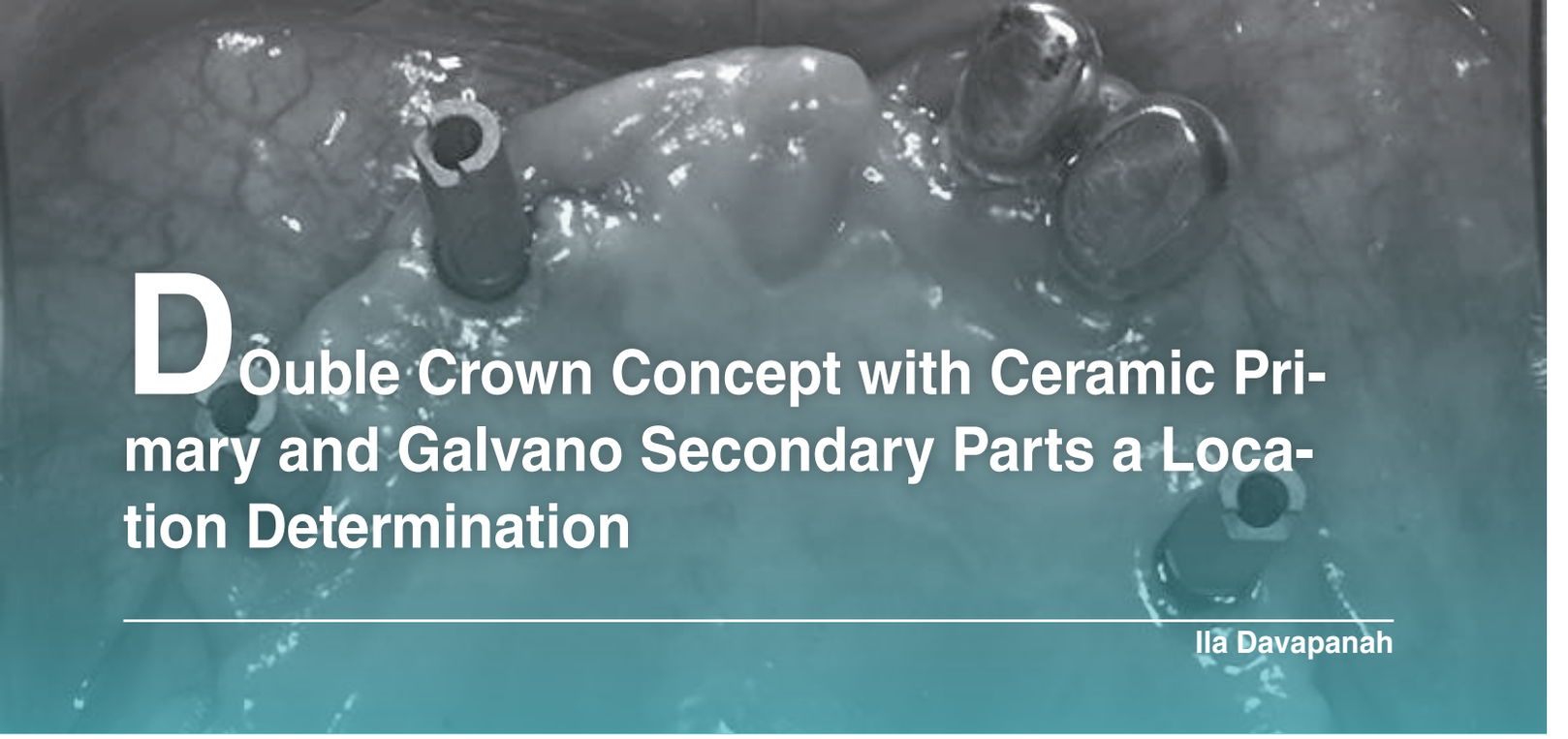


Double Crown Concept with Ceramic Primary and Galvano Secondary Parts a Location Determination

Ila Davapanah

SUMMARY

The double crown concept, in which natural abutment teeth are connected to implants, is presented using a patient case treated in a fully digital workflow. This concept has a number of advantages. Because of the optimal force transmission, only a small number of implants and/or abutment teeth are required. In addition, the system is comfortable for patients and allows for easy oral hygiene. Likewise, the system can be easily adjusted and repaired.

