Cranio-maxillofacial

Implant Directions®

Vol.3 No.1 March 2008

Clinical Research »

Outcomes of immediately loaded full arch reconstructions on basal implants and teeth in the mandible

Ihde S.

ISSN 1864-1199 / e-ISSN 1864-1237

OFFPRINT

Published by IF Publishing, Germany

Editorial board

Single Issue Price
Euro 30
Annual Subscription
Euro 120

Contact
publishing@implantfoundation.org

CMF.Impl.dir.
ISSN 1864-1199
e-ISSN 1864-1237

Disclaimer

Clinical Research

Outcomes of immediately loaded full arch reconstructions on basal implants and teeth in the mandible: retrospective report on 115 consecutive cases during a period of up to 134 months.

AUTHOR:
Ihde Stefan K.A., Dr.med.dent.*
Lindenstr. 68
CH-8738 Uetliburg
e-mail: dr.ihde@bluewin.ch

ABSTRACT

We report on a retrospective review of outcomes after the insertion and usage of basal implants alone or in combination with natural abutments for treating patients with full arch bridges in the mandible. From June 1996 to August 2007, 115 consecutive patients seeking implant treatment in the lower jaw received 457 basal implants and a total of 130 bridges thereon. Only cases where basal implants were used alone or in combination with teeth were included. During the observation period no patient seeking treatment was turned away for any reason. Teeth were included into the constructions whenever available and in an appropriate location and condition. The mean age at implant surgery was 60.7 years. Even in cases of severe bone atrophy, no augmentations were performed. All patients received fully loaded fixed bridges between 3 to 12 days postoperatively. Whenever implants had to be replaced after extractions, this was done in one surgical step without waiting or healing time. An overall success rate of 93.4 % was observed. Basal implants alone or in combination with stable teeth can securely be placed and used in immediate load protocols to form a base for full arch bridges in the edentulous or partly dentate mandible.

KEYWORDS

Basal implants, BOI®, Diskos®, immediate load, immediate implant placement, full arch mandibular reconstructions.

INTRODUCTION

Placement of circular bridges on basal implants in immediate load conditions is a frequently performed procedure and there are various reports on this procedure in the literarture[1, 8, 11]. Other than in axial (crestal) implantology, the restoration of basal implants is in most cases done by a fixed bridge: telescopes are contraindicated and bar-based restorations are rarely delivered. Due to the straight forward treatment protocol and the possibility to avoid intermediate prosthetical constructions, the overall treatment costs are low. All these aspects reflect the desire and expectations of the overwhelming majority of the patients [13].

Atrophy is the result of a lack of bony stimulation and nutrition. Generalized diseases may

aggravate the disease and promote the bone loss.[3,4]

The management of quantitative and/or qualitative poor bone with root-form dental implants typically requires additional procedures to ensure sufficient stability[5], with augmentations, bone transplants or distractions being the most "popular" procedures. The management of the atrophied distal mandible with axial implants imposes special problems, since the nerve canal forbids in many cases the usage of the full amount of vertical bone in the zone bearing most of the chewing forces. Augmentations and distractions in this region are difficult and associated with considerable patient discomfort. If teeth are to be extracted, additional waiting time before equipping the mandible with axial implants has to be considered. Additional treatment steps such as augmentations and distractions add risks to the procedure, delay loading, and increase costs.

Basal implants are placed transosseously and at least one base-plate is bicortically anchored in the basal, cortical bone. Basal implants utilize the horizontal bone supply as well as the cortical bone walls; therefore, they are well suited for placement immediately after extractions. It is understood today, that basal implants undergo a dual mechanism of integration: ring areas in direct, primary contact with the native bone show primary integration though osteonal remodeling also occurs. Empty slot areas (the void space left after osteotomy and insertion) fill with callus, which later undergo osteonal remodeling[13]. This dual integration also allows placement of basal implants right into extraction sockets of teeth or implants and other cavities, e.g. empty spaces left after cystektomies or granulation removals, or may even be applicated trans-sinusally.

