Have a look inside ...

In the world of dental implantology, people meet in many places, meet colleagues and companions, discuss and debate and experience this and that. We assume that you feel the same way.

We at BEGO Implant Systems are told that we are in love with detail, well, almost obsessed when we talk about our products. At times the significance of the external features becomes apparent only when you take a look into the details. And that’s what we have done in this issue with the editorial *The Value of Original Components*.

Our case reports are dedicated to the variety of prosthodontic treatment options and show you the treatment with product solutions from BEGO Implant Systems.

Meet two of our employees again in our interview series. *We are BEGO Implant Systems*, experience the new service appearance LiVE and make a note of the date for the next *Art of Implantology Conference 2020*.

Enjoy our Close Up magazine.

With hearty greetings from your

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THE VALUE OF ORIGINAL COMPONENTS

Compatibility or the question of systemic interaction of the implant components

Dr Pantelis Petrakakis, freelance journalist and dentist, Düsseldorf
MDT Christoph F. Staufenbiel, BEGO Implant Systems, Bremen
Dr Nina Rätscho, BEGO Implant Systems, Bremen

Abstract

The long-term success of implant treatment depends on many biological, mechanical and patient-related factors. One aspect of the mechanical factors is the fit of the individual components in the implant system. A well-coordinated implant system strives for the highest possible accuracy of fit of the system components so as not to jeopardize the longevity of the implant-prosthodontic reconstruction.

Prosthodontic components from third-party vendors or external suppliers, known as *copycats*, are being advertised more and more often. The question this raises is whether these cheaper and supposedly identical third-party components are comparable to the original components of the implant system, in terms of quality and safety.

The interface between the implant and the prosthodontic abutment is a sensitive area that could be affected by components that are supposedly identical but not fitting perfectly. For this reason the validity and supposedly comparable usability of the third-party components must be critically scrutinized.

An implant system and its central location

Where signalling molecules orchestrate the body’s cells and the interplay of cells results in function and aesthetics, an implant system must be in harmony with the physiological, anatomical and mechanical events.

The focus of an implant system is the implant body (Fig. 1).

The special features of anatomical structures and indication-dependent characteristics are taken into account in the geometry and design, surface and joint of the implant body. The implantation bed is prepared with surgical tools that are tailored to the implant body. The protection of the bone and the controlled preparation of the implant bed are important steps for a successful osseointegration of the implant.
The implant-prosthetic junction is a sensitive area that deserves special attention. The type and construction of the internal connection and the design of the prosthodontic components are precisely coordinated with all manufacturers of dental implants and tested in combination as a functional unit with the prosthesis screw in conformance with DIN ISO 14801.

The exact dimensions, tolerances and geometries of the prosthodontic interface are the basis for a functional and long-lasting implant-prostodontic restoration of the patients.

Fig. 1
In an implant system, all components are well-coordinated.
The use of third-party components in an implant system

So far, few studies have been published on the use of original components compared to components from third-party suppliers, particularly the prosthodontic components. In the 1990s there were efforts to copy components of different implant systems and to offer them cheaper (ZANARDI et al., 2012). The components of the third-party manufacturers were already criticized at the time, as inaccuracies were observed in the fit, which led to biomechanical disadvantages for the implant-prosthodontic reconstruction as a result of higher micro-movements and micro-gap formation (BINON 1995, DELLOW et al., 1997). Publications warn of technical and biological problems that may arise from an inadequate fit, especially between the abutment and the implant (HURSON, 2016, IVANOVSKI, 2015). Fitting inaccuracies lead to an increase in stress in the area of the implant-prosthodontic connection and also cause an unfavourable stress transmission in the peri-implant bone (ASSUNCAO et al., 2011).

Using abutments from various third-party manufacturers on an implant system allows the clinician the option to offer implant therapy more cost-effectively. The increasing number of suppliers of non-implant-system products in the market highlights the importance of extensive experimental in-vitro and clinical human trials, especially in terms of commitment of dentists and patient safety.

Discrepancies in the fit and complications in the use of third-party components in the implant system

The use of non-implant components in an implant-prosthodontic restoration can result in mating inaccuracies and technical problems (Fig. 2). Micromovements between implant and prosthodontics can cause major problems, both in materials and in the biological field. Thus, the use of third-party components causes larger micro-movements than when using original components. The results of a recent in vitro study show that an oblique load with an acting force of 200 N, causes an average gap formation at the implant-prosthodontic interface which is up to three times higher if third-party components are used instead of the original components (BERBERI et al., 2016).

Another special feature are custom-made abutments. In a systematic review, mean vertical gaps between 50 and 160 μm could be identified (LALITHAMMA et al., 2014, PEREIRA et al., 2017). Cervical discrepancies of 70 μm (BAE et al., 2017) and up to 100 μm (PEREIRA et al., 2017) are considered clinically acceptable. Other authors point out that there is a lack of a clear, agreed definition of tolerances in the fit between the implant and the superstructure (ABDUO & JUDGE, 2014, KANO et al., 2007, MORAIS ALVES DA CUNHA et al., 2012).

A special role is played by the prefabricated, clearly oversized blanks, so-called pre-milled blanks or prefabricated abutments. If manufactured by the implant manufacturer, these components have the original connection point to the implant. After the scan and design process, these abutments are clamped by standardized workpiece holders in milling machines, which are usually provided by the laboratory, and customized according to the clinical situation, while the original connection to the implant remains unaffected.

