymes (van Winkelhoff et al. 1986). B. forsythus was identified on the basis of the typical colony morphology, Gram-staining and production of trypsin-like enzyme (Braham & Mondla 1992). F. nucleatum and P. micros were identified on the basis of colony morphology, Gram-stain and production of specific enzymes (API 32 A, Biomerieux, La Balme, Les Grottes, France).

Data analysis
Qualitative data and quantitative data were analysed after categorisation using chi-square tests to assess differences in distribution between the two groups regarding
clinical, radiographic and microbiological parameters. Differences between quantitative variables were tested with the (paired) t-test if the population was normally distributed and with Wilcoxon’s ranked sign test (paired data) or Mann-Whitney’s test (independent data) if the criteria for using parametric tests were not fulfilled. The course of clinical and radiographic parameters within the groups during the evaluation period was evaluated with Friedman’s test for more than two related samples. For all univariate tests, a significance level of 0.05 was chosen.

The strength of possible associations between clinical and radiographic parameters on the one hand and the presence of target microorganisms on the other was assessed with Spearman’s rank correlation coefficient. A multiple stepwise regression analysis was performed to assess the joint contribution of the peri-implant mucosal condition (mucosa score, plaque score, pocket probing depth, bleeding score) and microbiological findings to the bone loss between T0 and T12.

Results

Loss of implants

At T0, one IMZ implant showed probing pockets depths of 12mm and there were signs of inflammation (mucosa score 2), though the Periotest value was –3 and the implant did not show signs of mobility. Radiographic examination revealed a mesial bone defect of 10mm and a distal bone defect of 3mm. The implant was left in place, but at T6 it had to be removed because of increased mobility. Three weeks after removal, two new implants, one mesial and one distal to the former implant location, were successfully inserted.

Peri-implant parameters

The plaque scores in the ITI group were significantly higher than those in the IMZ group at T6 and T12 (chi-square test, P = 0.05 and P = 0.006, respectively, Fig.1). The bleeding score in the IMZ group was significantly higher than in the ITI group at T0 (chi-square test, P = 0.05, Fig.4). With regard to mucosa scores and the presence of calculus, no differences in distribution between the two groups were found (chi-square tests, P > 0.05, Figs2 and 3).

In the IMZ group there was a significant reduction in the plaque score in the course of the observation period (Friedman test, P = 0.04, Fig.1). In the ITI group there was a significant increase in the bleeding score (Friedman test, P = 0.05, Fig.4). With regard to mucosa and calculus scores, no significant changes were found in the two groups during the observation period (Friedman test, P > 0.05, Figs2 and 3). The difference between the probing pocket depths in the IMZ group and in the ITI group was significant at T0 (IMZ: mean 3.6mm, median 3.0mm, range 2–12; ITI: mean 2.4mm, median 2.0mm, range 1–5; Mann-Whitney U = 334, P < 0.05) as well as at T12 (IMZ: mean 3.3mm, median 3mm, range 1–5;
the floor of the mouth. Therefore, the radiographic observations of 38 IMZ and 38 ITI implants could be analysed. The mean amount of bone loss between T0 and T12 was 0.6 mm in both groups (ITI: SD = 0.8; IMZ: SD = 0.9). A multiple regression analysis did not yield a model relating clinical parameters and target microorganisms with the amount of bone loss between T0 and T12.

Microbiological parameters
Three patients had taken antibiotics during the previous 3 months for different medical purposes. They were recalled for sampling 3 months later. The mean number of colony forming units was \(3.6 \times 10^6\) (SD = 6.9 \(\times\) 10^6) in the IMZ group and 16 \(\times\) 10^6 (SD = 47 \(\times\) 10^6) in the ITI group, which was not significant difference. P. intermedia was found significantly more often around ITI implants than around IMZ implants (\(y^2 = 6.4, P = 0.01\), Table 1). B. forsythius was found at ITI sites only. A. actinomycetemcomitans was not found at any of the implant sites.

In the ITI group, several associations (Spearman's rho < 0.6 in all cases) between the clinical parameters and the presence of target microorganisms could be established (Table 1). These associations were not found in the IMZ group.

In the ITI group, bone loss was observed in 26 IMZ implants and in 34 ITI implants (Figs 5 and 6). These implants were divided into two subgroups, i.e. those with sites showing \(\leq 1\) mm bone loss and with sites with >1 mm bone loss. No association could be demonstrated between the amount of bone loss and the presence of any of the target microorganisms (Table 1).