There is a long tradition in combining basal implants with stable teeth. As a matter of fact, professional who use basal implants continue to discuss whether to do so or not which should be validated by such data analyses as reported in this manuscript.

METHODS

SUBJECTS

From June 1996 to August 2007, 115 consecutive patients (60% female) receiving 457 basal implants and 130 full arch prosthetic constructions in the mandible thereon were enrolled in this study. All patients seeking implant treatment during this period have been treated using basal implants alone or in combination with natural abutments. Patients receiving at least one screw type implant were excluded from this study, because their inclusion would make distinction between the benefits of these two implant types difficult and would not allow reporting on the independent performance of basal implants. The surgical and prosthetic treatments were all performed by the same group of clinicians. The mean age at implant surgery was 60.7 years (SD=9.8; median=61; range: 33 to 80 years, Fig. 6). The average number of implants used per circular bridge was 3.9 and on average 3.5 teeth were included into the constructions. Sixty-seven constructions on 330 implants were erected only

on basal implants, without teeth -, with three implants being the minimum and eight implants being the maximum number of implants used for the fixation of these mandibular bridges (Average number of implants in this subgroup: 4.9 basal implants per mandible), thirty edentulous mandibles received four strategically placed basal implants only. A typical treatment plan with teeth includes the six front teeth and two basal implants placed in the area of the 2nd molar (Fig. 3), typical treatment plans without teeth would include basal implants at least in the strategic positions of the canines and second molars (Fig. 2, 4).

IMPLANTS

Basal implants consist of a thin vertical shaft (1.9 – 2.3 mmd) and one to three horizontal base plates, designed for cortical load transmission. (Fig.1) Unlike the traditional axial ("root-form") implants, which are inserted vertically and primarily designed to be supported by trabecular bone, these implants are inserted from the lateral aspect of the jaw bone into a T-shaped slot created by high-speed precision instruments, providing bi- or multi-cortical support and immediate fixation even if placed in extraction sites right away. Hence, they are commonly called "disk" or "lateral" or "basal" implants [10].

BOI® implants transmit the masticatory forces into cortical bone areas and they are placed to utilize resorption free bone areas, such as the interforaminal region and the bone below the linea oblique in the distal mandible. The site of force transmission is far away from the area of bacterial invasion; hence base plates never develop infections as long as they are well integrated. The vertical implant shafts are not meant to transfer masticatory loads directly to the bone, hence they are relatively thin and allowed to be machined or even polished. As a result peri-implant infections are never seen in basal implants. Basal implants have proven to be well suitable for smokers.[12]

During the treatment- and observation period, the manufacturer has made a number of small changes in the implant design and this study does not distinguish between the different types available at their times, since treatment protocols and indications did not change. As a principle, the fixed bridge on basal implants (Brands: BOI®, Diskos®) serves as an immediate external fixation for the implants. The bridge also distributes the masticatory loads between the implants and it allows masticatory function at the same time.

SURGICAL TECHNIQUE

Under local anaesthesia, an appropriate full thickness flap is raised. Using high-speed precision cutters, the implant bed is prepared which provides the appropriate number of vertical and horizontal slots for the chosen implant. Basal implants must always be inserted bicortically and trans-osseously. The implants are inserted (depending on the anatomical condition and the desired position) from the lateral, me-

dial or palatinal aspect of the jaw bone with careful tapping action until full bi- or multicortical support is achieved. The presence of sufficient support is verified visually or manually by testing with the fingers. The implants may also be fixed horizontally by use of bone screws (Brand: SSF), when primary stability cannot be achieved right away, e.g. when the implant bed is not exactly congruent to the implant or parts of the implant cannot reach cortical walls, or if these walls are missing after the extraction of teeth or soft tissue.
A flapless, trans-mucosal insertion is not possible for basal implants.

OUTCOME EVALUATION

Implants were counted as successful, if they are in situ at the point of observation, connected to a bridge in function, if they allow mastication without pain or visible infection, and if no indication for their removal according to the "Consensus on BOI®" was given [14].