In a laboratory study conducted by GIGANDET et al. (2014), implants from three different manufacturers were supplied with the original abutments. Wax-up abutments were fabricated on one of the implant systems and then scanned with the respective scanning system of the other two implant systems and milled individually milled with titanium grade V using CAD / CAM technique. The abutments made using CAD / CAM technique differed greatly in the design of the interface between implant and abutment and showed a higher mean rotational latitude. The authors concluded that the poorer fit leads to a higher risk of implant and abutment fractures and recommended the use of native abutments.
An *in vitro* study confirms the results of this study. By combining individually milled abutments of a third-party supplier with different implants, significantly higher clefts could be observed in the implant-prosthodontic interface than when using original abutments (de MORAIS ALVES DA CUNHA et al., 2012).

In another *in vitro* study, major differences in fit and inaccuracies of fit were observed between titanium abutments of different manufacturers, when fitted on the same implant (MATTHEOS et al., 2017).

SUI et al. (2014) reported that in the implant-and-abutment system, the preferred site of a fatigue fracture depends on the material properties of the components. If the material properties of implant and abutment are the same, fatigue fractures are more likely to be observed in the area of the screw, while if the material properties differ, the respective susceptibility to fracture of the material is decisive. Thus, individual abutments made of zirconium oxide that do not match perfectly, if fitted on titanium implants, the micro-movements did not lead to fractures of the prosthesis screws, but rather to an increased susceptibility to fractures in the area of the abutments.

The information about the nature of the implant-prosthodontic connection and the resulting micro-movements due to inaccuracies of fit and their biological effects given in the scientific literature is partly contradictory.

The results of a recent systematic review show that heavy stresses are transmitted to the bones if the fits of the abutments are inadequate. However, contrary to expectations, these unsuitable conditions of stress and the marginal gap formation do not have biological consequences such as crestal bone loss and/or a negative influence on the osseointegration of the implants. In fact, technical complications such as fractures of the prosthesis screw were observed (KATSOLIS et al., 2017).

In addition to an inadequate stress transfer to the crestal bone, another problem that arises as a result of fit inaccuracies at the implant-prosthodontic connection site is the bacterial colonization of the micro-gap and this can lead to biological complications.

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**Fig. 2**

Schematic representation of an implant with a prosthodontic restoration with original components (A) and a restoration using third-party components (B). Possible design structures that can lead to inaccuracies of fit are indicated.

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The role of material properties in an implant system

The material properties of the components play a crucial role in the interaction of the components of an implant system (SUI et al., 2014).

To avoid complications such as fatigue fractures within the implant-prosthodontic restoration, manufacturers of implant systems perform extensive regulatory examinations and tests, in which the implant, abutment and screw are always tested until they break (ISO 14801). Even within an implant system, varying material properties of the components can lead to measurable deviations in the developmental phase, the occurrence of which is taken into account in the development and testing of the implant systems by means of design optimizations.

In a recent in vitro study, an implant type was screwed to third-party abutments made of zirconium oxide, titanium and gold. In abutments and prosthesis screws discrepancies and inaccuracies of fit were found between the different material groups of the abutments as well as within the material groups (FOKAS et al., 2018). In another in-vitro study, major differences in fit and inaccuracies of fit were observed between titanium abutments of various third-party suppliers, when fitted on the same implant (MATTHEOS et al., 2017). The increased susceptibility to fracture of zirconium oxide abutments with poor fit has been described in another in vitro study (SUI et al., 2014).

Screw loosening between implant and abutment leads to a prosthodontic failure, particularly in the case of cemented intermediate implant structures. Therefore, for the implant-prosthodontic treatment to be a success, an appropriate pre-stress (Preload) is a mandatory requirement when fixing the prosthesis screw.

The material of the prosthesis screws is of great importance for the generation of the appropriate preload when fixing the abutment on the implant. If the preload is too low, it causes a loosening of the prosthesis screw, while too high values often end up in screw fractures (DOOLABH et al., 2014).

When using third-party abutments and their prosthesis screws on an implant, the risk of technical complications in a prosthodontic restoration is very high. Due to various reasons, such as the patient’s change of location or the so-called health tourism, the prosthesis screws that originally belong to the implant end up being used in prosthodontic third-party abutments, resulting in poor adhesion. In addition to the question as to whether the material properties allow a long-lasting function, the fit of the screw’s bearing surface in the abutment is another aspect. For these second generation combinations of original and third-party components there are risks for technical and biological complications that are unpredictable.

Discussion and Conclusion

The option of using third-party components instead of native original components in implant-prosthodontic restorations initially provides a more cost-effective solution. Whether these options are comparable to the original components of the implant system with regard to quality and safety, will only become apparent with long-term observations (Fig. 3).

On careful consideration of the currently available evidence of technical complications, it should be noted that the use of third-party components in systems with existing system-inherent inaccuracies of fit is more likely to result in further deterioration of fit.

Regardless of previous considerations when using third-party prosthesis alien to the implant system, experimental studies have shown that, even between original abutments and implants of the same system, the fit may not have the required precision due to limitations during the manufacturing process (ALVES, et al., 2016, LALITHHAMMA, et al., 2014, ZANARDI, et al., 2012). Surface defects can occur during the fabrication of implants and abutments, adversely affecting the fitting and this can contribute to increasing the microgap (LOPES, et al., 2018). Positioning errors are possible due to manufacturing-related rotational tolerances causing a faulty fixation.
of the abutment and ultimately a less precise fit of the prosthodontic superstructures (Nicoll et al., 2013 SEMPERVIRENS-Hogg et al., 2013).

From a legal perspective, the use of *copy cats* is perhaps questionable. A ruling of the Frankfurt district court in 2012 (Az 2-03 O 84/12) confirms that components from different suppliers cannot be combined without a special Certification of conformity. Accordingly, in the opinion of the court, due to the limited conformity assessment a curative treatment using third-party components or *copycats* with system parts from other manufacturers may not be carried out.

