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FULL LENGTH ARTICLE»

TEMPORARY GAIN OF STABILITY INBASAL IMPLANTS THROUGH CORTICAL BONE SCREWS

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IMMEDIATE REPLACEMENT OF DAMAGED OR FAILING SCREW IMPLANTS BY LATERAL BASAL IMPLANTS

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Temporary gain of stability in basal implants through cortical bone screws

Authors:
Ihde S.*, Dimitroff Y**, Konstantinovic V.S.***, Ihde A.*

*Private Practitioners, 8738 Uetliburg, Switzerland, www.ihde.com

**Private Practitioner, Sofia, Bulgaria, www.alphads.com

*** Prof. Dr. V.S. Konstantinovic, Head of Department, The Clinic of Maxillofacial Surgery, School of Dentistry, University of Belgrade, Serbia, vskvita@sbb.rs

E-mail of the corresponding author: ihde@ihde.com

Abstract

Aims: Differences in basal dental implant stability with and without the use of cortical bone screws were investigated using the «Ostell»® device. Because the precision of the slot prepared into the bone depends on the surgeon's skill (clean cut in one plane) and bone density (D1 to D4), the implant's fit and primary stability differs. The study describes the increase of the implant's stability after securing the implant with additional cortical bone screws and evaluates the change in the medium term stability of the secured implant.

Methods: Three basal dental implants were inserted into the metatarsal bone of an adult sheep. After insertion the implant stability was measured with the help of the Ostell® device. The same measurement was performed seven weeks later, before sections were taken for histologic evaluation.

Results: Securing basal dental implant with cortical bone screws increases the stability of the implant as measured with the Ostell® device. After six weeks implants with and without cortical bone screw showed identical Ostell® values.

Conclusions: Adding cortical bone screws increases the primary stability of basal dental implants. The advantage regarding the stability vanished during the first six weeks, although the implants gained osseous integration. Implants stabilized by bone screws and non-stabilized implants appeared equally well integrated in the histology. Since stability of all implants is important especially when treatment protocols under immediate loading are applied, the inclusion of cortical bone screws into the treatment concept should be evaluated if intra-operative stability of single implants is an issue.

Keywords: Basal dental implants; lateral implant fixation; cortical implant fixation; TOI/BOI.

Introduction

Basal dental implants are frequently used as a stable base for intra-oral constructions in cases where vertical bone supply is reduced. Their use has been widely investigated and prospective [Kopp S., Bienengräber V., Ihde S., 2009, Kopp 2007] and retrospective [Ihde 2008, Ihde S, Mutter L. 2003, Donsimoni et al 2004] studies have been published.

Conventional dental implants require primary stability and a maximum bone to implant contact for an uneventful osseous integration. Basal dental implant are inserted into a T-shaped bone slot. Only a small portion of the implant's surface is initially in direct contact with the native bone: the outer rings of these implants rest and get stuck kin the cortical. The voids of the osteotomy-slots fill with blood which during the healing is transformed into woven bone. Gradually the blood cloth transforms into connective tissue, which gradually turns into woven bone. The woven bone areas then remodel into osteonal bone. The process has been investigated and described as «dual-integration» [Ihde Ihde 2011].

Additional advantages of the BOI implants in the long term are the small diameter neck in the BOI EXT (1.9 to 2.1 mm – resulting in less bacterial retention around the implant neck) and the fact that the masticatory loads are transferred away from the crest to the resorption stable bone areas.

In cases of very reduced bone supply and if the access to the site is difficult, it can be difficult for the surgeon to achieve primary stability of the basal implant. Using additional cortical bone screws for securing basal implants seem a good option for increasing the stability of the implant especially during the first phase of treatment, until the bridge splits the implants.

Material and Methods

For this preliminary experiment one sheep was operated. Under i.v.-sedation three basal dental implants (Diskos IDO 9/12, c.p. Ti)were inserted using a lateral inserting technique into the distal third of the left metatarsal bone of an adult sheep. The initial stability of the implants was measured (Table 1), by using the Ostell Device and a Smartpeg Typ 1 touch-less detector. The implant which exhibited the lowest initial stability was then secured by a lateral bone screw (SSF 2.7 mmd, 12 mml, Ti6Al4V). The stability of this implant was measured again. Immediately after this the site was closed by resorbable and non-resorbable sutures in two layers.