DATA ANALYSIS

Descriptive statistics were calculated for baseline variables. The primary outcome of interest was implant failure defined as any reason for having to remove an implant. Survival was based on the period from implant placement to final follow-up. Because basal implants are designed for immediate loading (meaning that immediate loading is the method of choice and late or delayed loading is a rather poor, even dangerous protocol for this type of implant), it was of course not possible to distinguish between a "healing" phase and a "loading" phase and especially in this circular restorations all implants were loaded under full masticatory loads. All failures were counted immediately if they were observed.

RESULTS

Patients were followed for a mean of 67.1 months (Median=69.5; SD=28.8; range: 3-134 months, Fig. 7) in this study. Six patients (5.2%) with 16 implants (3.5%) were lost to follow-up for different reasons. Patients refraining from follow-up for more than12 months were excluded from the study and counted as drop out. Another seven patients (6.1 %) died during the observation period with all of their implants (n= 30; 6.6% of all implants) in full function. Those cases and implants were kept in the study but the implants were censored at the point of death. All implants were loaded immediately or within the first 24 hours after the implantation with a fixed temporary or permanent bridge. Fixation of the second, more permanent, prosthetic construction followed in subsequent days after surgery in most cases. In extraction cases, "final" bridges were delivered after 6-18 months if requested by the patient. We found an overall survival rate of 93.4% of the implants during the follow-up period.

If was reported after the healing period mobility of the implant causing an internal irritation of the periosteum was the most common cause. In cases where the implant could be

left in place [14], this was addressed by a occlusal reorganization, i.e. grinding or building up chewing surfaces, thus relieving the interface region between the endosseous implant part and the bone from overload and allowing the peri-implant bone to recover and to remineralize. In the distal mandible, vertical bone growth even along the implant was observed regularly [12]. Two implants had to be removed, because the vertical bone growth did not allow cleaning of the site any more and recurrent infections occurred. The replacement implants were situated more anteriorly. At the time of the first intervention, a more anterior placement of the implant had not been possible, because the available bone crestally of the alveolar bundle of vessels was less than 1 mm. Only at the time of the second intervention, enough bone whose growth had been induced by functional stimulation and/or the remodeling following the first intervention, had been available. (Fig. 10a, 10b). For the replacement of the implant, the bridges were shortened and the new implant parts were connected to the existing bridge by means of over-cementation. Those two implants were not counted as a failure since they did not meet the criteria of failure. Fifteen (13%). bridges had to be renewed completely, following implant and/or tooth loss. The majority of the renewals were caused by tooth associated problems (decay, decementation of bridge, loosening of posts inside root canals followed by loosening of the bridges), often followed by implant loss due to overload (and subsequent mobility) or even implant fracture.
Implant losses (n = 30) occurred mainly during the first four years after implant placement (Fig.8), with the mean time of lost implants in function being 783 days (Std.-Dev. 530 days).

DISCUSSION

We report a 93.4% implant survival rate among a consecutive series of 115 patients receiving 457 basal implants and a total of 130 fixed circular bridges in the mandible.
This result is great, that even cases of severe atrophy were treated in one surgical intervention with basal implants, thus avoiding augmentations and bone transplants. Combined with the early external fixation via the bridges, this implant system responds well to early load analogous with physiological forces observed orthopedic surgery with early partial weight bearing. Living healthy bone will be remodeled and grows with daily use. It may be possible to minimize the antagonistic contacts in subtotal constructions to reduce the initial forces, but in circular bridges on implants this is impossible. So the application of a real immediate loading protocol is necessary. All patients were treated under local anaesthesia in a regular dental office. The average absence from work was 1.9 days for the initial treatment phase. No one stopped working for more than one week. Most of the patients went back to work on the day after implant placement. None of the patients including those showing severe atrophy, had to be hospitalized.