Based on the current studies, it can be seen that supposedly identical components from third-party providers are primarily associated with an increased risk of technical complications. An increased risk of biological complications is currently unclear, but cannot be ruled out.

If follow-up care is required, the legal liability considerations should be taken into account. If third-party components are used, no warranty can be given, which leads to an increased cost. Therefore, careful consideration should be given to the extent to which *copycats* are a substitute for matched, quality-tested and clinically proven original system components, and whether they are ultimately worthwhile. This decision should always be made with the patient’s involvement and after his clarification in the form of an *informed consent*.

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**Fig. 3** The critical importance of the fit and the interaction of original components can be clearly demonstrated at prominent points.

1. The Original Semados® prosthodontics have a precisely fitting screw seat in the abutment.
2. Third-party prosthodontics have significantly different cone angles for the screw seat and the screw head of the prosthesis screw.
3. The implant has an integrated Platform Switch in the shoulder area, and the original prosthodontics are tuned to it, thus bringing about the complete Platform Switch.
4. The design geometry of the third-party components with the much larger diameter in the area of the integrated Platform Switch does not use this to its advantage.
5. The original Semados® prosthodontics with the hexagonal guide inside the implant have a precisely fitting and symmetrical seat for the best possible mechanical properties.
6. The third-party prosthodontics have unequal gaps on the right and left of the hexagon inside the implant.

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**References**

- Click here to open the full bibliography.
Implant abutments are a fundamental part of prosthodontic rehabilitation. Implant abutments are in direct contact with peri-implant soft tissue in the subcrestal zone and are by definition medical products whose cleaning and disinfection procedures are of great clinical importance.

The preparation and sterilization for ready-made and customized CAD/CAM abutments should be given a fixed place in the course of the implant-prosthodontic treatment. Preparation and cleaning of semi-critical or critical medical products that are associated with the mucous membrane are subject to valid standard procedures conforming to the Medical Devices Act. Abutments made using CAD/CAM technique without appropriate preparation show contamination. Whether the abutments are made centrally or in a laboratory, is irrelevant here. In hybrid structures, residue resulting from adherence to the titanium base, polishing residues, and other surface deposits may be present in the peri-implant submucosal area of the abutment.

Using standardized reworking of the abutment for removal of debris such as organic and inorganic impurities, milling chips, coolant or chemical residues of the surface treatment, the structures can be proven to be antibacterially cleaned and preserved. The risk of infection from insufficiently cleaned abutments cannot yet be clearly estimated. Initial studies show that inadequately prepared abutments lead to significantly increased peri-implant bone resorption.

According to Dr. med. Peter Gehrke and Carsten Fischer, cleaned surfaces of the prosthodontic abutments with defined residual roughness can be determined for instance, by applying the validated concept for the preparation of implant abutment structures.
IMMEDIATE RESTORATION WITH THE
ONE CARE PACKAGE (OCP)

Immediate implantation in the molar region of the mandibula

Dr Ángel Manchón Miralles, Clínica Dental Sanchinarro, Madrid, Spain

Initial situation

A 37-year-old male patient presented in the clinic after tooth loss in region 36 (Fig. 2). The loss of teeth had been preceded by failed endodontic treatment four months earlier. The patient was healthy and showed very good oral hygiene.

Surgical Procedure

A mucoperiosteal flap was prepared and the bone was exposed. The alveolar bone in region 36 had a height of 13 mm and a width of 7 mm. The preparation of the implant bed was carried out according to the drilling protocol of the manufacturer (BEGO Implant Systems, Bremen). The Semados® RSX implant (Ø 4.5 and length 11.5 mm) was subcrestally set at 0.5 mm with an insertion torque of 35 Ncm. The implant stability quotient was 81 (Fig. 3-5).

Prosthodontic procedure

The prosthodontic restoration was performed immediately with a provisional single-tooth crown. The final restoration with a cemented single-tooth crown was performed three months after implantation. The One Care Package (Fig. 1, OCP, BEGO Implant Systems, Bremen) was chosen for the prosthodontic restoration. The PS OCP abutment was screwed in after implantation, the impression coping was placed and a closed-tray impression taken. The PS OCP multifunction cap serves as a healing cap for the first few days (Fig. 6-9). Eight days post-operatively, the healing process is good and the provisional crown (PMMA, VIPI Produtos Odontológicos, Brazil) has been cemented to the PS OCP abutment (Fig. 10-14).

Result

The final restoration was performed. three months after implantation. The soft tissue had a well-shaped contour. After the closed-tray impression had been taken, the final crown of zirconium (Zirkonzahn, Germany) was cemented (Fig. 15-20). Radiographic check performed seven months post surgery showed good, stable bony integration of the implant (Figure 21).
Fig. 2
OPG (a) and CBCT (b) showing the initial condition

Fig. 3
Preoperative situation

Fig. 4
Preparation of the muco-periosteal flap

Fig. 5
0.5 mm subcrestally inserted BEGO Semados® RSX implant
(Ø 4.5, L 11.5)

Fig. 6
OCP-Abutment (BEGO Implant Systems) in situ

Fig. 7
OCP-impression coping on the OCP-abutment

Fig. 8
Closed tray impression

Fig. 9
OCP-Multi-function cap in position

Fig. 10 & 11
Situation eight days post-operatively.
Fig. 12
Provisional crown

Fig. 13 & 14
Provisional crown in situ

Fig. 15 & 16
Situation three months after implantation

Fig. 17
Closed-tray impression

Fig. 18
Final crown

Fig. 19 & 20
Cemented final crown

Fig. 21
X-ray image seven months after implantation
Conclusion

The concept of restoration behind the One Care Package from BEGO Implant Systems is based on the approach of introducing the final abutment in the first prosthodontic session and leaving it in situ. The following steps are performed at soft tissue level to promote the undisturbed apposition and contouring of the soft tissue.