One IMZ implant site harbouring P. gingivalis and showed bone loss of 1.6 mm between T0 and T12. Both ITI implants in one patient harbouring P. gingivalis and these sites showed bone loss between T0 and T12 of 0.2 and 0.5 mm, respectively. Another ITI implant site harbouring P. gingivalis showed bone loss of 0.4 mm.

Discussion
This prospective randomised study is the first in which clinical, radiographic and microbiological results of two-stage non-submerged implants and one-stage im-

ITI: mean 2.9 mm, median 3 mm, range 1–5; Mann–Whitney U = 582, P = 0.02. At T12, the IMZ group showed significantly more implant sites with pockets \(\geq 4\) mm compared to the ITI group (chi-square test, \(P = 0.04\), Table 1). In the ITI group, there was a significant increase in probing pocket depth during the observation period (Friedman test, \(P = 0.007\)). The periotest values were identical for both groups and ranged from \(-4.8\) at T0 to \(-5.1\) at T12.

Radiographic parameters
In two patients (one in the IMZ group and one in the ITI group) no standardised radiographs could be made of both implants, because the Dolderbar was placed labial to the implants to prevent interference with the floor of the mouth. Therefore, the radiographic observations of 38 IMZ and 38 ITI implants could be analysed. The mean amount of bone loss between T0 and T12 was 0.6 mm in both groups (ITI: SD = 0.8; IMZ: SD = 0.9). A multiple regression analysis did not yield a model relating clinical parameters and target microorganisms with the amount of bone loss between T0 and T12.

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Table 1. Results at T12. Number of implants with a mucosa score, plaque score, bleeding score ≥ 1 or a probing pocket depth ≥ 4 mm or with different amounts of bone loss between T0 and T12, colonised with the target organisms. Aa: A. actinomyctemcomitans, Pg: P. gingivalis, Pi: P. intermedia, Pm: P. micros, Bf: B. forsythus, Fn: F. nucleatum, Cr: C. rectus

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*Associations between clinical parameters and the target organisms are marked with an asterisk.

**In two patients no standardised radiographs could be made of both implants and one implant was lost. Therefore, the radiographic results were described of 37 IMZ and 38 ITI implants.

plants have been compared. Between-group differences primarily relate to microbiological issues. Only minor clinical differences and no important radiographic differences between the two groups were found in this study, suggesting that a two-stage implant system can be safely used for implant insertion in a nonsubmerged procedure.

At the 1-year evaluation (T12), 79 implants were successfully functioning. One IMZ implant had to be removed after 6 months of functioning. Because this implant already showed a severe peri-implant destruction at the beginning of the study without being mobile, it is likely that only partial osseointegration had occurred, which was insufficient to withstand the forces of the overdenture in function. Two new implants at a mesial and distal location of the old implant bed resulted in successful re-implants.

The clinical results are more or less comparable with the results in studies evaluating one-stage or two-stage implant systems (Cox & Zarb 1987; Mericske-Stern et al. 1994; Batenburg et al. 1998b; Heydenrijk et al. 1998). In the IMZ group, significantly more implants showed pockets ≥4 mm than in the ITI group. This difference might be attributed to the shape of the IMZ implants, which can hamper easy insertion of the pocket probe (Spiekermann et al. 1995). The slight increase in average probing pocket depth in the ITI group is in agreement with the observations of Wismeijer et al. (1999).

Reproducible radiographs of sufficient quality are necessary in a longitudinal trial to detect the first bone to implant contact accurately. The intraoral radiographs used in the present study have been shown to satisfy this criterion (Batenburg et al. 1998a). The landmarks necessary for the evaluation were easy to identify. A major drawback of this technique is that the first radiograph can be obtained no sooner than after placement of the bar, which was at least 5 months after implant insertion. However, crestal bone loss around nonsubmerged implants has been shown to occur mainly within the first months after implant insertion (Hermann et al. 1997; Pham et al. 1994). Because no standardised intraoral radiographs could be made immediately after implant insertion, no information was available considering the initial bone level. The mean bone loss of 0.6 mm between T0 and T12 found in the ITI group of the present study was comparable to the results of other studies (Weber et al. 1992; Åstrand et al. 1996; Brägger et al. 1998; Batenburg et al. 1998b; Wismeijer et al. 1999). Two-stage implant systems show an average peri-implant bone loss in the first year ranging from 0.9 to 1.6 mm (Brägger et al. 1998). In the present study, a mean peri-implant bone loss of 0.6 mm was noticed in the IMZ group, suggesting that these implants are doing extremely well. However, implant sites with bone loss exceeding 1.0 mm between T0 and T12 were observed in both groups. Because this is substantially more than the average in our study, these implants are possibly at risk of failure and are therefore of special interest for long-term evaluation. These long-term evaluations will have to determine whether the bone loss is physiologic or pathologic and what factors are involved.

