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Ihde S.

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Comparison of basal and crestal implants and their modus of application.

Ihde S. Dr. med.dent, PhD
Gommiswald Dental Clinic
CH-8737 Gommiswald/SG
Switzerland
dr.ihde@implant.com

1. Introduction

Crestal and basal implants are endosseous aids to create osseointegrated points of retention for fixed or removable dentures. These two types of implants are not only differentiated by the way they are inserted and by the way forces are transmitted. Rather, the more substantial differences lie in the planning and execution of prosthodontic care and, most of all, in the post-insertion treatment regime. For this reason, the literature on basal implants has introduced the terms "orthopaedic technique" and "orthopaedic implant" to mark a clear distinction between them and the well-known term "dental implant".

According to the well-known implantological rules for dental restorations, crestal implants (i.e. implants inserted from the top of the alveolar crest into the bone: cylinders, blade implants) are indicated in situations with an adequate vertical bone supply is given. Crestal implants function well in patients who provide enough bone when treatment starts, but results are not predictable as soon as augmentations become part of the treatment plan. Augmentation procedures are possible today, but they increase the risks and costs of dental implant treatment as well as the number of necessary operations. Patients providing severely atrophied jaw bones (i.e. those patients who need the implantologists attention most) paradoxically receive little or no treatment, as long as crestal implants are considered the device of first choice.

Basal implants, i.e. BOI®, Diskos®, by contrast, were developed additionally and primarily for immediate use as well as for use in the atrophied jawbone. They can also be applied where very little vertical bone is present, while the supply of horizontal bone is still sufficient (even if these quantities are not contiguous, e.g. in the sinus region): there are no "difficult" or "impossible" cases for implantologists familiar with basal implants, and their treatment leads in all cases straight forward to the desired treatment result. The typical objective of treatments including basal implants is a fixed restoration with 12 teeth per jaw. Optionally, removable dentures may be inserted as well, as long as enough basal implants are splinted by rigid connectors (bars). Single crowns are primarily realized on internal or single-unit BOI implants. They may be loaded immediately only in favourable situations. As the use of BOI implants can help avoid risky and expensive bone augmentation procedures, these implants are the therapy of first choice in moderately or severely atrophied jaws as well as in those cases, where immediate loading or cheaper treatments are desired by the patients.

Whereas crestal (or: axial) implants are inserted vertically from the crest of the alveolar ridge, basal implants are inserted laterally. These lat-

ter implants are synonymously called basal implants, or lateral implants or disk implants . With basal implants, the regions of load transmission and the place of bacterial attack do not coincide: no masticatory forces need to be transmitted to the bone via vertical aspects of the implant; the positive retention in the bone is created in the cortical bone region.

2. Differences in perioperative status

An implant bed that is congruent with the implant shape is created for crestal (axial) implants, using burs. Most common crestal implants in use today feature a self-tapping thread, many types feature compression of bone. Once the crestal implant is inserted, the insertion site is obturated by the implant itself. Any infection carried into the implanted bone intraoperatively or any infection that had already been present preoperatively (such as residual ostitis) can endanger the therapeutic result considerably by leading to an early loss ("idiopathic loss") of implants. The mechanism resulting in early loss can be described as follows: To combat any such infection, the flow of blood from and to the bone must be increased. However, this is inherently inconsistent with the existence of bone tissue . The resulting increased oxygen pressure in the bone results in local bone loss, which does not necessarily involve bacteria or purulence. The implant loses its stability and will be lost subsequently. The bone loss associated with this scenario is usually low, since it barely affects any areas beyond the implant bed itself, if the implant is also rapidly exfoliated. If, however, exfoliation does not occur – for example because the implants are kept in place within the bone by the prosthodontic superstructure – an infection may develop in the spongeous region that spreads and causes a significant dissolution of the spongeous and cortical bone substance. In this case, the cortical bone will be replaced by rapidly formed plexiform bone, while the bone marrow spaces remain filled with granulation tissue. The histological findings are typical for an osteomyelitis (Figure 1).