There are few studies focussing on this approach and are based on different indications. In an animal study ABRAHAMSSON et al. (2003) investigated whether the change of the prosthodontic abutment has an influence on the soft tissue. After three months of healing the prosthodontic abutments were fixed. On the one hand, the abutments were removed once a month, cleaned and re-inserted, while on the other hand, the abutments remained undisturbed in situ. After 6 months, the abutments that were repeatedly removed, showed an apically displaced connective tissue associated with a loss of marginal bone height, which the authors attributed to the formation of an attached biological width (ABRAHAMSSON et al., 1997). In a similar study design, the final abutments or healing posts were inserted three months after implantation. After the further 2 weeks the healing post was replaced by the final abutment. After 6 months the repeated change in the abutment had no effect on the length of the epithelium, the height of the fixed gingiva and the marginal bone level.

ANGELIS et al. (2016) found no positive influence of the concept on the preservation of the marginal peri-implant bone level. They concluded from a comparison with existing literature that in addition to the concept of prosthodontic restoration, other factors such as the time of implantation also influence the maintenance of the peri-implant bone level. A comparison of provisional and final abutments on immediately inserted implants platform switch showed a significant difference in preserving peri-implant bone level at 12 months. For the restoration with final abutments, a better preservation of the bone level was measured (0.11 mm, SD 0.06 mm) than with the provisional abutments (0.58 mm, SD 0.11 mm), although the observed bone level differences are not clinically significant (GRANDI et al., 2014).

Although the existing literature so far provides no compelling evidence for the superiority of the concept of introducing the final abutment in the first prosthodontic session (BECKER et al., 2012), it does offer significant benefits. It ensures that the soft tissue is formed from the beginning in its final contour. Subsequent aesthetic corrective measures and risks are eliminated (BEUER et al., 2014 & 2015). By saving treatment time and sessions, due consideration is given to patient welfare. The further steps can be carried out quickly and efficiently and this implies less stress and burdens for the patient. For the clinician, shorter treatment times and fewer sessions open up the possibility of treating more patients.

References

- Click here to open the full bibliography.

One Care Package

- Find out more about the product One Care Package (OCP) of BEGO Implant Systems.
WE ARE BEGO IMPLANT SYSTEMS

Two employees, five questions, ten answers

A system is perfect only if all the components harmonize with each other in detail. This is our claim. We combine indication-adapted implantology products and first-class service.

We - that is BEGO Implant Systems.
We are the people at BEGO Implant Systems.

David Vila
Miriam Schocke

“Technical Advisor – I supervise the implantology specialists in Galicia / Spain and Portugal. I advise on the products, I am the contact person for the questions and problems faced by our customers. At the first surgical interventions, I am usually present as a health care professional (dental hygienist) to help with any problems that may arise.”

“Departmental Head for Customs and Export control – Our department organizes the worldwide transport of our products and their documentation. In the export control, we check whether our products are subject to international export restrictions and monitor the sanctions to ensure that our products only get to the right countries and the right hands. Within the legal framework, we develop the best logistic solutions for our products and our customers.”

What is your job at BEGO Implant Systems?
7th May 2012 – I work for BEGO Iberia, the Spanish subsidiary of BEGO Implant Systems. I hope to stay here for many more years.

Balance and Focus – Focusing on human qualities and employee engagement as well as our successful products that deliver good clinical outcomes.

Empathy – I am a very compassionate person. Sometimes I do not know whether this is good or bad. But this is how I am in professional as well as in private life. Being in close contact with our customers means that I can always connect with them quickly.

Generations / Change – For three years I have been working in the non-profit organization Amigos de los Mayores, that means "Friends of the Elderly", based in the city of Vigo / Spain. We accompany old people. Believe it or not, there are many elderly people who are alone or feel lonely. We accompany these people, keep in touch with them by phone so that they feel cared for and help them in everyday life. We try to give people a space where they can make contacts and friendships, we organize summer festivals, Christmas celebrations, carnival and food in different neighbourhoods. Of course, we also do public relations work to show how many older people live in solitude and we are looking for sponsors, partners and authorities who support our work.

Since when are you part of BEGO Implant Systems?

To your mind, what distinguishes BEGO Implant Systems as an employer?

Which of your personal skills can you use particularly well at your workplace?

And otherwise?

Confidence and support – At BEGO Implant Systems friendliness towards families is actually implemented, for me the re-entry after the birth of my daughter was smooth. I can flexibly set up the number of working hours and the home office in consultation with my colleagues, there is a lot of cohesion and you can feel that you are needed. An excellent balance between family and work.

Communication – I am in contact with many colleagues from all departments. Where unexpected points of contact or challenges arise, I proactively search for a solution and have to be able to think outside the box. I use my accuracy to define our options within the legal framework - my creativity in order to find all options within this framework and to implement the ideal solution.

Family man – I love to be creative. Doing crafts, painting and designing, especially with my little daughter, I can live it out at the moment. In the crib, I can take part a little in the 'working day' of my daughter. That's a nice balance to my job duties. I have an eye for beautiful things and details, and I like to do these things myself. For example, I designed the cocktails and decoration on my wedding in a play of mint and apricot colours. That's my thing, and that's where I feel the ambition to do something special.
REBUS

If you take a closer look, you'll find something reliable.