No correlation between the peri-implant mucosal aspects and bone loss between T0 and T12 was found, which has been reported earlier (Mericke-Stern et al. 1994; Batenburg et al. 1998b).

In our study we included edentulous patients because they provide a unique opportunity to study the colonisation of dental implants. Before implantation, these pa-
patients are devoid of tooth surfaces serving as sources for A. actinomycescomitans and P. gingivalis to colonise (Apse et al. 1989; Koka et al. 1993; Mombelli et al. 1995; Quirynen & Listgarten 1990, 1996; Lee et al. 1999; Van Winkelhoff et al. 2000). Therefore, edentulous patients are only rarely colonised by A. actinomycescomitans and P. gingivalis (Danser et al. 1997), although in three patients of the present study P. gingivalis was cultured which is probably due to transmission from another subject (Danser et al. 1998).

Mombelli et al. (1988) concluded that one-stage implants in edentulous patients were colonised by a microflora similar to the microflora of the oral mucosal surfaces before implantation. Therefore, the implants were colonised by predominantly facultative cocci associated with periodontal health. Moreover, these authors concluded that the colonisation was established quite soon after implantation and that no important shifts in the composition could be demonstrated over time.

The mean number of colony forming units found around the ITI implants of the present study is comparable with other studies evaluating stable ITI dental implants in edentulous patients (Mombelli et al. 1987, 1988). It is likely that marginal bone resorption around an ITI implant is related to exposure of a rough surface. The rough/smooth interface of the ITI implants is located at crestal level, while in the IMZ implants this interface is located approximately 1 mm deeper. It seems likely that this rough surface exposure favours microbial colonisation. However, despite the difference in plaque score, no significant difference was found between the amounts of colony forming units of the two implant types.

In three recent studies, the submucosal microflora around IMZ implants were evaluated (Danser et al. 1997; Pontoriero et al. 1994; Augthun & Conrads 1997). Because of the differences in study design, the results of the two latter studies were difficult to compare with the present study. In the study of Pontoriero et al. (1994), implants were inserted in partially edentulous patients with a history of moderate advanced periodontitis and only bacterial morphotypes were enumerated instead of bacterial determination, as used in the present study. In the study of Augthun et al. (1997) edentulous patients with IMZ implants showing bone loss exceeding 5 mm were included. A high incidence of A. actinomycescomitans and P. intermedia and a low incidence of F. nucleatum were observed. The high incidence of A. actinomycescomitans observed in edentulous patients in this study was particularly striking, although A. actinomycescomitans has recently been found in an edentulous patient (Van Winkelhoff & Wolf 2000). In the present study, A. actinomycescomitans was not detected and a low incidence of P. intermedia and a high incidence of F. nucleatum were observed around the IMZ implants. The major reason for the differences in results probably relates to the inclusion of only failing implants in the study of Augthun et al. (1997). In the study of Danser et al. (1997), in which 20 edentulous patients were treated with either IMZ or Brånemark implants, a microbiota associated with periodontal health was found. A. actinomycescomitans and P. gingivalis were not detected. These authors reported a peri-implant microflora comparable with that around the IMZ implants of our study.

Three studies report the colonisation of stable ITI implants in edentulous patients (Mombelli et al. 1987, 1988; Mombelli & Merieske-Stern 1990). P. gingivalis was not isolated and P. intermedia and Fusobacterium species were found only occasionally. These results differ from those found in our study, which cannot be explained by differences in study design. The most plausible explanation for the higher incidence of P. intermedia and B. forsythus in the ITI group of our study was the higher plaque scores in this group, although no significant association between these parameters was found.

Several studies showed associations between clinical parameters and the peri-implant microflora. A trend was found between the bleeding index and the proportion of motile organisms in edentulous patients (Papaioannou et al. 1995). For increasing pocket depths, a significant decline in cocci and a significant increase for other morphotypes (motiles and Spirochetes) as well as the total number of organisms was observed (Sanz et al. 1990; Rams et al. 1991). In the study of Mombelli & Merieske-Stern (1990) the relative proportion of Capnocytophaga was significantly related to probing pocket depth, and in the study of Danser et al. (1997) all subjects harbouring P. intermedia showed pockets > 4 mm. In the study of Keller et al. (1998), Fusobacterium species and P. intermedia were found in significantly higher numbers in the deeper periodontal pockets. However, in several other studies no correlation was established between the frequency of any group of microorganism and the clinical parameters (Lekholm et al. 1986b; Adel et al. 1986; Apse et al. 1989, Mombelli et al. 1995; Sbridone et al. 1999). In the ITI group, we found several weak associations between clinical parameters and the presence of the target microorganisms, to which no clinical significance can be attributed. No association was found between the presence of any of the target microorganisms and the amount of bone loss. In three patients of the present study, P. gingivalis, which is considered to be the most periodontopathic species in adults, was cultured. Although the amount of bone loss during the first year of loading (between 0.2 and 0.5 mm) could be considered normal in two patients, the bone loss of 1.6 mm between T0 and T12 observed in the third patient might suggest a possible association with the presence of P. gingivalis.