After seven weeks the sheep was sacrificed and the site re-opened. Again the stability was measured using the Ostell-Device. The bone segment was then forwarded for the preparation of slides for histologic examination.

Results

After the SSF bone screw was applied, the initial stability of the basal implant increased from 33 to 51. After seven weeks all three implants showed identical Ostell-values of 44.

The histologic examination revealed an uneventful integration of the unloaded implants into the loaded bone. One implant had been dislocated from its original position. Along its vertical implant part full osseo-integration was found, while the part peaking out of the bone to the lateral was due to is extra-bony position not integrated (Fig. 4, middle section). The base plate of the implant which was secured by the bone screw had been placed through the marrow space of the bone. Along the transition are osseo-integration hat occurred, indication that the implant served as an osseo-conductive surface. Likewise the part of the bone screw which had reached in to the empty space in the center of the bone, was overgrown by new bone. Around the crestal part of the implant and the head o the bone screw large amounts of new bone had been formed. This bone was under heavy remodeling when the specimen was taken (Fig. 4, right). The third implant osseo-integrated uneventfully with all of it's endossous surface.

Discussion

The usage of the Ostell®-device is the state of the art technology when it comes to measure implant stability. The advantage compared to other technologies like i.e. the Periotest-device is, that the Ostell device avoids direct contact between the implant and the measuring device. The device can be calibrated and is widely used for animal experiments and measurements in humans [Cawley et all 1998, Meredith 1997, Su et all 2009, Fernsebner M. 2006].

Before any measurement can take place, the «Smartpeg»- screw-on-device must be connected to the implant. Smartpegs are available for a number of implant types featuring an internal implant-to-abutment connection. For our experiment Smartpegs for the «Straumann Oktasystem®» were used, because these pins fit the internal thread of the implant system under investigation here. We had chosen this implant system, because it allowed standardized measurements with the Ostell device.

The implants underwent a submerged, non-loaded healing period without being splinted by prosthetics, although the typical treatment plan for the intra-oral use of basal implants would have been an immediate load protocol.

It was not astonishing, that the results of the measurements after healing were identical for all implants: in case of bone injuries the whole bone undergoes remodeling, even if only a local injury occurs.

Conclusion

The use of SSF bone screws for the lateral fixation of basal dental implants will have no effect on the long term stability of theses implants. The screws are not a replacement for the achievement of an osseous integration.

SSF bone screws are nevertheless a useful intra-operative device, which may help the surgeon to gain good primary stability for selected basal implants.

Table

	Implant stability* after insertion	Implant stability* after bone screw application	Implant stability* after seven weeks
Implant 1	33	51	44
Implant 2	44	-	44
Implant 3	44	-	44

*in Ostell-Values

Figures

Fig. 1: Lateral view on three basal dental implants installed into the metatarsal bone of the lamb. One implant was secured by a cortical bone screw.

Fig. 2: The stability of the implant is measured by using the Ostell-device after the Smartpeg Typ 1 was mounted on the basal dental implant.