Search and find the six hidden errors and send us a photo of the highlighted error at closeup@bego.com.

The first 10 submissions from you will receive a small surprise that keeps on givin!

Join us online - click here for the search image!

- Of course, you can also test your online search quality and participate. Here you will find the search image and the conditions of participation.

Closing date is 30.6.2019
BEGO Implant Systems is represented in over 50 countries worldwide. Despite all the communication options available to us, direct exchange between us, our customers and users is essential.
Precisely fitting implant meso- and superstructures place high demands on implants and implant abutments. Hence, it is necessary that the geometries and materials perfectly coordinate with each other. To me, the long-term experience of major international implant manufacturers means an in-depth knowledge about selection of materials and coordination of the geometry of the respective connections. Even after years of prosthodontic restoration, I still want to be able to rely on this quality and, in the event of any clinical complications or a new production of the intermediate implant structure, on the service and guarantee of the implant manufacturer.

We are talking about a two-part medical product which, with a high degree of precision, developmental know-how and several years of interdisciplinary experience of the manufacturers, is to be used in the patient after detailed technical and clinical documentation. Some of the ISO standards test the precise interaction of implant, screw and abutment as early as in the development phase in model trials, which should then be underpinned in the product life cycle. Furthermore, the dental technician craft is subject to master craftsmanship and this seal of approval should also be reflected in the selection of materials. Long-term implantological treatment can be a success only with the functional interplay of everyday clinical practice, indication-appropriate workmanship and high standards of industrial manufacturing.

Where is the motivation for using originals?
Do generics / copycats expect the same long-term success as the originals?

If the implant-abutment geometry is not matched precisely, it can cause micro-movement of the abutment, screw loosening or in the worst case, a fracture of the abutment or the implant neck. This must be avoided at all costs!

Which risks or complications arise from the use of copycats?

Screw loosening is a sign that the system implant, abutment and crown do not harmonize properly. Consequences can be a failure of the abutment or in unfavourable cases even an implant loss.

A success is when the system remains resilient and efficient for years to come. In the development of an implant system, the overall concept of implant, abutment and screw is always tested. These simulations are not performed in combination with counterfeit products and the current study on copycats in dental implantology does not allow any assessment of success.

Initial studies on this topic suggest that CAD / CAM abutments of third-party and low-cost suppliers are inferior to industrially produced quality abutment in terms of their bending fracture load and accuracy of fit.
Looking at the specific situation of the patient, the primary question is which type of connection between implant and the intermediate implant structures and which type of restoration (fixed vs. removable, or conditionally removable) is suitable for a - from a dental perspective - predictable treatment outcome and to achieve long-term treatment success. Success of the treatment is defined not only from the point of view of the dentist. The satisfaction of the patient, the manageability or ability to take care of the new dental prosthesis and the economic aspects must also be taken into account in the desired treatment result [10]. The success of a treatment obviously depends to a greater extent on how the patient perceives the treatment outcome from his point of view and not how the success of the therapy is defined and perceived by the practitioner [11].

In this context, a minimally invasive approach without extensive augmentation is a treatment option favoured by the majority of patients [4, 12]. It is of interest to know to what extent an implant restoration is actually possible in patients with a resorption of the bony alveolar process without bone augmentation and how many implants are necessary to achieve a satisfactory rehabilitation of the patients.
Implant treatment therefore focuses on the objective functional parameters such as the long-term rehabilitation of chewing and/or speaking ability, as well as patient-specific psychosocial factors such as a better quality of life and improved aesthetics [3]. In order to take the patient’s preferences into consideration and at the same time not jeopardize the success of the treatment, a functional communication between the dentist and the patient is essential [14, 15]. Despite good communication between the patient and the practitioner, it cannot always be ruled out that the patient’s expectations regarding his prosthodontic rehabilitation cannot be fulfilled [16-18]. Therefore, it is appropriate to use implant systems that simultaneously allow multiple treatment options and are thus independent of the final decision on the design of the superstructure and the type of fixation and which allow redesigning of the prosthodontic restoration during the course of treatment [18]. In the case of a reduced budget, patients can initially be given removable dentures which is more cost-effective. If the patient’s economic situation permits, the removable denture can be easily converted into a higher-quality, fixed prosthodontic option. Conversely, this approach also has the advantage that of being able to patients with increasing age and with a potential for increasing loss of hygiene can again be treated with a removable implant-supported prosthesis.

This fact has already been recognized by the manufacturer. Thus, for example, the company BEGO Implant Systems (Bremen, Germany) offers implant systems that can be equipped flexibly with different prosthodontic abutment and connection systems.

Flexibility is especially important in light of the fact that no generally valid recommendations can be made from the statements currently available in the literature as to which treatment option for restoration with implant-supported dentures is the treatment of choice. As a retrospective comparative clinical study has shown, the number of implants or the nature of the connection between the implant and the superstructure do not appear to have any impact on oral quality of life [19]. However, the results of another clinical study showed that this result is not universal with respect to the type of prosthodontic connection. There, interforaminal implants placed in the lower jaw by means of bars led to an oral quality of life that was perceived to be significantly better than in case of implants without bar connectors [20].

In turn, the number of implants and the type of prosthodontic attachments had no influence on patient satisfaction.

The finding that objective parameters, such as the success or survival rates of implants and prosthodontic intermediate implant structures also do not seem to depend on the number of implants, but in most cases, the fixation of implant-supported intermediate implant structures in the lower jaw over a minimum of two [21] or maximum of four to six implants is considered as a suitable and foreseeable treatment option [22-25]. In implant-prosthetic and laboratory terms, having fewer implants has the advantage of facilitating parallel insertion on the patient and parallelization in the laboratory as well as fabrication of the intermediate implant structure.