The situation with basal implants is completely different. For basal implants, a T-shaped slot is cut into the bone, which is practically left unobturated by the implant immediately after insertion. Neither intraoperative nor preoperative infection will normally threaten the treatment result, since suppuration from the osteotomy slot is usually uninhibited at all times. In animal studies, no failure of BOI® implants (infection of the implant site, primary implant loss, absence of osseointegration) could be provoked by contamination or infection present preoperatively or introduced intraoperatively. The degradation products of infection are resorbed via the periosteal tissues or removed to the oral cavity through the mucosal access. The necessary pressure is built from inside the bone. This pressure must never be blocked, and the direction of flow must never be inverted by the dentist. Early idiopathic loss thus hardly ever occurs with basal implants.

3. Infection around integrated implants

3.1 Crestal (axial) implants

Crestal implants are supposed to osseointegrate along the vertical axis of the implant.

The term "osseointegration" describes a state in which there is no more than an ultra-thin layer of connective tissue between the implant surface and the mineralized bone matrix and where this layer contains neither blood vessels or directional fibres or other components characteristic of the periodontal system. This is why osseointegrated crestal implants do not contribute – as opposed to natural teeth or freshly inserted basal implants – to draining the bony implant site.

If peri-implantitis develops around crestal implants, the adducing vessels of the peri-implant mucosa are widened in a pathological way. In addition, the blood is removed by the same route it came, requiring space. The resulting increasing the oxygen pressure in itself causes bone loss. Whether or not the counteracting tendency toward retention of the mineralization or toward remineralization is preserved will depend on functional stimuli. This is why crestal implants (if initially osseointegrated) are often lastingly and stably osseointegrated at their apical end even though their upper enossal portion may be subject to funnel- or crater-shaped areas of bone collapse (Fig. 2 a). Once the crestal bone is lost, macrotrajectorial load transmission is shifted to the basal aspect of the bone, or at least the middle implant region, in almost all areas of the jaw. As the total bone mass is reduced due to the bone collapse, yet the task of transmitting loads is not made easier as masticatory function persists, the remaining basal bone areas have to be more strongly mineralized. This will afford them better protection from further resorption. The surface of crestal implants is usually enlarged in their enossal part today, as they do not have the retentive baseplates that basal implants have. The state of the art is that typical surface enlargements are often created by the manufacturer by adding a TPS layer, by sandblasting, by etching or by a combination of these latter procedures. The surface enlargements are to improve the adhesive properties of the blood and the bone cells, presumably creating a "cell-friendly" environment. Unfortunately, bacteria are also cells, even cells of approximately the same size – and a bone-friendly surface is always at the same time a bacteria-friendly surface. This is why peri-implantitis around crestal implants is difficult to control: As soon as surface-enlarged portions of the implant surface are exposed to the oral cavity, these bacteria may travel more deeply and below the bone level due to the "candle wick" phenomenon, again increasing blood circulation and promoting bone loss. As we have seen, only more highly mineralized bone have better protection against resorption as a result of the predominant trajectorial load. This is why some crestal implants have a hybrid design, where the 1–2 mm of the enossal aspect of the implants located most closely to the mucosa are not surface-enlarged. However, these implants tend to require more vertical bone to achieve sufficient retention. More recently, microsphere-coated surfaces have been introduced in dental implantology, something that has been a familiar concept in endo-

prosthetics for quite some time now: Sintered titanium microspheres 100–150 µm in diameter are completely smooth, offering no microretention for bacteria, even though the surface looks very rough to the naked eye. Fillies et al. (12) have shown that the type and roughness of implant surfaces determines the behaviour of the osteoblasts. Osteogenic cells will settle or be created on smooth, microstructured surfaces more quickly than on SLA surfaces. The latter show more fibroblastic than osteoblastic cells, something that ultimately has considerable influence on implant integration

