Implant-supported conical crowns

Historical development and review of innovative systems

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Using conical crowns on antirotational implant connections historically required the expensive fabrication of customized primary and secondary crowns. The Kobold system is a double-crown system using prefabricated components. It is suitable for immediate restoration using a splinted superstructure as well as for simple conical crown restorations on two or more implants or for extending existing restorations on natural abutments.

_Dentures supported by implants that are splinted with a bar were described by P. D. Ledermann as early as in 1979. This concept was adopted by many dentists and remains a viable and proven option up today. Long-term studies have confirmed the efficacy und function of this splinting/connecting technique both for immediate and for delayed restoration cases. Conical crowns have come a long way since their beginnings in the 1970s. Used as prefabricated implant-supported components, they still offer many benefits. From a hygienic point of view, however, these designs present with obvious deficiencies. So-called microgaps can be a significant problem with individually cast frameworks, some of which require a tertiary structure to eliminate divergences (Fig. 1).

_Telescopic or conical crowns as connective elements

Telescope or conical crowns as connection elements for natural abutments have been recognized

Fig. 1_ Bar construction in a immediate postoperative view. Clearly discernible marginal gap.
Fig. 2_ Customized conical crowns on IMZ implants, 1984.
Fig. 3_ Control radiograph of the IMZ conical crowns.
Fig. 4_ Negatively tapered coping for milling a custom primary crown.

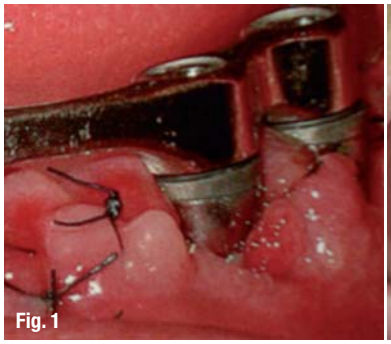
Fig. 1


Fig. 2

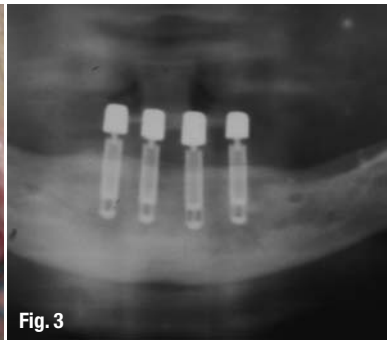
Fig. 3


Fig. 4


Fig. 5


Fig. 6


Fig. 7

and very successful for several decades now. They also offer excellent hygiene. In 1968, Dr Karlheinz Körber filed a patent application for the fabrication of conical crowns and their use. The patent application for the parallelometer used for this procedure today was submitted by Körber—now a university professor—in 1971. Conical crowns have become increasingly popular in oral implantology. Individually milled crowns were first used by Dr Nikola Laux (Hamburg, Germany) in 1984, on the IMZ implant system (Figs. 2 and 3); a patent application followed in 1988. Laux was one of the pioneers of the double-crown technique on implants. The first conical crowns were casted and milled individually. However, any proven contemporary technology should strive to develop automated fabrication methods. A first step in this direction were prefabricated negatively tapered copings, including copings made from titanium alloys, that were subsequently milled (Fig. 4), so that the primary copings no longer had to be casted individually. In 1989, the first manufacturer began to produce completely prefabricated conical crowns according to the Laux system (Fig. 5). But it was not until the 1990s, when various types of internal connectors made implant-abutment connections more reliable, that the first publications on individually milled telescope or conical crowns appeared in print. The use of laboratory fabricated telescope or conical crowns on implants gradually became a standard procedure as an alternative to bar-supported restorations.The electroforming technique and tension-free adhesive connections between abutments (passive fit) in high quality laboratory made restorations have brought great improvements (Fig. 6), regardless of whether the restorations are supported by natural teeth or by implants. A passive fit is an indispensable precondition for implant-supported restorations and a guarantee for the long-term success of implants.