The principle of using a reduced number of implants was implemented in the All-on-4® concept, which was already developed by Paolo Maló in the late 1990s. This procedure allows a minimally invasive approach to immediate restoration with fixed provisional or final dental prostheses on a reduced number of implants. In this type of restoration in the lower jaw, the interforaminal area can be considered as an insertion site, as that is where the supply of bone is usually the largest and there is no risk of injury to the inferior alveolar nerve when placing the implants. The two proximal implants are inserted straight while the distal implants are inserted at an angle, in order to obtain the largest possible support polygon for the prosthodontic intermediate implant structure. The inclination of the distal implants is then balanced with specially designed abutments.

The apparently low impact of the number of implants and the nature of the connection to the intermediate implant structure on functional and psychosocial parameters has also been shown in two randomized clinical investigations by Krennmair et al. There, an improvement in patient satisfaction was also achieved in the stabilization of mandibular prostheses on only two implants. After functioning for one or five years no implant loss was observed [26, 27]. The same studies also showed that the type of connection between implant and the prosthodontic intermediate implant structure (ball-and-socket joint vs. locator) had no impact on the subjective perception-guided patient preference or on the objective implant-related clinical and radiographic parameters [26].
Objective of the case report

The objective of the present case report was to test different prosthodontic restoration concepts for implant placement without any augmentation measures on a patient. On the basis of this procedure, it was to be determined to what extent attachment systems are actually interchangeable without much effort. Locator®- like abutments (PS Easy-Con, BEGO Implant Systems, Bremen, Germany) and ball-headed anchors (PS BA, BEGO Implant Systems) were used for a removable prosthodontic restoration. As a conditionally removable option, a composite-veneered bridge was fabricated and fixed on abutments of the MultiPlus system (BEGO Implant Systems) on a cobalt-chromium framework produced by means of laser melting.

Initial situation

The 69-year-old male patient presented in our clinic with the desire to be provided with an implant-supported dental prosthesis in the lower jaw. He had no systemic diseases, was a non-smoker and did not take any medications. The oral hygiene of the patient was average. He wanted a dental prosthesis that is minimally invasive, and would be fixed on a reduced number of implants without any augmentative measures. The patient had previously been provided with a removable mucosal partial denture with a plastic base fixed to the only remaining tooth 33 by means of curved retaining elements for a period of eight years. Due to massive periodontal problems, the tooth was no longer worth preserving (Fig. 1 and 2). In the opposite jaw, the patient was provided with fixed crowns / bridges, which were also inadequate and would need to be replaced at a later date. Basically, it is assumed that in the case of a residual bone smaller than 5.0 mm in width bone augmentation measures must be carried out in connection with implant treatment, so as to obtain a sufficiently large bone bed for the implants [28]. In the present case, the alveolar process in the area of the insertion sites of the implants barely met the requirements for implantation without additional augmentation measures. After consultation with the patient we decided to extract the tooth 33 and a subsequent implant-supported prosthodontic
restoration of the lower jaw on four implants in the canine and molar area on both sides without any additional augmentation measures. According to the Misch classification, the quality of mandibular alveolar bone was classified as D3 [29-31]. Bones of grade D3 in addition to the second highest grade D2 are among the most frequently observed bone densities. In the literature it is described that in D1 and D4 bones the risk of early implant losses is higher compared to the other two bone quality classes [32]. Nevertheless, in view of the relatively low bone supply, a two-step procedure with a delayed loading protocol and covered healing was chosen to ensure a sufficient stability of the implants in the alveolar bone over a healing period of several weeks. Implant treatment was carried out about three months after extraction of the tooth 33. Within this period, enough bone was formed in the area of the bony defect in tooth 33, for implantation to be performed in this region (Fig. 3).

**Surgical phase**

The implant placement was performed under local anaesthesia and under direct vision with the formation of a mucoperiosteal flap. The open procedure was chosen as there was an advanced resorption of the bony alveolar process in the oro-vestibular direction, thus allowing a very good assessment of bone contours and bone quality and implant positioning under direct vision [33-35].

BEGO Semados® RSX Implants (BEGO Implant Systems) with the standard diameters 3.75 mm (region 036 and 043) and 4.10 mm (region 046 and 033) were used. The implantation was performed without support according to the manufacturer's standard protocol. All implants were placed epicrestally at the buccal point, except for the implant in region 043 (Figure 4). Since the alveolar ridge was saddle-shaped, the implant neck was approximately 1.0 mm subcrestal for all implants. The implant in region 043 was inserted approximately 2.0 mm subcrestally in the lingual direction.

Due to the good vertical bone supply, implants with a length of 11.5 mm could be used in the canine area and implants with a length of 10 mm in the posterior region. In this case, it was not necessary to bend the implants in the posterior region – as is usual with the classic All-on-4® method (Fig. 5). The mucosa was sutured tight over the implants and the patient was instructed not to wear the prosthesis for a week. The one-week prosthesis course was prescribed to reduce the risk of mucosal perforation in the region of the implants and subsequent infection [36]. One week after implantation, the patient presented again for suture removal. The mucosa in the surgical area had no inflammation and showed no signs of infection (Fig. 6).
Prosthodontic phase

After another 7-week healing period, the implants were exposed and restored with platform switch and gingival formers (PS HP, BEGO Implant Systems) (Fig. 7). Two weeks later, impressions for the implants were taken. After another two weeks, the patient’s final prosthodontic restoration was performed.