3.2 Basal implants

With basal implants, load transmission is supposed to occur primarily (and initially exclusively) within the basal aspect of the implant, far away from the site of bacterial infection. All aspects of the implant are smoothly polished. Several basal implant systems with different platforms are available today – internal systems that can be secured against rotation and that have an internal screw connection (Figure 3) and external systems that do not have a rotation-protected external thread (Figure 4)[1] . By design, the mucosal penetration areas are considerably smaller with external systems than with internal systems. Whether or not this results in different degrees of resistance to infection (countable as losses / time unit) has not been examined. "Examining" the status of the peri-implant bone with a probe is considered malpractice with basal implants, as no osseointegration is required on the vertical aspect of the implant anyway for permanent function of the implant. The path of insertion of the vertical aspect of the implants can no longer be determined postoperatively, and the positions of the horizontal disk suspensions are unknown. For those two reasons probing may yield false "results". On the other hand, probing may carry pathogens into the depth of the interfacial region that is filled with non-irritant connective tissue at a time when there is little chance of suppuration left. Callus formation and the maturation maturing of the callus in the slot areas are endangered through probing. Facultative pathogens can be transported to an environment that is normally inaccessible to them and cause great damage. In particular, the maxillary sinus area may be contaminated by germs of oral origin by simple probing, if bone height is reduced or if a trans-sinus implant insertion was performed. Probing around basal implants is therefore contraindicated and potentially dangerous . The same considerations show that rinses and any medication down along the threaded pins and under pressure is contraindicated: Ahead of the medication, liquid contaminated with pathogens is pressed into the deep without any control. The direction of flow is deleteriously inverted, resulting in infectious osteolysis (otherwise a rare occurrence). The pressure applied by the "treatment provider" and his syringe is greater by a factor than the internal pressure pf the bone or soft tissues, so that this procedure will almost invariably result in massive adduction of germs

[1] With basal implants, the terms "internal" and "external" thus refer to the thread and not – as with crestal implants – to the type and position of the surfaces that protect against rotation.

and the spread of infection, which may become chronic. A similar effect is observed if dental restorations are seated loosely on individual implants for a protracted time period (months or years) and the continuous relative movement of the abutment and crown creates a chronic submucosal inoculation with debris and pathogens. Here, too, inoculation pressure is higher than internal tissue pressure, resulting in repeated inversion of the direction of flow and increasing osteolysis due to the measures taken by the body to fight infections.

With basal implants, there are normally no funnel- or crater-shaped areas of bone collapse anyway, as the cortical bone closes as part of the healing process and no infection can be transported into the depth of the bone along the smooth threaded pins. Exceptions may occur if there is functionally related massive vertical bone growth along the threaded pin . Surprisingly, bone growth is in some cases unfavourable, but this is explained by the fact that bone growth will cause colonized intraoral areas of the implant to be relocated to submucosal or enossal regions. The proper therapy in these cases consists invariably in creating local drainage around the vertical implant part.

Bicortical screws (BCS®) are also considered as "basal implants", because they transmit masticatory loads deep into the bone, usually into the opposite cortical, while (full) osseointegration along the axis of the implant is not a pre-requisite. BCS provide at least initally some elasticity, they are not at all prone to peri-implantitis (due to their polished surface and their thin mucosal penetration diameter).

4. Peculiarities of basal implants

4.1 Overload osteolysis and basal implants

It is normally impossible to perform successful recovery treatment for mobile crestal implants, as the mucosal penetration area is too large and infections will recur and descend continuously along the rough interface area.

The situation is different around basal implants: One possible complication of basal implants – although initially reversible – is (functional) overload osteolysis. Successful therapeutic measures are possible. The physiological background should be explained briefly:

- On one hand, the load-transmitting interface areas are located in the cortical bone, which has to perform structural tasks and therefore has a more pronounced self-preservation tendency, and a more favourable prognosis, than spongious bone, which is of minor importance both structurally and with regard to macrotrajectorial tasks and therefore dispensable. It should be noted, however, that large-lumened crestal fixtures (just as teeth) are on the way of the jaws macrotrajectories anyway, so that these bone lines must seek different paths.
- On the other hand, masticatory forces transmitted via the basal implants to an enossal location create local microcracks in the cortical bone. Microcracks are repaired by the formation of secondary osteons, the process is called "remodelling"; this, however, will temporarily increase the porosity of the af-