The protocol was already introduced in the mid-1990s. A stress-free, precise fit is achieved via an electroformed mesostructure and its intraoral bonding to the tertiary framework. The overall structure of the retaining element consists of a conical patrix made of zirconium oxide (primary part) and an electroformed coping produced by direct electroplating (secondary part). The tertiary framework is manufactured from a non-precious metal (NEM) using the selective laser melting process.

The treatment of the patient is described in detail for each step. As a special feature, a pure digital impression is taken with an intraoral scanner (IOS), which is much more accurate than conventional impressions. Another advantage of digital impression taking is the time saved. In addition, digital impressions are comfortable for the patient, as no impression material is used and therefore there is no pressure or gag reflex. Since the 3D models of the teeth and jaw are processed and analyzed on the computer, this allows for better planning and execution of the treatments.

INTRODUCTION

In the future, the prosthetic restoration of older patients with a low number of teeth or who are edentulous will take up an increasingly large part of the work in a dental laboratory. However, it should be borne in mind that older age does not automatically lead to edentulism. Many older patients who still feel young want dentures that meet high standards both functionally and aesthetically. The treatment team must take individual gerostomatological conditions into account when choosing a restoration. These include the degree of atrophy and the number of abutments, but also the increasing multimorbidity of the patients. In particular, the limited motor skills of elderly patients must be taken into account with regard to the care of the prosthetic restoration.[1]

In addition, a modern retaining element should take into account existing residual teeth and, if possible, connect them with implants. Until now, this has been considered a neuralgic point in removable restorations. This article deals with the double crown concept, which has been successful for decades. Its advantages are a reduced number of abutments and problem-free expandability after abutment loss. Removable constructions also simplify hygienic measures. Finally, double crowns are also a well-functioning option in implant prosthetics.[1]

Keywords

removable prosthesis, double crown concept, geroprosthetics, casuistry, digital workflow, CAD/CAM, abutment augmentation, ceramic primary crown, galvano secondary crown

Implants and natural abutments

In principle, double crowns are considered the only retention element in prosthetic dentistry in which natural abutment teeth can be connected to implants. In double crowns, abutment teeth with primary and secondary crowns are in a circumferential relationship, allowing occlusal forces to be transmitted along the longitudinal axis of the abutment tooth.[2] In this way, functional loads on the denture base can be optimally distributed to the abutment teeth.[3] This has the advantage that the number of implants to be placed can be reduced.

Double crowns have been found to have a higher survival rate compared to other attachments.[4] They are also very suitable for use in severely reduced dentition.[5,6] This is because the enclosure of the abutment teeth ensures axial transmission of masticatory forces and provides stabilization against horizontal and vertical forces.[7] The retaining element itself is concealed when the denture is placed, i.e., no metal clasps are visible, which can be aesthetically advantageous. In addition, oral hygiene is relatively easy to perform.[8] When the entire residual dentition is included, the framework can be designed without large connectors.[9] These advantages provide patients with greater comfort and correlate with improved oral health-related quality of life.[10] In addition, if an abutment is lost, the existing removable partial denture (RPD) can be easily adapted to the new situation by relining.[11,12] Repairs and adjustments can easily be made if one of the abutment teeth needs to be extracted.[13]

There is also an important psychological argument for the combination "tooth + implant". For example, many patients want existing teeth to be integrated into the new restoration because they want to retain their natural last teeth for as long as possible. In addition, the natural (abutment) tooth is a tactile organ, as long as it can be integrated into a prosthetic therapy, the original tactile sensation is preserved.[1]

For a double crown prosthesis, the minimum number of implants or abutment teeth specified is six for the upper jaw and four for the lower jaw. During planning, this type of restoration must be treated mentally like a removable bridge, not a prosthesis. This is an essential aspect for the static conception. The reason for this is that no masticatory force is applied to the basal mucosa portions, but the restoration is supported only on the retaining elements. The soft tissue is merely covered and not loaded, which must be taken into account in the planning and statics.[1]

Holding force via fine gold matrices (Weigl protocol)

The protocol was introduced in the mid-1990s.[14] A stress-free, precise fit is achieved via a galvano-mesostructure and its intraoral bonding to the tertiary framework.[15,16] After the ceramic retaining element was developed in the early years from materials such as pressed ceramics, Empress 2 or Procera, zirconium oxide has now established itself as the living standard. According to clinical experience, all other materials are too prone to fracture; only zirconium oxide provides a permanently good surface.

