www.edi-journal.com

ISSN 1862-2879 | Volume 18

Issue 4/22

EDI Journal

European Journal for Dental Implantologists

© hakinmhan, alessandro de carli/EyeEm – stock.adobe.com

TOPIC

The path of the BDIZ EDI 2023

»EDI News: 18th Expert Symposium: Update on short, angulated and reduced-diameter implants · BDIZ EDI office in Munich as of 2023 · BDIZ EDI informs - 2023 Online training courses next year »European Law: No headscarf in the workplace? »Case Studies: New crestal bone formation thanks to a microstructured back-taper concept · Use of hyaluronic acid in reconstructive periodontal surgery · Severe bone atrophy of the maxilla and mandible · Snake technique in the treatment of posterior peri-implant soft-tissue defects

BDIZ EDI

Bundesverband der implantologisch tätigen Zahnärzte in Europa e.V.
European Association of Dental Implantologists

New crestal bone formation thanks to a microstructured back-taper concept

Prof. Dr Jörg Neugebauer, Dr Steffen Kistler, Dr Ingo Frank, Dr Jacqueline Meier, MDT Siegfried Weiß, Dr Frank Kistler & Prof. Günter Dhom, Germany

Implant design is constantly evolving to optimise success rates and to minimise risks. However, not all new developments provide only extra benefits; some changes to implant systems may also have unfavourable effects. Achieving a long-term stable and risk-free peri-implant hard- and soft-tissue situation must therefore build on different factors in symbiosis, especially in the transitional region from bone to soft tissue.

The long-term success of endosseous implants depends on a stable peri-implant bone level. In recent decades, approaches to implant design in the crestal area have changed significantly.[22] In the beginnings of oral implantology, the assumption had been that a transgingival design—with the abutment connection situated at a distance from the bone level—would be advantageous. Today we know that the microstructured implant surface is essential for osseointegration and for a stable bone level.[7,26] Consequently, the polished regions at the edge on the implant were progressively reduced and the rough region extended, depending on the design of the implant–abutment connection.

Systems with a rough surface as initially presented were viewed critically. It was thought that they increased the peri-implantitis risk, as a rough surface was seen as a predictive factor for microbiological colonisation.[3] However, it has been demonstrated that the risk of peri-implantitis is not determined by the roughness of the surface alone but also by its three-dimensional structure. Thus, implants with a subtractively modified surface (by sandblasting or sandblasting plus etching) are associated with fewer biological complications than implants with an additively modified surface (by coating or anodising).[1,9]

New scientific insights into the process osseointegration have led to improvements in implant surfaces, as it was recognised that microstructuring improves bone healing. The mechanistic principle that long and large-volume implants are more favourable for long-term success was abandoned as a result. Healing times are no longer differentiated by implant location (maxilla or mandible); the relevant aspect is the stability of the implant in its bone bed.

Over the years, it has also become apparent that connective tissue has different requirements in terms of microstructure in contact with the implant surface or with the bone. Bone cells require a three-dimensional, micro- and nanoporous microstructure, while the subepithelial soft tissue requires a two-dimensional rough microstructure for adhesion. However, bone can also attach to this merely two-dimensional microstructured surface, because osteoblast extensions can attach to the insides of the pores. On the other hand, the subepithelial connective tissue requires a rougher structure for adhesion than the epithelium. In addition to the potentially less pronounced bone apposition to a smooth implant surface, this also results in deep epithelial growth, so deeper pockets of peri-implant soft tissue are observed in implants with a partially polished surface, especially when placed epicrestally or even subcrestally.

Self-tapping implants placed in bone prepare to take account of specific bone density can also shorten the osseointegration time from the classic three to four months even in a cancellous

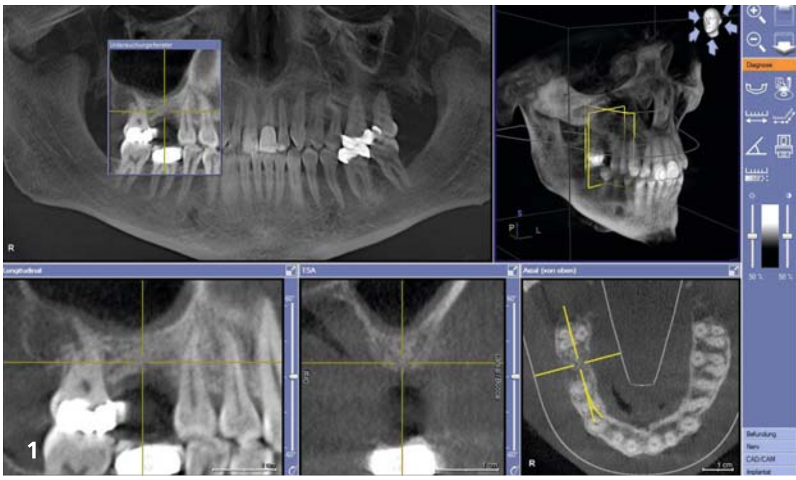

Fig. 1: CBCT for preoperative determination of the qualitative and quantitative bone supply.