fected bone region and temporarily reduce the degree of mineralization additionally. If microcracks accumulate at the bone/implant interface, the reduction in mineralization can also be detected on radiographs (Figure 5 a: the osteolytic area initially exhibits only diffuse radiological borders). As long as the bone substance is not torn away from the implant (Fig. 5 b; this is generally accompanied by clear radiological borders) and the area is not superinfected, the loss of mineralization remains diffuse but usually reversible , abd it should be remembered, that the term "osseointegration" describes the close contact between bone and the implant, but it does not describe a high degree of mineralization. Osseointegration at a lowered degree if mineralization is not the same as "fibrointegration". Orthopaedic surgeons describe the equivalent status of orthopaedic implants as "sterile loosening", but they usually have no means of treating this status. Basal implants in this status have a good chance of getting reintegrated at a high degree of mineralization, if loads are reduced to an adequate amount. The measures necessary are discussed below and they are part of the education of a basal implantologist.

Radiological findings should be secured both in the form of overview radiographs (tomographs) and in the form of summary radiographs (small-format radiographs). The implant will now be slightly mobile, which is easily discernible clinically. If areas with mineralization deficiencies are superinfected, granulation tissue is created in the interfacial region that will hardly be replaced by new bone without an added osteotomy stimulus, especially since granulation tissue requires or results in an increase in blood circulation that is maintained from a periosteal direction or enossally and which per se inhibits new bone formation. Nevertheless, even these implants could be re-integrated in isolated cases if the implant site per se exhibits pronounced remineralization tendencies, for functional reasons. Typical examples of such areas with pronounced remineralization are the region of the mandibular second molars, and the maxillary and mandibular canines (the so-called strategic positions) and of course the basal regions of the jawbones as such. These areas must therefore be preferred as implant sites – and other sites outside the strategic regions may even be dispensed with in the case of complete rehabilitation of an entire jaw if the concept of strategic implant positioning is consistently followed. Additional implants may be placed if the preferred regions offer insufficient anchorage.

An equilibrated masticatory pattern is of particular importance for maintaining mineralization in the interfacial region, especially in the first months after implant placement. Unilateral or anterior (like in Class II/2 malocclusions) masticatory patterns result in unilateral or anterior overload (which would seem to be immediately apparent) and also in increased porosity of the crestal aspect of the jawbone on the balancing or distal part of the jaw and thus in atypical patterns of mineralization. , This porosity is a consequence of the increased BMU (bone morphological unit) activity in this region due to a predominance of tensile forces in this region. For

this reason, mobilization of basal implants can be expected also on the non-working side on which the implants are subject to high extrusion forces within the framework of asymmetrical mastication. In case of mobility, it is therefore necessary to make adjustments on the side opposite the mobile side, something that crestal implantologists with their typical mechanist mindset almost invariably get wrong. Alternatively, occlusal areas on the "underload" side should receive an additive occlusal adjustment, leading to an equal loading of both sides of the jaw.

4.2. Therapeutic considerations for overload osteolysis

First and foremost, the prognosis of the implant must be determined according to the Consensus on basal implants. As long as implant removal is not indicated, there are several therapeutic strategies that can be followed:

- First of all, it must be determined whether or not the masticatory pattern is evenly balanced and symmetrical. If this is not or no longer the case, the first therapeutic step must be aimed at achieving a bilaterally balanced situation with regard to bone mineralization tendencies.
- In some cases, extensive occlusal adjustment will therefore be required. Deficiencies in vertical dimension must be treated prosthodontically (e.g. by building on the superstructure with composite or by fabricating a new superstructure with changes in vertical dimension). The development of anterior masticatory patterns must be prevented with all means and immediately. Existing anterior masticatory patterns can usually be corrected by increasing the vertical dimension; however, the optimum bite plane must be retained or created and this determines, in which jaw the addition has to be made.
- Furthermore, the question must be evaluated whether or not remineralisation xii by way of self-healing or supported by a suitable therapy can be expected at the existing mobile implants. Possible therapeutic steps are temporary isolation of individual implants from the superstructure, facilitating remineralization of the bone surrounding these implants. It should be noted that not all implants can be detached at the same times some have to perform. The lower bone density caused by function does not lead to reintegration; on the contrary, the result will be implant mobility.
- If excessive parafunctional habits or nocturnal positional deviations of the mandible are suspected, the fixed denture can be replaced, permanently, temporarily or prophylactically, by a bar-supported denture. This type of denture is supposed to be removed by patients at night. This will help avoid peak nocturnal pressure on the bone/implant interface and result in a very stable direct fixation of the implants relative to each other. Masticatory shear forces will also be more favourably distributed between the bar and the denture.
- It is also possible to add basal implants without removing mobile basal implants (Fig. 6a, 6b). Both implants can subsequently be integrated with a high degree of mineralization. The rationale of this procedure is found in