_Requirements of telescope or conical crowns

Telescopes require perfect parallelism or a well defined slight conicity of the primary copings. This can only be achieved with custom components or customized prefabricated components. Conical crowns with a cone angle of 4° allow for axial divergence between adjacent implants of up to 8°. But considering the anatomical shape of the jaws, especially the maxilla, it is almost impossible to place anterior implants in a direction that they do not exceed this axial divergence. Simple prefabricated systems that do not compensate axial divergences are unlikely to gain widespread acceptance. The problem of angle compensation has to be solved in the simplest possible manner. Any manipulation in the laboratory constitutes a compromise that defeats the purpose of working with prefabricated components. Laser welding, luting or adjusting of primary copings should be a thing of the past. Angle compensation should be fully automatic, so that errors do not occur in the first place. Once a connective element for removable restorations achieves this goal, it will hardly be possible to improve it. Conical crowns offer secure anchorage and provide mutual stabilization against transverse forces. They allow the fabrication of removable bridges and skeleton

Fig. 5_ Prefabricated conical crowns according to Dr. Nikola Laux on Paraplant implants.
Fig. 6_ Electroformed crowns, adhesively integrated into a full denture as secondary crowns.
Fig. 7_ Smiling Cone system compensating for axial diversions.

Fig. 8_ Pressing both parts together creates a ball joint that responds to implant divergences.
Fig. 9_ The ball joint in the Kobold secondary crown has a self-cleaning effect.
Fig. 10_ Tooth 13 had to be extracted in the mandible. Five implants were inserted and loaded immediately.
Fig. 11_ The implants in site.

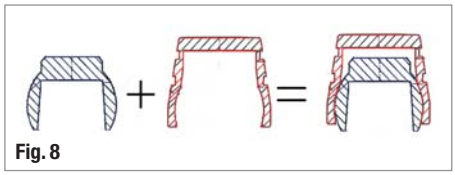
Fig. 8

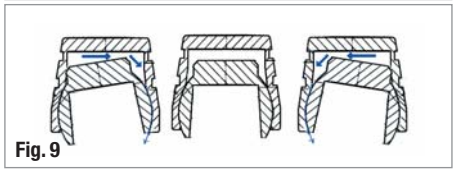
Fig. 9


Fig. 10

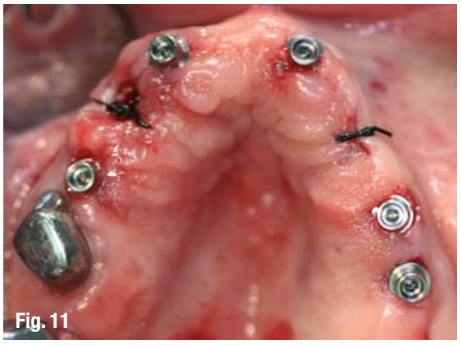
Fig. 11


Fig. 12

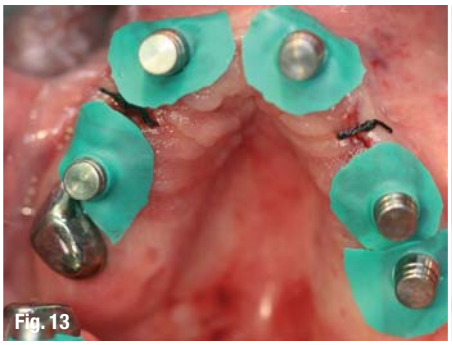
Fig. 13


Fig. 14

Fig. 12_ The primary crowns for the Kobold conical crowns connected to the implant.

Fig. 13_ The secondary crowns are inserted with positive pressure to actuate the friction.

Fig. 14_ A piece of rubber dam is pulled over the secondary crowns to prevent resin from flowing into undercuts when integrating the secondary crowns.

dentures that are just as comfortable to wear as fixed prosthetic dentures. Attachments that use rubber rings are subject to greater wear and tear and are unable to distribute transverse forces evenly to the implants. Fabricating maxillary dentures without a palatal bar or removable bridges is a challenge therefore, and the inherent problems cannot be solved by modified ball attachments with rubber rings or by magnetic attachments. While these will keep a denture in its approximate position in the mouth, masticatory forces are transmitted in a relatively uncontrolled manner.