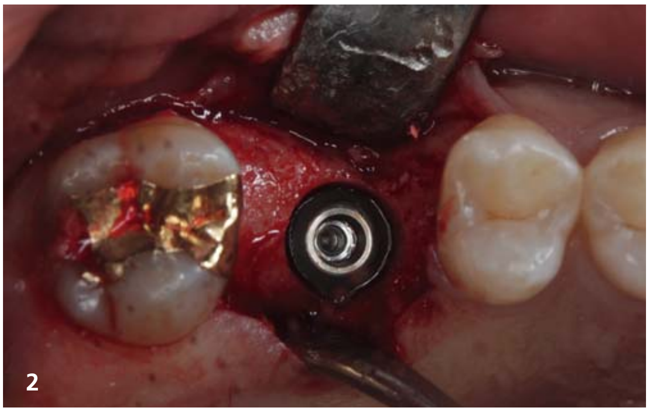

Fig. 2: Subcrestal positioning of the short implant (copaSky, diameter 5 mm, length 5.2 mm; bredent medical). **Fig. 3:** Layering bone chips (collected while the implant bed was prepared) in the open space of the implant site.

bone bed.[20] These considerations are also reflected in the positive results obtained with reduced-diameter or short or ultrashort implants. Various studies have shown that this contemporary implant design is no longer associated with any loss of stability after two to four weeks, as was postulated previously in the literature, thereby facilitating immediate restoration, which turn itself accelerates remodelling and results in more stable osseointegration. Since this approach also reduces the trauma to the gingival attachment previous scene after multiple exchanges of prosthetic components, the peri-implant bone level can be expected to be more stable.[24]

With the development of the tapered implant–abutment connection as an alternative to the conventional internal plug-in connection geometry, the so-called platform switch was promoted with a view to achieving a more stable bone level.[13] However, the underlying animal studies conducted at that time were still performed with cylindrical implants with a 90° angle and a machined margin, which were placed epicrestally.[19,25] Depending on the implant design, the combination of these different factors led to contradictory results, which gave rise to vivid discussions in the field. The sole advantage of the platform switch was assumed to be the smaller-diameter emergence profile of the abutment–superstructure. Two effects are evident here. For one, the soft tissue is attached to the upper margin of the implant, so that the attached epithelium is not detached if the soft tissue is compressed by a slipping bolus. Another advantage is that more soft tissue can form above the level of the bone, with the stronger soft tissue thought to lead to increased vascularisation.[8,12]

The dynamics of the masticatory forces result in high loads on the implant–abutment connection and the implant neck. Particularly in implant systems with an internal anti-rotational feature and a conical connection, sufficiently thick walls must be present in the crestal region to ensure the stability of the implant.[13] Often this will result in a ledge or a less pronounced thread. In addition, atrophy usually manifests itself in terms of crestal ridge becoming significantly narrower, requiring bone augmentation to obtain a sufficient bony implant bed.

In platform-switching implants, however, right-angled or even projecting sharp-edged crestal designs provide no advantage in terms of the stability of the implant body, since the outer aspects

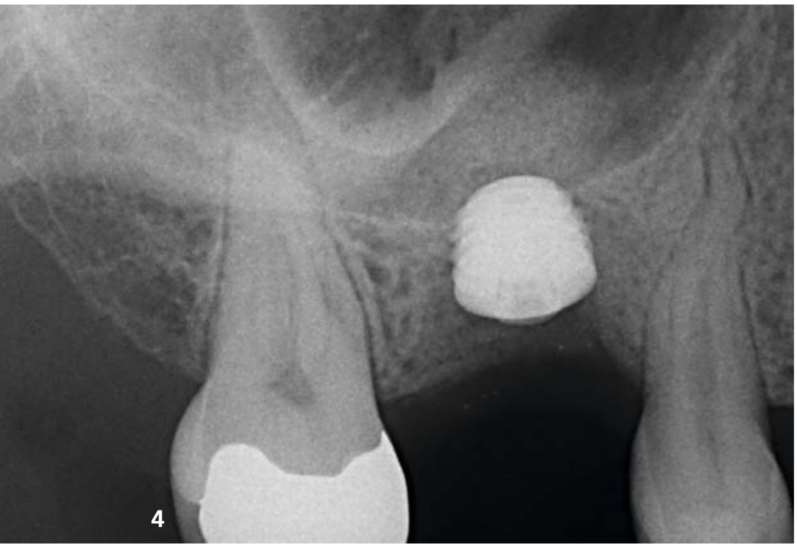

Fig. 4: Radiographic control of the minimally invasive internal sinus floor elevation. **Fig. 5:** Non-irritated soft tissue two weeks after exposure. Deep implant position.