The overall structure of the holding element consists of a conical patrix made of zirconium oxide (primary part) and an electroformed coping produced by direct electrodeposition (secondary part). The tertiary framework is manufactured from a non-precious metal (NEM) using the selective laser melting process. The advantage of this is the high accuracy of fit. Added to this is the good price-performance ratio. Materials such as titanium, acetal or polyetheretherketone (PEEK) are not suitable for the fabrication of the tertiary framework. These materials bring with them a high degree of inherent mobility.

CASUISTRY

The 62-year-old patient presented with a denture in the maxilla and requested an implant-retained prosthetic restoration. Three of the remaining teeth in the maxilla were still worth preserving. After differential diagnostic evaluation of the initial situation, a removable, telescopic restoration in the maxilla was desired. In this case, teeth #17 and #27 were fitted with polymethyl methacrylate (PMMA) crowns. However, they do not play a supporting role in the overall planning of the combination prosthesis, since after strategic abutment augmentation (Fig 3) for polygonal support, the four required abutments are sufficient for a prosthesis span up to the 7s. The procedure for the maxillary restoration is described below. Start with the preparatory measures such as the digital mock-up to ensure accurate determination of the horizontal and vertical jaw relation (Fig 1 and Fig 2).



Fig 1. Initial situation. The telescopic prosthesis is defined in the further course as a mock-up for the final restoration





Fig 2. Initial clinical situation without denture (right). Digital impression of the initial situation in the maxilla without prosthesis as a basic model for fabricating the surgical guide for full-guided implant placement (left).

Planning and implant placement

Virtual planning of the implant positions is performed in the sense of backward planning.

For this purpose, a DVT of the skull is generated as a Dicom data set and a situation model via the intraoral scanner (IOS) as an STL data set. For three-dimensional planning, the DVT and STL data (situation model) are imported into the software (R2GATE=MEGAGEN planning software) (Fig 3 and Fig 4). Careful coordination of data acquisition, planning and fabrication is important for this.

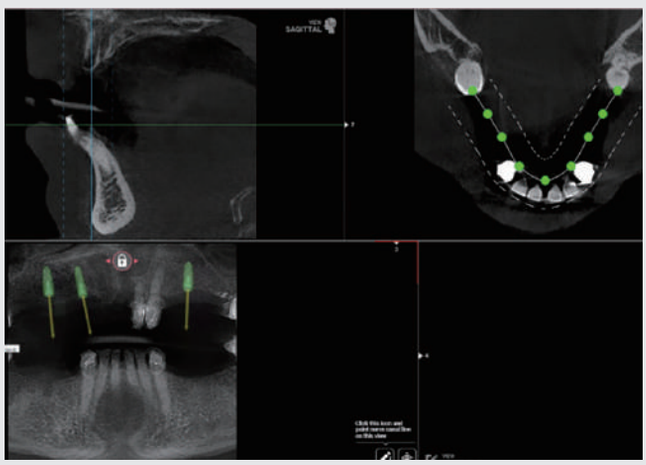
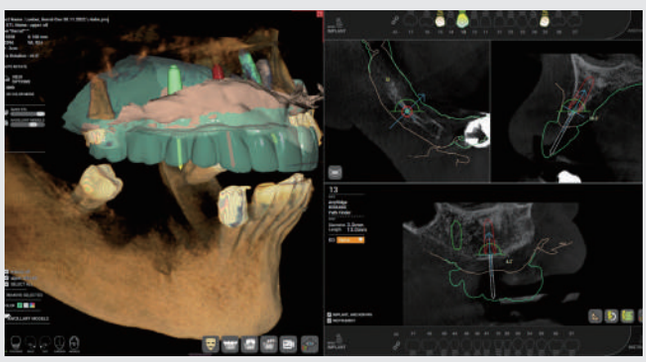


Fig 3. Fixed implant positions for further planning at positions #15, #13, # 25





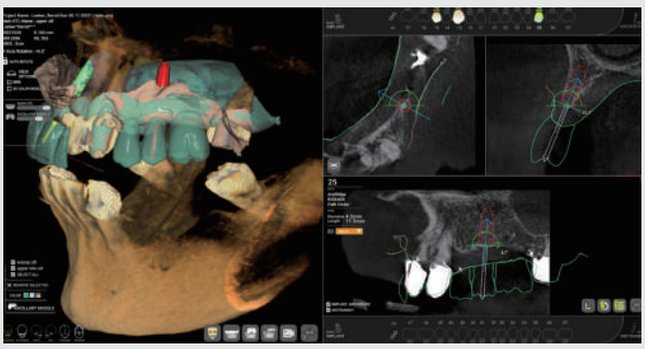


Fig 4. Illustration of full guided implant planning with MegaGen® AnyRidge implants in the R2GATE planning software.