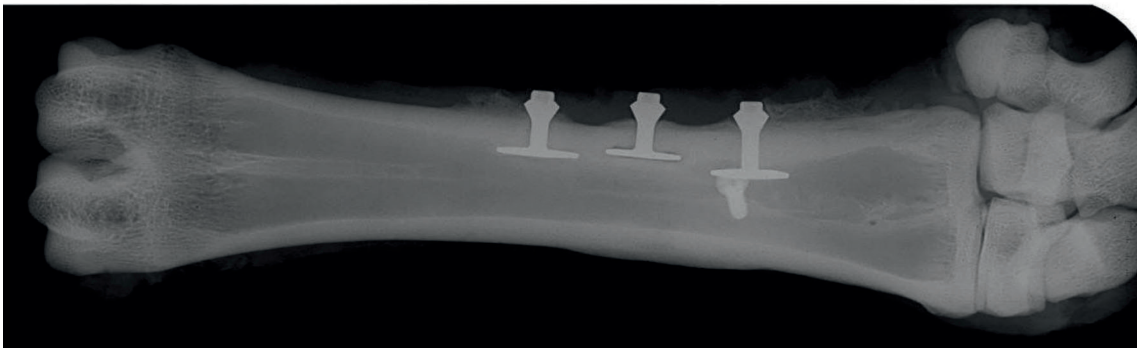

Fig. 3: Radiographic overview on the three implants (1, 2, 3) before the histologic sections were performed. New bone formation (modeling) is seen near all implant heads.

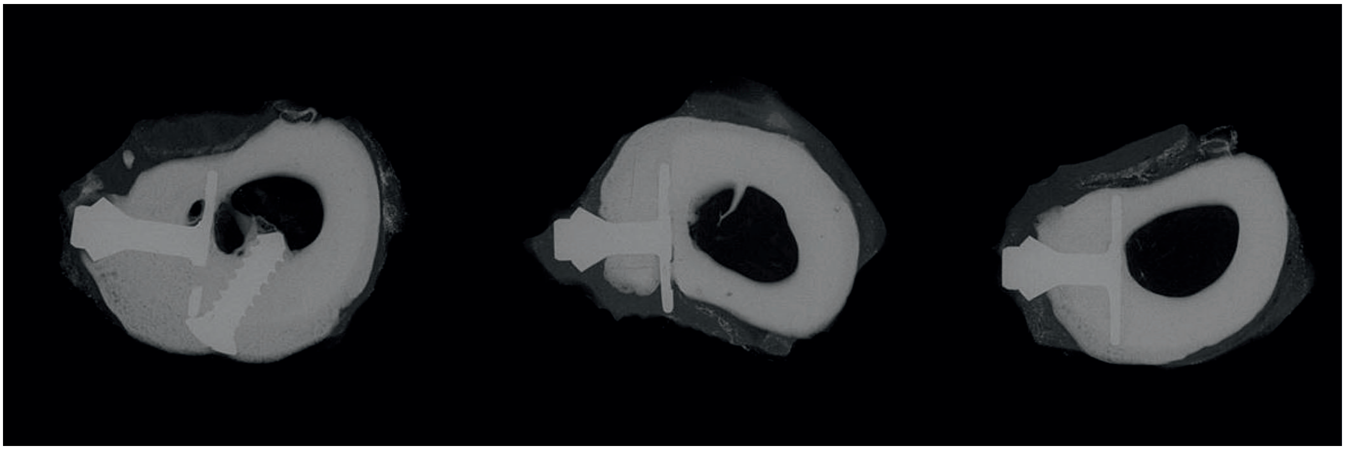

Fig 4: Histologic cross sections along the implants. Although the middle implant had been inserted deep enough during the operation (compare Figs. 1, 2), it was apparently dislocated before integration could occur. The bone slot around this implant had nevertheless been closed with new bone. The implant on the right was uneventfully integrated in the position chosen by the surgeon.