_Prefabricated conical crowns

This Syncone concept for the Ankylos system was original presented in 2001. It was the first prefabricated abutment with a tertiary component that compensated axial divergences. Here, the concept of the wobble cone was applied to a conical axisymmetric implant-abutment connection. However, these conical crowns must be aligned without the help of an antirotational mechanism and require highly precise and time-consuming procedures including the use of suitable paralleling gauges. An imprecise alignment may result in jamming on insertion or removal of the restoration. This may result in eccentric strain, especially in cases of immediate restoration that may contribute to osseointegration failure. For this reason, the Syncone system (Morse taper connection) cannot be used for implants with an antirotational mechanism such as a hex connector. Hex connectors can only be adjusted in 60° increments and do not permit any finer adjustments. In 2005, Bredent introduced its Smiling Cone, the first conical crown to permit actual divergences of up to 20° which can be used on different implant systems (Fig. 7).

_The Kobold conical crown system

The Kobold conical crown system is a new system presented by Dr. Robert Laux the developer of the Smiling Cone. It, too, permits angle compensation, but follows a different concept. While the Smiling Cone works across two different angle regions, the Kobold system achieves angle compensation by way of a ball joint inside the secondary crown that self-adjusts while inserting or removing the denture (Fig. 8).

The Kobold conical crown provides the desired angle compensation automatically by allowing the secondary crown to function as a ball joint. When a divergence manifests itself on denture insertion, the internal ball moves in the correct position and allows the restoration to be inserted (Fig. 9). Kobold conical crowns can be used with different implant systems, and additional implant systems are in the process of including Kobold crowns in their product range. Kobold conical crowns offer prosthetic options previously available only with the Syncone or the Smiling Cone. Depending on the indication, Kobold conical crowns show resilience when two implants are used. Secondary splinting becomes effective when using more than two implants. The Kobold conical crown makes collaboration with the dental laboratory more efficient. The lab does not have to switch to ball attachments or magnets if the

Fig. 15_ Completed restoration and a happy patient.

Fig. 16_ Secondary crowns in site.

Fig. 17_ Grinded denture.


Fig. 15


Fig. 16


Fig. 17

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Fig. 18


Fig. 19

Fig. 20

Fig. 18_ Secondary crowns and rubber dam.
Fig. 19_ Completed denture.
Fig. 20_ Vinyl polysiloxane bite registration material.

dentist wants to use prefabricated parts. The Kobold system is a double-crown system using prefabricated components. It is suitable for immediate restoration using a splinted superstructure as well as for simple conical crown restorations on two implants or for extending existing restorations on dental implants or on natural teeth. For combination dentures, natural teeth can be restored with custom telescope or conical crowns, while implants receive prefabricated crowns. It is particularly easy to integrate one or several implants with conical crowns in an existing restoration already using telescopes or conical crowns.

The advantages of this kind of prefabricated conical crown (Kobold system) are many:

_Defined adhesion of approximate 8 N after a 25 N load.
_The mobile ball joint secondary crown provides angle compensation for divergent implants.
_The prefabricated conical crowns exhibit only minimal wears and offer functional friction for a period of many years.
_Conical crowns can be easily cleaned thanks to secondary splinting.
_The cost of a prefabricated conical crown is considerably lower than that of a custom double crown.
_The abutments are self-cleaning.
_The primary copings are easy to clean.
_The CAD/CAM production process results in very narrow so-called microgaps.
_Only a single metal (titanium) is used.
_Collaboration with the laboratory is easy and efficient.

_Clinical procedure in the maxilla

The procedure is easily applicable to the maxilla. Multiple maxillary implants are nearly impossible to place with exactly parallel axes. However, the Kobold crown easily compensates any divergences. We recommend inserting at least six implants in the maxilla. More implants can of course be provided if the quality of the bone is soft like D3 or D4 bone acc. to the categories of C.E. Misch or if the length of the implants is not sufficient. Reducing the number of implants below six is generally not recommended, as this will compromise long-term stability. Figures 10 to 15 illustrate a patient case in which a 73-year-old patient received five implants that were restored immediately.

_Clinical procedure in the mandible

Direct procedure

Figures 16 to 19 illustrate a patient case in which a patient received four implants in the mandible, to be restored later. Following a healing period of three months, four Kobold conical crowns were fixed. To polymerize the secondary crowns into the existing complete denture, the copings were finger-pressed onto the primary crowns (Fig. 16).