the distribution of the 0- and 1-areas within the bone itself. Mobile implants create 0-areas at the implant/bone interface, that is, areas that cannot perform any macrotrajectorial load transmission tasks. These tasks must then be performed mostly by bone areas in the vicinity, which will mature to form highly mineralized 1-areas. However, implantation into these 1-areas will interrupt the macrotrajectorial load transmission at the new implant site and promote the bone's tendency to once again increase mineralization around the mobile basal implant. Since the masticatory forces will subsequently be distributed to two implants, both implants can stabilize at an even pace. If the dentist intervenes in time, implant removal can be avoided in this manner. Additional implants may be required for the only reason that the masticatory forces can be greatly increased once the removable denture is replaced by fixed bridges. This increase in masticatory forces, however, will be accompanied with an absolute increase in bone mass and an improvement in bone quality (degree of mineralization), something that may have made the insertion of additional basal implants possible in the first place. Often the placement of additions BCS implants is easier than placing more BOI, as BCS implants may be inserted without flap procedure.

- If the fixed denture must or should remain in place as is, the masticatory forces can be temporarily reduced by injecting botulinum toxin (such as Dysport®) into the masseter (and temporal) muscles. This measure also prevents parafunctional loads and has been clinically proven to be extremely effective. Botulinum toxin can be administered prophylactically in cases with a scant bone supply, especially in the maxilla and especially if bar-retained removable superstructures are to be avoided right from the start. Therapeutically, the administration of botulinum toxin is indicated when BOI implant-supported superstructures (bone/implant/restoration systems) have become mobile due to parafunction or due to changes in the bite plane or masticatory pattern that have remained uncontrolled for too long. Note that the cause of overloading or miss-loading must be treated while the medication is acting. Else, after the effect of botulinumtoxin ceases, the mobility of the implants will return of course.
- It will frequently be necessary to perform several of the above measures in combination. At any rate, the correct therapeutic decisions must be made well in time and implemented determinedly, as "self-healing" per se, with all adverse influences remaining present, can be expected only in very isolated cases.

The question as to when or for how long the measures described above may be expected to result in "healing" or restabilization at all cannot be answered summarily. A great deal of clinical experience with basal implants is required to be able to make halfway reliable recommendations in borderline cases. In particular, care must be taken to re-examine the primary healing process after implant insertion and to check what types of basal implants were used. In particular the

thickness of the disks, the surface structure of the enossal aspects and the material properties (titanium graduation) of the implant in question are important factors of treatment planning. Usually, an untrained secondary treatment provider will not have the required familiarity with the aspect of masticatory function and its relation to bone physiology.

This alone is reason enough for complications always to be treated by the primary treatment provider. If that is not possible when complications occur, close consultation is required between the primary and the secondary treatment provider.

BOI implants inserted trans-sinusally without prior augmentation or lefting of the Schneiderian membrane may cause or promote sinusitis if there is vertical mobility (usually cause by overloading). Trans-sinus implant placement with augmentation (e.g. with Nanos®), by contrast, show a rather favourable stabilization potential over the medium term. Primary stabilisation must always be gained in native bone. Placement of a tubero-pterygoid screw distally of the basal implant in area 6 of the upper jaw, reduces the chances of overloading implants in the sinus area dramatically. For this reason this type of basal implant should be placed always in combination with BOIs.

4.3 Replacing basal and crestal implants

If an indication for replacing a basal implant really exists, this measure should be taken right away, since mobile implants will invariably cause bone damage. By contrast with screw-type implants, BOI implants will never exfoliate spontaneously. For this reason and because overload trauma may be transferred from one side of the jaw to the other via the denture or via an involuntary change in the preferred working side, there is no point in waiting. The objective of any replacement will be to restore the full function of the fixed restoration and thereby the full range of masticatory movements. This is why the insertion of the new implant must be planned along with the removal of the old implant. In most cases, immediate reimplantation will be possible and indicated.