Prosthodontic attachments for removable reconstructions

To fix removable, total prosthodontic reconstructions, our case report uses ball attachment anchor (PS BA, BEGO Implant Systems) and Locator®-like Easy-Con abutments (PS Easy-Con, BEGO Implant Systems). Ball attachments consist of a spherical metallic male part (Fig. 8). The female part is incorporated into the prosthesis and could be made of metal or plastic (Figure 9). The advantages of the ball attachment include the good hygienic ability, the low costs and the reduced treatment time [7].

A relatively high frequency of repairs owing to retention losses is also compensated by the fact that repairs in this system can be carried out very quickly and easily. However, due to their height, ball attachment anchors require a sufficient inter-maxillary distance, which can complicate the design of the prosthodontic restoration because the anchor requires a correspondingly large vertical space and the attachment extends far into the oral cavity. Another disadvantage is that ball attachment anchors can be used only on implants that are inserted axially or in parallel. The retention is significantly reduced on implants that are not inserted in parallel beyond an angulation > 15 degrees [7].

In our case, the implants were positioned approximately parallel so that there were no major deviations of the implant axes (Fig. 10). There was ample inter-maxillary space and we were able to provide the patient with a mandibular overdenture prosthesis fixed to ball attachments. The clinical outcome was equally satisfactory for clinicians and patients in terms of aesthetics and function (Fig. 11 and 12).
The Easy-Con system (PS Easy-Con) is also susceptible to repair, as the replacement of the polyamide inserts must take place following retention losses [26]. Since the restoration height is significantly lower with the ball attachment anchors, the Easy-Con abutments can be used very well as attachments with a small inter-maxillary distance. Easy-Con abutments consist of a metallic female part integrated in the abutment. This consists of a raised, annular edge. The polyamide (nylon) male part is placed on the annular abutment and maintains its retention over the outer surfaces and the inner surfaces of the metallic ring (Fig. 13). The base of the prosthesis is also made of polyamide inserts (Fig. 14). Due to the material-related elasticity of the Easy-Con components, the system has a good elasticity / resilience (self-aligning) and is able to adapt well to the movements of the intermediate implant structure during functional loading [7]. In contrast to the ball attachment system, differently designed male parts can allow axial non-parallelisms between implants to be compensated up to a deviation angle of 40 degrees without loss of retention [37]. The patient was also supplied with a functional and visually appealing overdenture prosthesis using the Easy-Con system (Fig. 15).

No significant differences in clinical or radiographic parameters could be identified between a Locator®-like abutments and ball attachment anchors in a clinical study conducted after a five-year period under functional loading [27]. In the case of ball attachment anchors, more frequent prosthodontic aftercare was initially required compared to Locator®-like abutments, but this decreased with increasing observation time and in terms of frequency this no longer differed from self-aligning systems.

In a more recent in vitro study, statistically significant differences were noticed in the retention behaviour and stability of a cobalt-chromium denture framework fixed on two implants depending on the respective prosthodontic attachment system, the force applied and the distribution of implants / implant positioning. The highest retention and stability values were measured with ball attachment anchors, followed by self-aligning systems [38]. The more distal the implants were placed, the higher were the retention and stability values found in the anterior-posterior direction. When Locator®-like abutments are joined on four implants in the lower jaw using bars, lower crestal bone loss rates and less follow-up were found compared to simple Locator® system joints on two implants [39]. The different effects on crestal bone resorption in this study were attributed to the stabilization effect through the bars rather than the type of prosthodontic connection. In contrast, an older in vitro examination showed that ball attachment anchors on implants lead to a better distribution of force in the posterior region of the lower jaw than the bar connectors [40]. In a comparative clinical study on the restoration of edentulous patients in the mandible using two implants and locators as against magnetic attachments significantly higher peri-implant bone loss was seen in locator attachments [41].

Fig. 15 Final prosthesis on PS Easy-Con abutments in situ
Fig. 16 PS MultiPlus-abutments in situ
Fig. 17 Close-up of PS MultiPlus abutment
Fig. 18 Good fit of the SLM-fabricated cobalt-chromium framework
On the basis of the available evidence, it is not yet possible to make definitive statements with regard to the influence of various prosthodontic connections in implant-supported, removable dentures on the remodelling behaviour of the crestal bone.

**Fixed implant-supported reconstructions**

The third treatment option selected was a conditionally removable reconstruction fixed to the native PS MultiPaxx abutment (Fig. 16 and 17). A cobalt-chromium framework (EOS, Electro Optical Systems Munich, Germany) produced by means of selective laser melting, formed the base of the conditionally removable bridge. In our patient’s case, a very good, accurate fit of the metal framework could be achieved (Fig. 18). The framework was veneered using composite (anaxblend big block dentin and big block enamel, anaxdent GmbH, Stuttgart, Germany) (Fig. 19a and b). The screw channels were sealed with composites (EcuSphere-Carat, DMG Chemisch-Pharmazeutische Fabrik GmbH, Hamburg, Germany) after the insertion of the intermediate implant structure (Fig. 20). The final clinical outcome was very satisfactory for the patient as the reconstruction was very natural and aesthetic (Fig. 21). It is important that the patient is intensively instructed about oral hygiene and cleaning of the dentures so as not to jeopardize the long-term success of the reconstruction. This is of great importance because patients are often unaware that implants require more care than natural teeth [42].

If it turns out that adequate oral care is not possible, other attachments can be used after discussing with the patient and the dentures can again be made removable.