There are limitations to the present study. The design of the basal implants used during the years has been improved by the manufacturer and we do not distinguish between the dif-

ferent designs. One major change in design which occurred approximately 1999 was that no surface enlargening (i.e sandblasting) was administered to the vertical implant surface. This change eradicated the crater-like bone losses found earlier in some of the basal implants of the sandblasted shaft type. Later, no sandblasting was not performed at all, i.e. basal implants are completely machined today (Fig.1). Another change in double-disk designs occurred approximately in the year 2000. From this point, the crestal base-plate was manufactured with more elasticity than the basal plate. Subsequently translucencies around the crestal plate, occurring in about 10-15% of those implants, were not observed any more. A slight increase in the thickness of the baseplate (0,1 - 0.2 mm) may have contributed to the fact that no fractures were seen in implants placed after 2002. Triple-base-plate designs with strong primary stability were introduced about the same time period. Those small changes and developments have combined with our learning curve and have made the treatment even more predictable in the last years of observation (Fig.9); it must be taken into account also that at the time when we started using and exploring the basal approach in implantology, no teaching and no textbooks were available and the author and his group as well as associated colleagues interested in this technique have learned the handling and possibilities auto-didactically. Losses of implants during the period 1997 – 2002 were unavoidable.

As progress in axial implantology occurs, many cases classified "untreatable" earlier, are treated today with screw type implants with considerable success, although for many patients, the installation of fixed teeth on those (axial) implants remains impractical. We feel that the patient cases which reached our office in the last years have become more difficult to treat and atrophies treated in our center became increasingly severe, because patients with more available bone at the start of treatment find a capable screw- implantologist easier today and they are not referred so easily. A new group of patients is seaking this treatment because of the possibility of immediate loading and avoiding risky, time consuming and expensive bone augmentations. This group is increasing.

Furthermore we have not treated a control group with bone augmentations or distractions, since this was not the desire of our patients. For patient cases presenting with severe bone atrophy (as shown in Figure 2 as an example), no realistic alternative treatment plan could be developed, carried out, or used as a comparison. The primary reason that none of our patients expressed the wish to have "more bone", was their desire for "fixed teeth" and they knew that our clinic offers straight forward treatments without augmentations or waiting times. So the "alternatives" simply wouldn't sell in the same dentists office. We have asked several other centers from whom we knew that they provided heavy maxillofacial surgery, distractions and bone augmentations during the same period of time, to contribute their retrospective data for comparism with our result. None of the centers receiving our inquiry was willing

to release data or to cooperate. However one of those centers, after seeing our results and how we solved the cases, changed the way of treatment drastically. Bone augmentations are not performed any more in this center and the system of basal implantology was impemented and is used more and more today. And finally, some patients seeking additional implants after screw implants have been placed in the anterior mandible were treated during the observation period. We have placed BOI® in the distal mandible to allow placement of a fixed bridge. These cases of "upgrading" are not included in this report because it could be argued that the outcome of this treatment could be mainly due to the integrated screw implants alone. Inclusion of those cases would not make the this report stronger.

This is a case series and can be compared to historical publications. Our survival rates are very similar to those found in the literature.[6-8,10-12] Diskimplants® are similar in design and function to BOI® implants and have reported rates of successful osseointegration of up to 97% with relatively long follow-up periods. Scortecci performed a prospective case series of 783 implants (627 Diskimplants®), placed in 72 patients with completely edentulous maxillae using an immediate load protocol. Follow-up ranged from 6 – 48 months. At 6 months, 98% of implants were osseointegrated, with all fixed prostheses remaining functional during the study period.[6] However Scortecci combined crestal and basal implants, which makes it difficult to distinguish between the merits of these designs on their own. This study shows that BOI® implants by themselves are safe and effective.

Ihde and Mutter performed a retrospective case series of 275 BOI® implants in 228 patients over a period of five years. Molars were replaced with BOI® implants in combination with anterior natural abutments. Osseointegration was achieved in 97.3% (n=254) of implants at final follow-up. Fifteen implants were lost.[7] The results are similar to our findings.