When replacing defective implants, the osteotomy for the new implant must always be created first (unless the new implant is to be inserted in the same position as the old one), that is, before the existing implant is removed. It has been shown that this procedure is much easier on the bone than the inverse procedure; often only very little bone substance must be removed to remove the old implant. Leaving isolated integrated implant parts (that have no contact with the oral cavity) in situ instead of sacrificing a lot of bone substance to remove them does not usually cause any problems and can be considered lege artis. Four procedures for removal and immediate replacement of basal implants are known today.

While after the removal of formerly integrated crestal implants only rarely new crestal implants can be placed (immediately or at all), the immediate replacement of (crestal and basal) implants by basal implants and their immediate loading is a simple and successful procedure, which is virtually always possible:

4.4. Post-insertion treatment of BOI implants seen from the vantage point of crestal implantology

When complications occur, crestal implantologists unfamiliar with BOI implants may occasionally argue that there is not enough bone left for further "implant treatment" once an implant is lost. This is incorrect, since there is always enough available bone in the cranial regions of the facial skull and the basal region of the mandible (see cases of extremely advanced application of basal implants on www.donsimoni.com). This line of argument also negates the fact that there had already been insufficient bone for crestal implants even before the beginning of therapy, which is why the patient had sought treatment from the BOI implantologist and NOT from the crestal implantologist.

In practical crestal implantology, saving a case over time (and beyond the warranty period ...) is an important aspect; ailing crestal implants that are well osseointegrated basally but show unavoidable system-related continuous bone loss near the alveolar ridge (see Fig. 2 b), it is possible to "sell" the patient many years of delaying peri-implantitis therapy until the situation deteriorates to the point that leaving the implant in place becomes inconsistent with any definition of an acceptable oral situation. This kind of approach is clearly wrong in the case of basal implants: Problems must be addressed immediately and professionally, not least in order to prevent the spread of overload-related damage to other implants (which carries a risk of subsequent fracture or overload osteolysis) and thus to prevent bone loss. It is also not necessary to wait with the corrective intervention, because every patient has enough bone for treatment with basal implants. The "waiting-strategy" of crestal implantologists is caused with the fear, that after the removal of the ailing crestal implant no further treatment with crestal implants is possible. This point of view is short sighted.

In crestal implantology, specific aspects of masticatory function play a minor role with regard to bone preservation and the preservation of the masticatory function per se. Certain implantological schools traditionally advocate narrow occlusal surfaces, restricting patients to a primitive chopping masticatory function. Allegedly, this is done to avoid shear forces and fractures in ceramics and implant-parts (implant bodies, screws, abutments); in reality, however, the desirable increased functional stimulation of the jawbone will not occur. That masticatory function can be controlled to positively influence and modulate the bone/implant interface is something that is beyond the experience of the typical crestal implantologist.

Particularly serious damage can be observed when and because a crestal implantologist – or a non-implantologist – does not have the possibility (material, knowledge, experience) to insert additional basal implants, while crestal implants cannot or must not be inserted due to a lack of vertical bone or due to their different biomechanical function. A good example is the extraction of teeth in the opposing jaw or on the contralateral side, which of course would require the insertion of a fixed implant-supported replacement resto-

ration in order to maintain a symmetrical masticatory function. If the patient is not informed of this or if the treatment is not performed, the consequence will be overload-related damage on the working side, either to natural teeth or to implants.

Orthopaedic deformation of the jawbone and the supporting ligaments and locomotor systems of the cranium as a result of changes in loads and function in turn result in changes in the relative position of the restorations in the maxilla and mandible. This will almost always make massive occlusal adjustments of the restorations necessary over time. These adjustments must usually be much more pronounced – orthopaedic deformations of bones being on the order of millimetres rather than of microns – than anything their experience tells dentists working with crestal (axial) implants or on natural teeth.

Special consideration when working with basal implants should always be given to the preservation of a chopping or a lateral masticatory function: anterior masticatory patterns must be corrected, which often requires an elevation of the restoration in the posterior region.