Removable, fully prosthodontic overdenture restorations on implants are of course less well accepted by patients than fixed implant-supported restorations [11, 43, 44]. The increased acceptance of fixed implant-supported intermediate implant structures can be attributed to the changed design of the prosthodontic replacement, as this is designed in the form of a bridge with veneers of ceramic or composite and without the plastic barrier required in the cover denture solution. The improved aesthetics and wearing comfort of bridges compared to cover denture prostheses obviously also lead to increased patient satisfaction [11, 43, 44]. However, oral hygiene procedures in fixed reconstructions are more difficult for the patient to perform than is the case with removable prostheses. However, removable reconstructions appear to be more susceptible to repair than fixed prostheses [45]. With respect to implant survival rates, in both fixed and removable intermediate implant structures, in contrast to the results of the examinations listed in the previous sections, the dependence on the number of implants appears to be a significant. A recent systematic review, including a meta-analysis, found that fixation of fixed reconstructions on four implants and removable dentures on two implants in the lower jaw lead to higher implant loss rates than if more implants were used to stabilize the intermediate implant structures [46].
Mounting options for the intermediate implant structure

Fixed dentures can either be cemented to the implants or screwed to the implants as conditionally removable dentures. While the cemented dentures can no longer be removed, the conditionally removable prosthodontic intermediate implant structures can be removed by the dentist. Both principles of fixation are controversially debated and are part of many clinical studies and systematic reviews, the results of which are not consistent. In a systematic review, no differences could be identified in the crestal bone remodelling rates, depending on the type of fixation [47]. Even in terms of implant survival rates and prosthodontic loss rates, no differences were found in a recent review [48]. The results of an earlier review demonstrate the superiority of cemented intermediate implant structures in biological and clinical terms [49]. In contrast, in a recent systematic review, biological and/or technical complications were more commonly observed in cemented total restorations than in screwed total reconstructions [50]. However, screwed ceramic intermediate implant structures had higher chipping rates of the veneers. In other systematic reviews, no differences were determined in the survival rates of the implants and the intermediate implant structures depending on the type of fixation [48, 51]. It is important to note that because the study designs are at times very different and in particular the definitions of success parameters vary, it is currently not possible to make a direct comparison of the two fixation types and evidence-based statements [52].

Conclusion

Ball attachment anchors (PS BA), Locator®-like abutments (PS Easy-Con) and MultiPlus attachments enable a good and predictable prosthodontic restoration on four implants. The fact that a minimally invasive approach to implant placement was chosen in this patient’s case increased the patient’s acceptance of the proposed implant treatment. The ability to target different prosthodontic solutions with a reduced number of implants, depending on patient-specific factors, facilitates fulfilling patient desires and allows the prosthodontic solution to be redesigned even during the course of treatment.
INTERVIEW

Guarantees more …

For dentists like Dr med. Mathias Siegmund the sustainable patient loyalty tops the wish list for long-term practical success. Along the way, implantation not only requires high-quality care, but also the confidence and sense of security of the patient, such as a warranty extension that includes dentist’s fees, labour and material costs. In an interview, the specialist dentist from Regensburg reports on the all-inclusive no-risk guarantee of BEGO SECURITY Implants.

Dr Siegmund, in addition to personal and indication-based information, what details do you think are important for your patients?

“…In addition to providing in-depth advice and treatment options, I always offer my patients tips on how to care for and maintain the implants. I point out the need for recall appointments and professional teeth cleaning. Another important aspect is the possibility of an extended guarantee agreement, which is linked to regular check-ups and cleaning."

What is your motivation to offer your patients an extended warranty for implantological restorations and what does "extended" mean?

“In addition to the statutory warranty for my work, the dental laboratory and the materials used, there is the option to cover all financial risks for the patient by means of a comprehensive warranty extension and also extending the warranty to five years. Of course, although we assume a much longer durability of the implantological work, this gives the patient additional security."

How do you argue in favour of that with your patients?

“We are so confident in our work and the product used that the extended five-year warranty is just one additional argument that would make the patient decide in favour of implantological work. Our practice provides the patient with the costs of BEGO SECURITY Implants warranty extension as a service."

What advantages do you see from the scope of BEGO SECURITY Implants?

“This BEGO Implants restoration warranty covers all prosthodontic components and CAD / CAM-manufactured custom abutments and their integrated dentures. The warranty is valid for five years from the date of implantation and includes my fee and all laboratory and material costs in the event of a claim. The cost for this service will be borne by us."

The benefits for the patient are clear, but how does it benefit you as a dentist?

“As a dentist I have the certainty that in case of damage my relationship with the laboratory and the suppliers remains financially unencumbered. The entire supply chain remains free of unnecessary burdens, has little effort on documentation and continues to work in a trusting relationship with the manufacturer. So everyone can concentrate on the important aspect, namely the well-being of the patient."

Dr med. dent. Mathias Siegmund, M.Sc., M.Sc.
How well-informed are the patients in terms of implant, durability and guarantees?

Rather less. However, there is a trend to become more secured, similar to cell phone and eyeglass insurance. An implant treatment is costly for many patients and the option of an extended warranty is truly a reassuring factor and a plus point.

What effort do you take in your practice?

Very little. None of the participants has to sign a contract, the patient receives a warranty sticker from our practice for his warranty certificate, and that is the end of the matter. To receive the guarantee, patients have to come to us twice a year for a recall and the associated professional tooth cleaning. Besides, this is a good instrument to develop a bond with the patient.

Have you experienced cases that have been settled positively with BEGO SECURITY?

Luckily, I haven't. For me this is always an indication of the quality of the products from BEGO Implant Systems. However, I also know from colleagues that the claims settlement process is quick and uncomplicated.

How do you see the future development of such additional services for implant restorations?

To me, these are valuable elements in the concept of patient care, which offer patients as well as all other participants a better security of care. The industry could also offer this in other areas.

Dr Siegmund, thank you very much for the interview.