Fig. 6: Fabrication of a zirconia crown on a prefabricated high-performance polymer abutment (Sky elegance; bredent medical). **Fig. 7:** Bonded hybrid crown with ideally configured emergence profile.

of the implant are not additionally loaded when lateral forces are applied. Moreover, this requires an even greater width of the horizontal bone. When small implant diameters are associated sharp-edged implant design, masticatory forces can even create pressure on the cortical bone, which usually leads to its resorption.[21]

If the implant neck is tapered, the mechanical stability of the implant body is not or only insignificantly affected, while the amount of friction to the local bone is reduced. This effect can become more pronounced as the diameter increases, allowing bone chips to be deposited on the so-called back-taper zone to supporting osseointegration.[6]

Since the surface structure is of great importance for the attachment of the subepithelial connective tissue and bone. In the transition zone, the back-taper zone should feature a rough, fine-pored structure, best be achieved by acid-etching.[11] Thus, depending on the position of the implant, there is a possibility that not only can the soft tissue attach to the back-taper zone but even new bone may form on it.[12] Thanks to this newly formed bone—especially in the case of a sloping alveolar ridge—will make any levelling of the bone to create a plateau unnecessary; all vertical portions of the alveolar ridge are preserved.

A multicentre study showed that when positioning a back-taper implant, care must be taken to ensure that the start of the back-taper zone is positioned subcrestally to allow a stable apposition of bone chips.[17] In a comparative study of 48 implants with a follow-up of up to 3.3 years, bone growth of 0.8 ± 0.851 mm was observed across all implants if the implants met this requirement. Implants in which the microstructured back-taper zone was positioned above the marginal bone level showed a slight bone resorption of 0.3 ± 0.626 mm, which is common for standard implants.[4]

Individual subcrestal positioning must be taken into account in implant planning and implant selection, as this position results in the implants being placed closer to the anatomically relevant structures than in epicrestal positioning.[15] If a system with drill stops is used, a shorter stop must be used so that the implant can be inserted deeper into the bone. In practical terms, this means that a drill stop for a 12 mm implant is used to place a 10 mm implant. This allows the starting point of the back-taper zone to be placed slightly subcrestally in the correct position.[5]

Discussion

Dental implants have evolved significantly over the past 50 years and have become very dependable in their application. However, since some less-than-ideal outcomes continue to be seen, various concepts for optimising the transgingival im-

Fig. 8: Inserted abutment crown prior to closing the screw channel. **Fig. 9:** Inserted abutment crown with a peri-implant sulcus shaped with the help of zirconia ceramics.

Fig. 10: Control radiograph of the inserted crown. Further consolidation of the bone bed thanks to the internal sinus floor procedure. **Fig. 11:** Follow-up 4.8 years after restoration. Bone has formed on the upper edge of the back-taper zone.

plant design have been pursued in the past.[18] However, a new design invariably changes other features of the product, and this can and will pose new problems. For example, implants developed for use on a sloping alveolar ridge typically exhibit a one- or two-sided bevel or so-called scalloped neck design.[16,23]

Such implants have been difficult to insert in the proper position due to their thread pitch. To compensate for this problem, a fine thread pitch was used in these systems, but the space within the thread flanks was too small and do not allow the incorporation of a functional bone structure complete with newly formed Haversian canals for the nourishment of the osteons.[2]

Therefore, in addition to the neck area, the thread profile is also relevant, especially for short implants. On the other hand, neither must the thread profile be too pronounced, because that would inhibit the success of peri-implantitis therapy because the granulation tissue can no longer be removed.[14]

Clinical relevance

New developments and improvements are still important in implantology today. They can optimise treatment outcomes if the results of clinical experience and scientific studies are implemented in a clinically relevant way to guide the design of implants and their surgical and restorative application. As clinical experience and initial scientific results show, a microstructured back-taper zone in combination with subcrestal implant placement seems not only to prevent bone resorption but even to achieve new bone forming around the implant.[17] However, these results need to be confirmed in further scientific studies.

Author details

Literature

Author details

Prof. Dr Jörg Neugebauer[1,3,4]
Dr Steffen Kistler[1]
Dr Ingo Frank[1]
Jacqueline Meier[1]
MDT Siegfried Weiß[1]
Dr Frank Kistler[1]
Prof. Günter Dhom[2,3]

1 Dental office of Dr Bayer and colleagues, Landsberg/Lech, Germany
2 Dental office of Prof. Dhom and colleagues, Ludwigshafen/Rhine, Germany
3 Transfer Institute for the Management of Dental and Oral Medicine, Steinbeis University, Berlin, Germany
4 Interdisciplinary Policlinic for Oral Surgery and Implantology and Department of Oral and Maxillofacial Plastic Surgery, University of Cologne, Germany