5. Summary

Therapeutic options for peri-implantitis around crestal implants are limited: usually the disease stops as soon as it reaches basal (i.e. resorption resistant) bone areals. Peri-implantitis is not found with basal implants.

For sterile loosening of basal implants, numerous therapeutic options exist: functional adjustments or combined surgical/functional treatment of bone/implant/restoration systems are required and in some cases the reduction of muscle forces is part of the therapy plan. Such options are not given for crestal implants.

Even the replacement or addition of basal implants is easily possible, since there is usually sufficient cortical bone available for additive therapy. Corrective actions must be taken in a timely manner. The correct diagnosis and treatment of problems related to basal implants requires specific clinical experience, specific tools and of course basal implants. This is why the work with and on basal implants is and has been restricted by the manufacturer to authorized practioners.

Also with respect to the accepted principle "primum nihil nocere", basal implants are the devices of first choice, whenever (unpredictable) augmentations are part of an alternative treatment plan.

The technique of basal implantology solves all problems connected with conventional (crestal) implantology. It is a customer oriented therapy, which meets the demands of the patients ideally.

Figures

Figure 1.
Histological section from a dog's mandible, four months postoperatively. The implant was inserted in a non-sterile manner and protected from exfoliation by the superstructure. The cortical bone in its entirety was re-formed as plexiform bone. The implant is not osseointegrated anywhere.

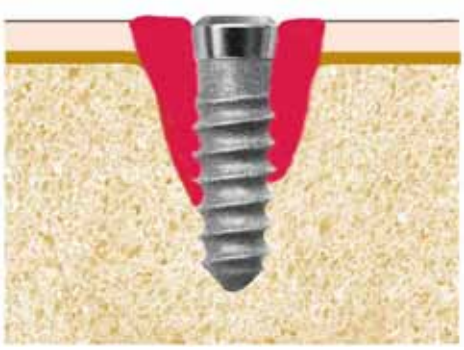

Fig. 2 a.
Funnel- or crater-shaped crestal implants may occur around osseointegrated crestal implants.
The extent of vertical bone loss can be determined by depth probing.

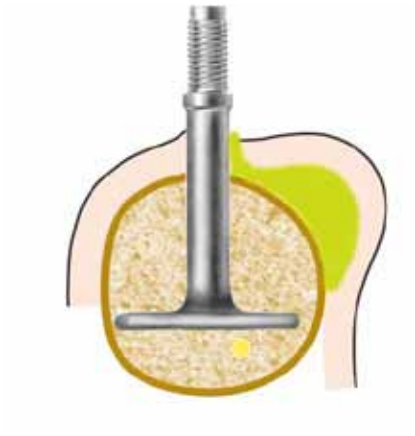

Fig. 2 b:
With integrated basal implants, infection originating in the oral cavity would not normally be expected to spread enossally, for as long as the implants are not mobile to the extent that they can be intruded. Infections can be caused by food retention or impaction or as a consequence of vertical bone growth. However, unlike with crestal implants, they do not spread intraosseously but submucosally. The latter may result in infected vertical parts if the implants are submerged below the mucosal level over time, eliminating the necessary gateway for suppuration as the area of penetration is closed with scar tissue. Any inflammation of this type will spread just like a submucosal abscess (Fig. 3) and is treated in the same way. It is recommended to make generous incisions to open the abscess. The mucosal area immediately adjacent to the threaded pin can be excised by electrosurgery. In rare cases, reduction osteotomies or the replacement of implants will be required if vertical bone growth becomes excessive.

Fig. 3. Internal BOI implants can have different platforms. Left: An ITI-compatible Diskos® implant with octagon. Right: A French "Diskimplant" with an external hex. These implants feature all advantages and disadvantages of screw implants with internal connection.

Fig. 4a, b. One piece basal implants for cortical engagement in vertical or horizontal bone bone morphology.

Fig. 5 a. Diagram showing a diffuse zone of low mineralization around the base plate of a functionally overloaded basal implant.