The complete denture was grinded to eliminate any contact with the secondary crowns in order to obtain a passive fit (Fig. 17), which was double checked with a silicone impression. It is recommended to pull a piece of perforated rubber dam over the secondary crowns (Fig. 18) to prevent resin from flowing into undercuts when gluing the sec-

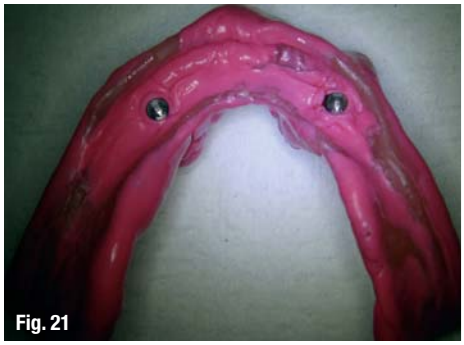
Fig. 21


Fig. 22


Fig. 23

Fig. 21_ Securing the secondary crowns and relining impression.
Fig. 22_ Implant analogues in the secondary crowns.
Fig. 23_ Cast fabrication.

ondary crowns. Excess resin might prevent the removal of the denture, jeopardizing the entire idea of a removable restoration. The relief areas should be so extensive and generous that no premature contact occurs between the denture of the secondary crowns that might jeopardize the passive fit of the denture and provoke failure especially in cases with immediate loading. The secondary crowns are integrated into the denture and the denture is finished and polished (Fig. 19). That result would take several weeks to achieve at the same quality level with custom components. If, despite all precautions, premature contacts do occur, the secondary crowns can be tilted slightly to one side to permit passive integration anyway. Once the secondary crowns have been attached with self-curing resin as described, the denture is sent to the laboratory for finishing. The patient is already satisfied at this stage because the adhesive connection of the secondary components already creates the typical "fixed-restoration" feeling.

Indirect procedure

If the dentist prefers the so-called indirect procedure performed in the dental laboratory, this preference can also be easily accommodated. Following connection of the primary components, the secondary components are placed over them intraoral, and the existing or new denture is relieved as described above. The denture is lined with a polyether or vinyl polysiloxane material (Fig. 20), and a fixating and relining impression is taken concurrently (Fig. 21).

To fabricate the cast, two primary parts mounted on implant analogues are inserted into the secondary components embedded in the impression (Fig. 22). The dental technician fabricates a master cast and relines and secures the secondary components (Fig. 23).

It is important to preserve the mobility of the joint inside the secondary component by blocking out this area with modelling wax. The indirect procedure deemphasizes the chair side aspect of the procedure while offering the same precision of fit – provided the impressions are accurate. The choice of procedure is entirely up to the dentist.

Immediate restoration and loading

In immediate loading cases it important to ensure that the patients themselves do not remove their restorations during the first few weeks. They are removed only at the dental office at five to seven day interval. At these appointments, patients will rinse with chlorhexidine digluconate. The denture is cleaned and reinserted by the dentist. It is particularly important to follow this procedure in the maxilla to avoid improper loading of the implants during the initial phase. Of course, patients must be instructed to avoid biting off bigger bits of food with their front teeth during the first few weeks to guard the implants against excessive chewing loads. When these instructions are followed and the bone supply is adequate for implants of 12 mm or more in length, the experience of several dentists with the procedure is good up to now. Needless to say, it should be used only for selected patients. The dentist must decide whether to incur the increased risk of immediate restoration/immediate loading based on the merits of the individual case. Patients in any case should participate in the decision-making process, and the decision must be documented comprehensively. The safest way is still to allow a certain healing period after implant insertion, which should not present a major obstacle in patients that had been edentulous for many years. The risk of failure after appropriate healing is very low. A skeleton denture without palatal bar can be provided after three months in the mandible or four to five months in the maxilla.

_Summary

Using conical crowns on antirotational implant connections historically required the expensive fabrication of custom primary and secondary crowns. The systems available today have their limitations in terms of handling or implants-superstructure stability. The double-crown-technique has been used for implants for more than twenty years. Yet it is only now that fully prefabricated systems are beginning to make inroads into the implant market. The Kobold system is such a double-crown system that uses prefabricated components. It is suitable both for immediate restoration by a splinted superstructure and for simple conical crown restorations on two implants or for extending existing restorations on natural abutments. In summary, the Kobold system is a reliable, simple and cost-efficient way to provide high quality prosthetic dentures. Kobold conical crowns offer prosthetic options previously available only with the Syncone or the Smiling Cone._

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