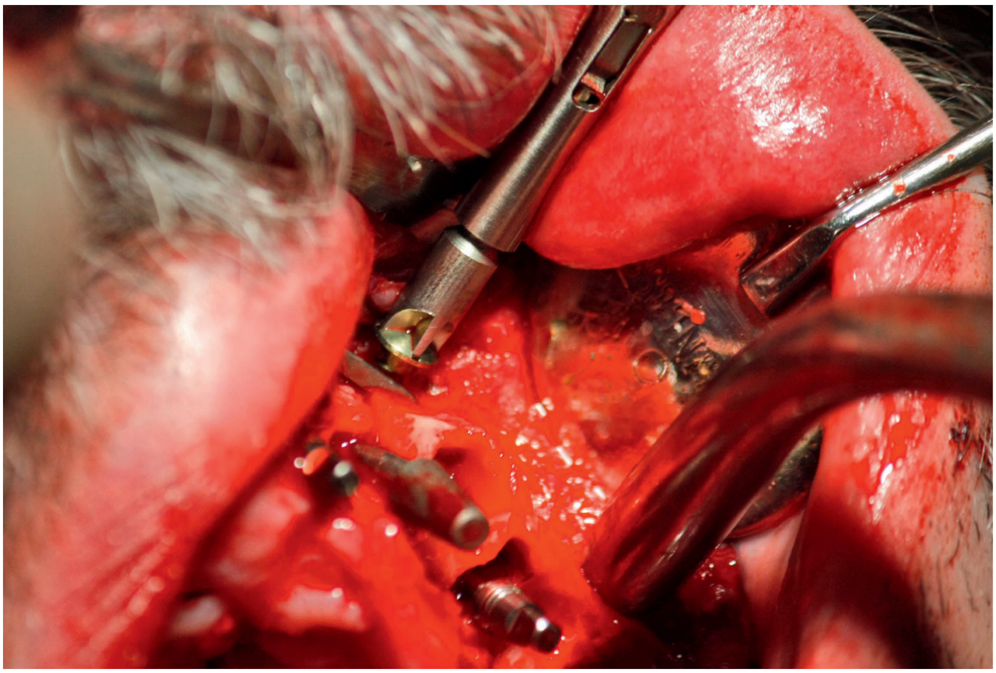

Fig. 5 A bone screw is inserted for the fixation of a single-base-plate implant (BS 12 h 10) in the area of the upper canine.

This experiment was approved by the ethics-comission of the stomatological faculty of Belgrade University, No. 36/42 (2010), and it was supported by the International Implant Foundation, Munich.

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Immediate Replacement of Damaged or Failing Screw Implants by Lateral Basal Implants[3]

Authors:
Stefan K.A. Ihde (DMD),
Antonina A. Ihde (DMD)
Evidence and Research Department,
The International Implant Foundation
DE-80802 Munich/Germany.
e-mail: ihde@ihde.com

Abstract

Replacing damaged dental implants by basal implants is a simple and reliable procedure. The conventional approach for such a procedure is to cut out the damaged implant including a significant amount of the surrounding bone with the help of a explantation device. The approach described here includes a vertical cut from the lateral aspect of the jaw bone towards the implant. Through this access-slot the implant is then sectioned vertically inside the bone. All titanium particles are flushed out and the implant is loosened by careful tapping. Then the implant is taken out. The vertical slot is then used for preparing one or several horizontal slots and for the later insertion of the lateral basal implant. This article describes and illustrates the process of the implant's replacement.

Keywords: Failure of dental implants, basal implants, TOI/BOI.

Introduction

As the number of dental implants placed is constantly increasing, failures are increasing also. Failures may be divided into three categories:

- Some implants fail early in osseo-integrating: they have to be removed or simply drop out.
- Some of the integrated implants fail (fracture) for mechanical reasons while they are in use.
- Sometimes implants may fracture while they are inserted, and this is then due to an overly strong insertion torque, in relationship to the thickness of the body of the implant. A typical example for this event is the fracture of single piece screw implants with bendable neck, without pre-compression of the bone cavity,
- Some implants undergo the undesired process of so called «peri-implantitis», during which crestal bone is lost while the implant remains stable due to strong osseo-integration in the apical part of the implant. In such a case the implant may not fracture, but it will be nevertheless necessary to take it out, as soon as the situation becomes unbearable for the patient.

Whenever implants fracture, at least a considerable part of the endosseous surface must be well osseo-integrated, because mechanical resistance combined with masticatory overloading are necessary to allow a fracture.