Although suspected periodontal pathogens were identified at implant sites in the present study, the clinical and radiological parameters were not indicative of deterioration, suggesting that the presence of potential periodontal pathogens around implants is not necessarily associated with future attachment loss or implant failure. However, it is possible that, as in the dentate situation, elevated numbers of these bacteria need to be present for extended periods of time to have an adverse impact on the tissues (Mombelli et al. 1995). From the periodontal literature it has become evident that periodontal pathogens are essential for the onset and progression of destructive periodontal disease, but interpatient variability in the host response is a major determinant of the expression of periodontal disease. In the implant literature there are indications that implant failure is primarily at a patient level and secondarily at implant level from a clinical or microbial perspective (Salicetti et al. 1997; Kronström et al. 2000). The question of susceptibility to infection of peri-implant tissue in the presence of these organisms might be answered in the long-term evaluation of our patients.
Conclusions

The results of this study indicate that dental implants designed for a submerged implantation procedure can also be used in a single-stage procedure and may be as predictable as on-stage implants. The microgap at crestal level in nonsubmerged implants appears to be of no importance in the establishment of the submucosal microbial flora and crestal bone loss during the first year of functioning.

Résumé

Le but de cette étude a été d'évaluer la possibilité d'utiliser le système implantaire en deux étapes lors d'un processus en une étape, d'étudier l'impact du mini-sillon au niveau creste et d'évaluer la microflore parodontaire. Quarante patients étaient inclus dans le groupe IMZ et vingt autres dans le groupe ITI. Après trois mois, des prothèses amovibles s'insérant dans une barre ou une attache ont été fabriquées. Une évaluation standard clinic et radiographique a été effectuée juste après l'insertion de la prothèse et six et douze mois plus tard. Douze mois après la mise en charge, des échantillons de Cassiobacter et de papillomicrobiotes ont été prélevés à l'aide de pointes en papier stériles et analysés pour déterminer la présence de pathogenes parodontaux potentiels. Le sillon parodontaire peut recevoir et recueillir des pathogenes parodontaux sans signe de parodontite durant une année. Les résultats ont montré que les implants en deux étapes insérés dans une barre ou une attache sont plus stables que les implants ITI. Ces résultats ont montré qu'il est possible d'utiliser des implants IMZ en deux étapes dans un processus en une étape et ont permis de déterminer la microflore parodontaire.

Resumen

La intención de este estudio fue evaluar si es factible usar un sistema de implantes de dos fases un procedimiento de una sola fase y estudiar el impacto del microhueso en el nivel creste al monitorizar la microflora en el área periimplantaria. En este estudio participaron cuarenta pacientes edentulos (Cawood & Howell clase V-VI). Tras distribuirlos aleatoriamente, 20 pacientes recibieron dos implantes IMZ insertados mediante un procedimiento de una sola fases y 20 pacientes recibieron dos implantes ITI. Tras 3 meses, se tomaron muestras periimplantarias con puntas de papel estériles y se analizó la presencia de patógenos periodontales usando técnicas de cultivo. Se perdió un implante IMZ debido a insuficiente osteointegración. Respecto a los parámetros clínicos en la evaluación de los 12 meses, se encontraron diferencias significativas entre los dos grupos en los índices de placa y la profundidad de sondaje (IMZ: media 3.3 mm; ITI: media 2.9 mm). La pérdida de hueso media en el primer año de función fue de 0.6 mm para ambos grupos. Se detección Previolda intermedia más frecuentemente en el grupo ITI (2 implantes) que en el grupo IMZ (3 implantes). Se encontró Porphyromonas gingivalis en 3 pacientes. En una de estos pacientes un implante mostró una pérdida de soporte de 1.6 mm entre T0 y T12. Se encontraron algunas relaciones entre los parámetros clínicos y los microorganismos diana en el grupo ITI. Estas relaciones no se encontraron en el grupo IMZ.

Zusammenfassung


References


Heydenrijk et al. Two-stage implants in a single-stage procedure