Fig. 5 b.
A clearly delimited light zone on the radiograph is indicative of an irreversible loosening and detachment of the bone in the interfacial region. In addition, these areas may be superinfected, which additionally stimulated blood circulation. Increased blood circulation as a response to infection is an environmental condition that endangers the presence of bone. Where there is no clinical mobility at all and only a clearly delimited low-density zone is visible radiographically, a pronounced vertical excursive movement of the threaded pin concurrent with sufficient integration of the ring area in the cortical bone may be present at least on one side of the respective jaw.

Fig. 6 a-b: Treating overload-related osteolysis by adding a second lateral implant. Because of the elastic properties of these implants, screw implants must not be included in wide-span bridges. Individual screw implants are mainly indicated for smaller segments or temporarily as accessory implants. It must be tested whether the elasticity of the additional enossal abutment is compatible with the existing bone/implant/restoration system.

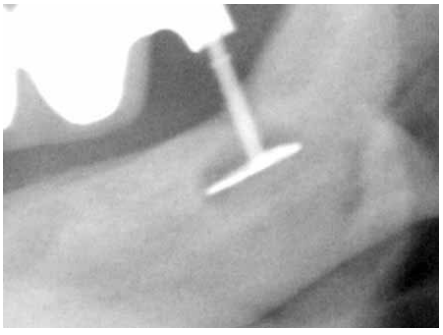

Fig. 6 a

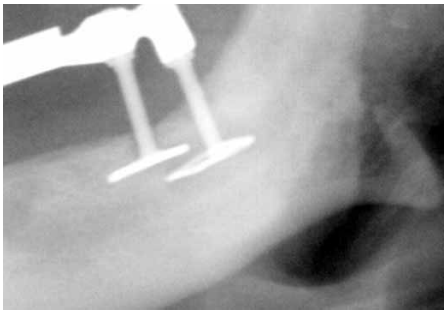

Fig. 6 b

1. Donsimoni JM. , Dohan A. ,Gabrieleff D. ,Dohan D. : Article original; Les implants maxillo-faciaux à plateaux d'assise : troisième partie : reconstructions maxillo-faciales; Les implants maxillo-faciaux à plateaux d'assise : concepts et technologies orthopédiques, réhabilitations maxillo-mandibulaires, reconstructions maxillo-faciales, réhabilitations dentaires partielles, techniques de réintervention, méta-analyse, Implantodontie 2004, 13, n°.2, 71-86
2. Geman & European Standard: DIN EN 31902-1
3. Kiær Thomas Bone perfusion and oxygenation. Scandinavian University Press, Acta Orthop Scand, 1994 Suppl 257:1-41
4. Fillies T. Primäre Osteoblastenreaktionen auf SLA-und mikrostrukturierten Implantatoberflächen; Mund Kiefer GesichtsChir, 2005 Sept:24-28
5. Internationnal Implant Foundation: Konsensus zu Sondierungen an basalen Implantaten; http://www.implantfoundation.org/index.php?page=870
6. Ihde S Adaptations fonctionelles de la hauteur de l'os peri-implantaire après implantation de BOI dans la mandibule. Implantodontie 2003 Dec : 23-33
7. Martin RB, Burr DB, Sharkey NA Skeletal Tissue Mechanics, Springer, New York, 1998
8. viii Ihde S.(Edt.): Principles of BOI, Springer, Berlin-Heidelberg, 2005
9. Korioth TWP, Hannam AG Deformation of the human mandible during simulated tooth clenching. J Prosthet Dent 1994 73;56:-66-7.)
10. Rubin C.T., Lanyon L.E.: Rubin C.T., Lanyon L.E. Regulation of bone formation by applied dynamic loads. J Bone Joint Surg 1984 66A:397-402
11. Besch KJ: „BOI Consensus" Schweiz Monatsschr Zahnm 1999 109:971-972
12. xii Rüedi T.P., Murphy W.M. AO Principles of bone management, AO Publishing, Thieme 2001 , ISBN 0-86577-886-8
13. Ihde S. (2005) Utilisation thérapeutique de la toxine botulique dans le traitement d'entretien en implantologie dentaire. Implantodontie 2005 14: 56 -61
14. xiv Ihde S. Utilisation prophylactique de la toxine botulique en implantologie dentaire
15. Implantodontie 2005 14:51 - 55