Implant fractures have different reasons. While in single implants local overload or loosening of abutment of screws are the dominating reasons for a fracture of the affected implant, in segments or circular bridges failure of cementation or loosening of screws dominate. In the later case, those implants tend to fracture, which are still well connected to the bridge. When it comes to avoid decementations, the implantologist faces a difficult decision: if he utilizes strong permanent cement (e.g. FUJI Plus) for bonding bridges to implants, he may have to destroy the work-piece, if a complication occurs and the bridge has to be removed after years. This creates additional costs and the question arises, who will have to cover them. If prosthetic work-pieces are fixed with a provisional cement, the danger of unwanted de-cementations is of course significantly higher. This may then give cause to fractures of implants or abutments which are still connected to the bridge, as loosened crowns create cantilevers. Basal implants rarely fracture during the phase of the initial integration, because the bone around the base-plates undergoes remodeling and thereby does not provide resistance for a fracture[2]. If overload occurs during this phase, the implant will rather not integrate, because cracks in the surrounding bone accumulate and prevent proper re-mineralization of the bone.

Lateral basal implants are safe and effective devices and they have been used for numerous years to treat partially or fully edentulous jaws. Other than crestal implants and teeth these implants utilize the outer corticals of the jaw bone, i.e. the oral aspect of the cortical as well as the vestibular. Bi-cortical anchorage is mandatory. For this reason basal implants are suitable for immediate placement into fresh extraction-sockets and for single base-plate implants the demand for vertical bone is minimal. Single-, double-, and triple base-plate implants have been introduced.

It has been known for decades, that lateral base plate implants may be used in fresh extraction areas. The fact that also the replacement of failed crestal implants is one of the domains of lateral basal implants has to our knowledge never been published in detail.

Materials and method

The technique which will allow the fast replacement of screw implants is illustrated in the Figs. 1 – 7.

The procedure can be carried out in local anesthesia. In order to have access to the implant site, a wide, lateral full thickness flap is created, using the well know techniques of oral surgery. When preparing the vertical slot, the surgeon will have to consider the position of the new implant and its way of insertion. Only after taking away the amount of bone for the new implant placement the surgeon will consider taking away more bone for the removal of the old or defective implants. This way the bone loss caused by the explantation is minimal.

In many cases the failing implant way be dislocated towards the slot and can be taken out easily. If this is not possible, the implant must be sectioned. We use a hard-metal cutter for this purpose. The metal particles can be flushed out or wiped out by a gauze cloth. If small particles of titanium or titanium alloy remain inside the bone, they tend to integrate just as implants.

After the failing implant was taken out completely, the horizontal slot(s) for the new implant are prepared. The new implant is chosen with respect to the available bone with and the demand for bi-cortical engagement.

If vertical bone was lost, the new implant will be chosen shorter than the failed implant and this often requires the fabrication of a new bridge. In most other cases the old bridge may be used. The fitting of the bridge should be controlled before the final flap closure is performed. For closing the flap the typical technique for basal implants is used[4].

Discussion

Patients which have been treated successfully with dental implants, will usually decide again for implants (and not for dentures), even if one or several implants fail. However the second «healing time» is not appreciated and of course the necessity to incorporate (and pay) new bridges is disappointing.

The leading principle of the procedure shown here is, that the vertical osteotomy is carried through while aiming in the first place at the placement of the new implant and not so much while aiming at the removal of the old implant. Hence the preparation of the full thickness flap and the vertical slot must consider primarily the final position of the basal implant and the pathway of the implant into its position. If this principle is followed, minimal amounts of bone have to be sacrificed.

Even if the procedure described here may safe the case quickly and effectively, the possible causes for the complication must be treated as well: unilateral patterns of chewing should be approached by creating the possibility for equally successful chewing on both sides of the arch. A symmetrical AFMP-angle during lateral movements of the mandible under contact is the benchmark for this effort. If rigidly supported chewing surfaces are not equally distributed in both jaws, more implants are often necessary to support the additional teeth. Our treatment aim is a fixed dentition from 6 – 6 in both jaws. Note, that it can also create problems to long term occlusal and masticatory stability, if on one side of the jaw too many chewing surfaces are present.

In many cases the abutment on the new implant will not fit exactly into the old crown. Other than on vulnerable teeth, this slight disadvantage can be accepted today, because strong and reliable cements with good adhesion to metals (such as e.g. FUJI Plus) allow a safe cementation while filling the inevitable gaps between the crown and the abutment.