Donsimoni et al performed a retrospective case series evaluating 1352 consecutive basal implants placed over a 10 year period in 234 circular bridges.[8] Osseointegration was achieved in 97%. Of the 41 implants that failed, 25 had to be replaced. Only one full upper bridge had to be permanently removed rendering a clinical success of 99.9%. Interestingly, smokers and non-smokers experienced similar rates of implant losses, whereas reports from axial implants indicate opposite results[9]. Donsimoni et al used only basal implants in their study; however, they inserted a greater number of basal implants per jaw (up to 12) compared to us (4.9 per jaw). The results presented in this article are consistent with our findings. Neither Scortecci, Ihde & Mutter or Donsimoni distinguished between placements into fresh extraction sockets and placements into healed bone.

The strengths of this study are many. Since we did not exclude any patients who presented to our clinic, even those sent away by colleagues, we feel that our findings are without any exception generalizeable. this includes patients who typically may be turned down due to poor bone

quality or recommended to receive bone augmentation procedures, or simply are otherwise "untreatable" (Fig. 2). According to our findings, these patients are good candidates for basal implants. This is a consecutive series of patients and hence does not represent a convenience sample or a select group.

CONCLUSION

The standard procedure for placing basal implants includes one surgery followed by immediate loading, thus reducing time, cost, and stress to the patient.[9-13] With the emphasis on horizontal rather than vertical placement, pre-implantological bone augmentation was never necessary. Estimated decrease in cost compared to augmentation-cases is ~ 50%. Compared to cases where augmentations and two-stage implant protocols are the chosen alternative, up to 95% of treatment time is saved[11]. There is no hospitalization required, no time period without proper masticatory function, no second surgery, no bone transplants, no bone distractions. We have observed for basal implants a success rate of 93.4 % during an observation period of up to 134 months. All lost implants were replaced in one single surgery where necessary. All patients reached and maintained the treatment aim of a fixed mandibular prosthesis. This indicates that the immediate placement and loading of basal implants for treating the mandible with fixed bridges, with or without inclusion of available teeth, is a safe and effective way of treatment.

Figure 1.

Typical one-piece basal implant (BOI®) with a broad, cortically anchored load transmission area, a thin and polished vertical part, bending zones, and abutment for cementation.

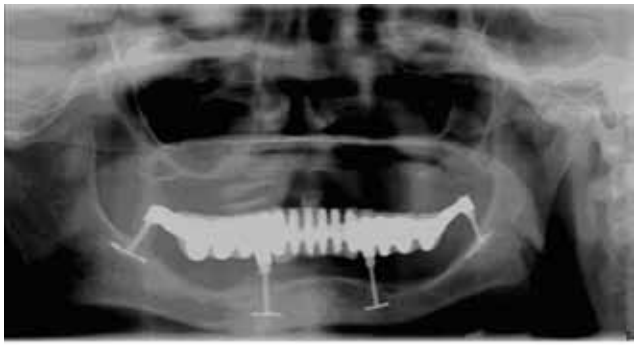

Figure 2.

Atrophied mandible after treatment with 4 BOI®-implants in strategic positions, 6 years post-operatively.

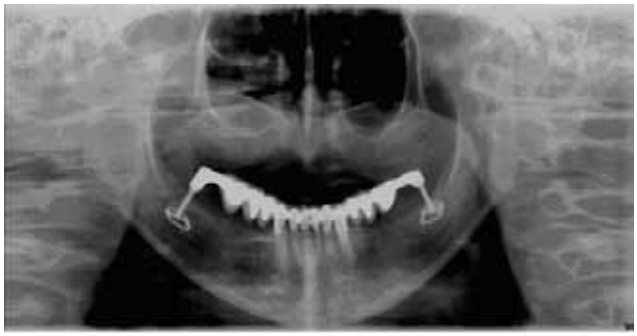

Figure 3.

Two BOI® implants used in combination with 6 anterior teeth, 7 years postoperatively.