If the fracture of the crestal implant is associated with vertical bone loss (e.g. due to a peri-implant bone retraction and the development of an unfavorable anchorage-to-prosthetics relationship), crestal implants are anyway the not the first choice, when it comes to replace the failed implant. In these cases treatment with crestal implants are often accompanied of preceded by bone augmentations or bone transplants. Both procedures increase the overall risks, necessary time and costs.

It is sometimes mentioned, that basal implants create large defects in bone and that they are difficult to remove. After working with basal implants for more than a decade, we cannot confirm this rumor. We have seen many cases when huge amounts vertical bone was lost around crestal dental implants: after this event either a bone transplant became necessary or the reconstruction absolutely required the installation of lateral basal implants (BOI ,TOI). In fact, even in the worst case which we have seen, a reconstruction with basal implants was always possible in one single step and in an immediate load procedure, whereas conventional techniques would have required invasive, expensive and demanding reconstructions. From our experience the work with (lateral) basal implants is today the only realistic chance to help patients in a reliable and affordable manner. The overall success-rates of basal implant are much better compared to procedures using bone-buildups in combination with two-stage conventional implants.

Conclusion

Implant failures are an inevitable event in today's implant driven dental practice. The number of failing implants is constantly increasing. In such cases the surgeon will aim at a quick resolution of the problem without additional surgical steps or bone buildup procedures. If basal implants are utilized to resolve the problem, an immediate successful restoration is possible. In most cases even the old prosthetic work-piece can be modified and utilized at least as a long term temporary.

Figures

Fig. 1: Mechanical failures are one of the reasons why well integrated dental implants have to be replaced.

Fig. 2: When a vestibular approach is chosen, the bone in the red area will be cut out in the direction towards the implant.

Fig. 3: With the help of a hard metal cutter a lengthy portion is cut off the damaged implant. This procedure requires good cooling, because the metallic structure of the implant will become hot.

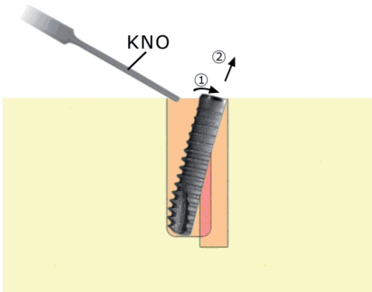

Fig. 4: As soon as enough material has been taken away, the implant is mobilized and discolated into the empty space inside the bone. After this it can be taken out. To loosen the implant a bone chisel or a Bein elevator may be used

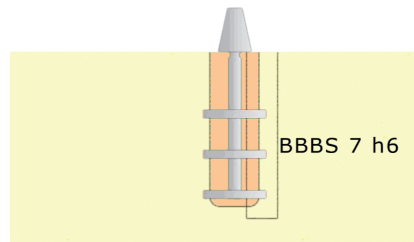

Fig. 6: In the case drawn here, the implant enters the bone through the vertical slot and it is then moved to the left inside the bone. If the available vertical bone is not enough to allow the placement of a triple-base-plate implant, double discs or implant with a single wider baseplate (e.g. with 12mmd) are a good option.

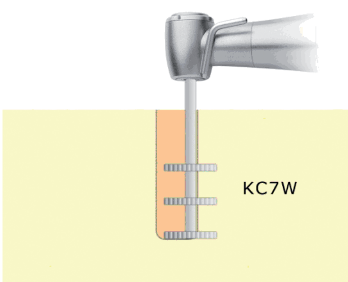

Fig. 5: With the help of a triple-cutter, three parallel horizontal osteotomies are cut into the bone. The new implant may be positioned directly in the extraction socket where the implant was.

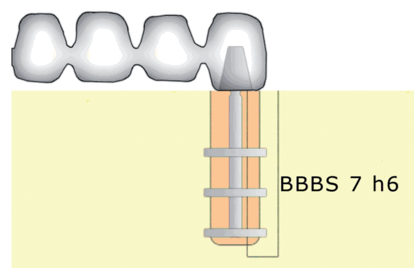

Fig. 7: If the vertical and horizontal position of the abutment was chosen right, the existing prosthetic workpiece is often used at least as a temporary.

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