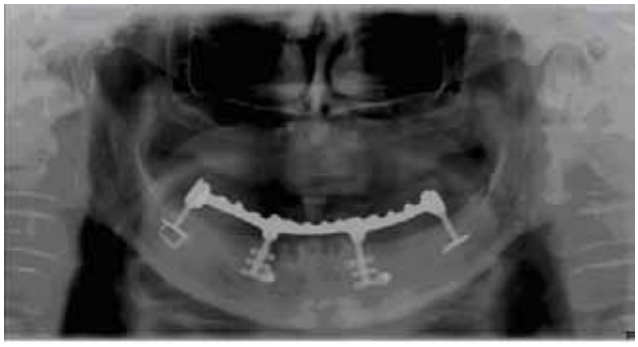

Figure 4.

Four BOI® implants are serving as a base for a full arch bridge in the mandible. The anterior implants are secured by horizontally inserted bone screws to enhance the primary stability (48 hours postoperatively).

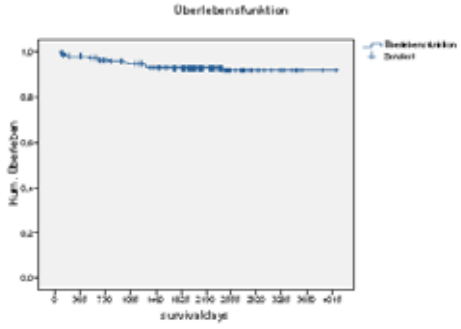

Figure 5.

Survival function for all implants during the observation period.

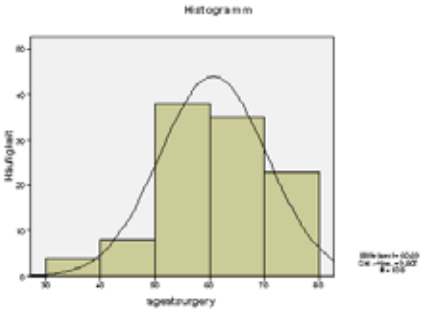

Figure 6.

Age distribution of patients treated during the observation period.

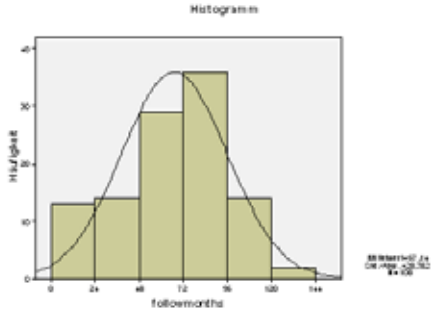

Figure 7.
Distribution of follow up times in this case series.

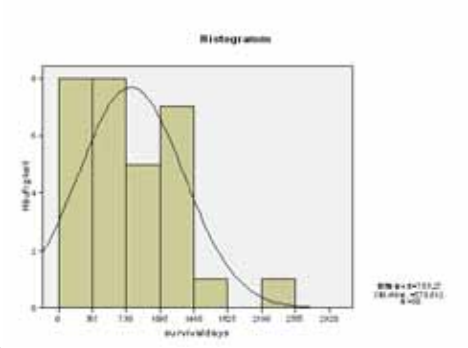

Figure 8.
Distribution of follow up times in this case series.

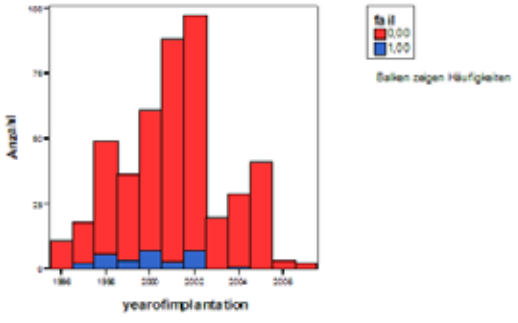

Figure 9.
Implant losses (blue) related implant placements (red) in the year of implant placement. The majority of the losses occurred in implants placed 1997 – 2002.

Fig. 10a, b:
Replacement of this BOI® implant in area 37 became necessary after vertical bone growth has made cleaning of the site impossible. The new implant was placed anteriorly, using the bone which had newly developed as a result of functional stimulus.

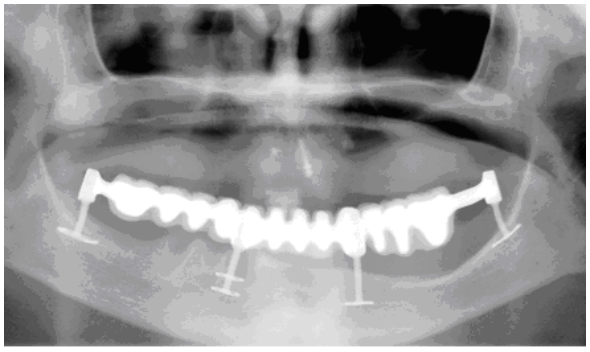

Figure 10 a.
Postoperative X-ray

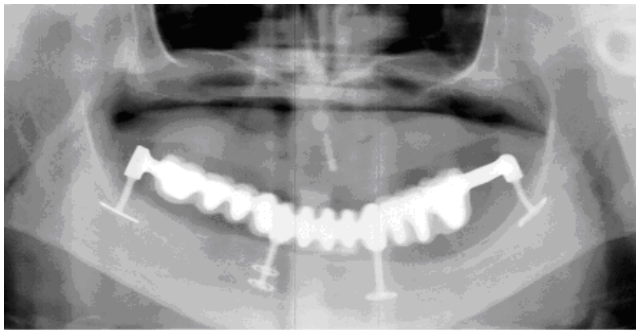

Figure 10b.
Control radiograph 18 month later.

REFERENCES

1. Ihde S, Eber M: Case report: restoration of edentulous mandible with 4 BOI implants in an immediate load procedure. Biomedical Papers of the Medical Faculty University Palacky Olomouc Czech Repub. 148(2):195-8; Dec 2004
2. Mander W:Sofortbelastung von elf Pfeilern nach transgingivaler Insertion (in German) Implantologie Journal 8:2-4, March 2004
3. Sanfilippo F and Bianchi AE: Osteoporosis: the effect on maxillary bone resorption and therapeutic possibilities by means of implant prostheses - a literature review and clinical considerations. International Journal of Periodontics and Restorative Dentistry 23: 447-57, 2003
4. von Wowern N: General and oral aspects of osteoporosis: a review. Clinical Oral Investigations 5: 71-82, 2001.
5. Boyne PJ, Lilly LC, Marx RE, Moy PK, Nevins M, Spagnoli DB and Triplett RG: De Novo Bone induction by recombinant human bone morphogenetic protein-2 (rhBMP-2) in maxillary sinus floor augmentation. Journal of Oral and Maxillofacial Surgery 63: 1693-707, 2005.
6. Scortecci G: Immediate function of cortically anchored disk-design implants without bone augmentation in moderately to severely resorbed completely edentulous maxillae. Journal of Oral Implantology 25: 70-9, 1999.
7. Ihde S and Mutter L: Versorgung von Freiend-Situationen mit basal osseointegrierten Implan taten bei reduziertem vertikalen Knochenangebot (in German). Deutsche Zahnärztliche Zeitschrift 58: 94-102, 2003.
8. Donsimoni JM, Dohan A, Gabrieff D and Dohan D: Les implants maxillofaciaux a plateaux d`assise (in French). Implantodontie. 13: 217-228, 2004.
9. Liran L and Schwartz-Arad D: The effects of cigarette smoking on dental implants and related surgery. Implant Dentistry. 14: 357-361, 2005.
10. German standard ISO 13904: Terminology in dental implantology, DIN, Karlsruhe, August 2004 (in German)
11. Ihde S: Restoration of the atrophied mandible using basal osseointegrated implants and fixed prosthetic superstructures. Implant Dentistry 10: 41-5, 2001.
12. Ihde S.: Adaptation fonctionelles de la hauteur de l`os peri-implantaire apre implantation de BOI® dans la mandibule (in French) Implantodontie 12(2003) 23-33
13. Ihde S: Principles of BOI®. Springer Berlin Heidelberg New York ISBN 3-540-21665-0, 2005
14. Besch K.-J.(Implantoralclub Deutschland) : Konsensus zu BOI®; Schweizerische Monatsschrift für Zahnmedizin, 1999; 109:971–972.