Fig 5. Postoperative radiograph (strategic abutment propagation).

After superimposing the data, the ideal prosthetic and anatomical specifications are determined. In the maxilla, three implants are planned at positions #15, #13, #25. These implants are placed using a navigation template (Fig 5). To ensure an optimal esthetic design of the prosthesis, no implants should be placed in the anterior region.

After healing and exposure of the implants (Fig 6), implementation of the prosthetic restoration begins.



Fig 6. Clinical situation of the upper jaw after exposure four months after surgery.

Precision and time savings through a fully digital workflow

For around 30 years, digital impression taking has offered numerous advantages over traditional impression taking in dentistry. It is more precise, faster and enables better planning and execution of treatments.

In addition, digital impression taking offers more comfort for the patient. Since no impression material is used, the unpleasant feeling of pressure and retching that many patients experience with traditional impression taking is eliminated.

Another advantage of digital impression taking is the ability to edit and analyze the 3D models of the teeth and jaw on the computer. This allows for better planning and execution of treatments, as the dentist can examine the models closely and identify potential problems in advance.

The use of intraoral scanners creates precise 3D models of the teeth and jaws in the initial situation. These have a higher level of accuracy and detail than conventional impressions. Since this step is performed in a few minutes, the number of sessions is significantly reduced. The creation of the individual trays as well as plastic templates for determining the correct jaw relation is no longer necessary.

To fabricate the primary telescopes and travel prostheses, the implant/tooth impression (Figs 7, 8, 9) is superimposed on the digital impression of the upper denture in situ, in ideal jaw relation, and used as a template for esthetics and occlusion. It should be noted that for this purpose the vertical dimension should be physiologically set or there is an option to restore the vertical dimension from the previous situation.

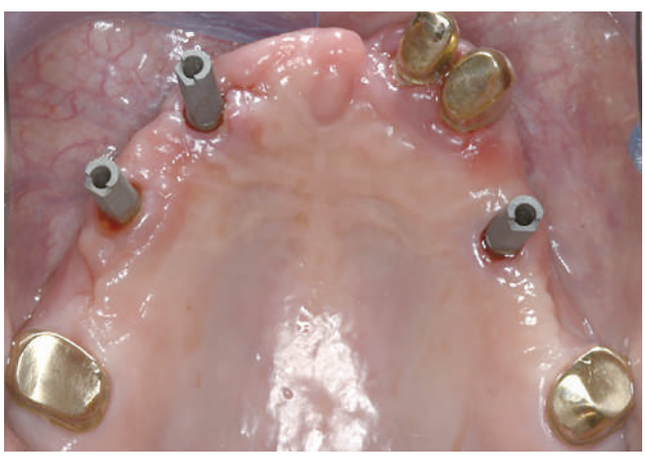


Fig 7. Positioning the scanbodies for digital impression taking



Fig 8. Digital impression with the Medit i700 IO scanner and the display in the Medit Link software.

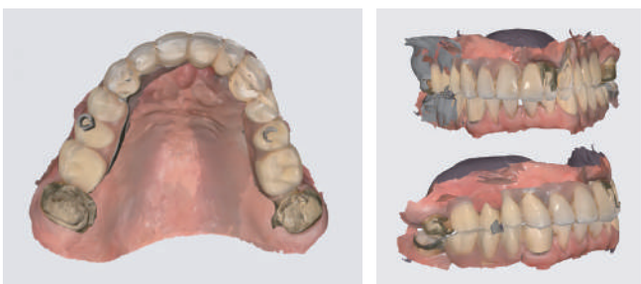


Fig 9. Digital impression of the initial situation as a mock-up and simultaneous determination of the vertical dimension

After fabrication of the primary telescopes in the digital workflow (Fig 10) and bonding of the implant-supported zircon shells to the abutments (Fig 11), the travel prosthesis can be digitally designed and milled (Fig 12).

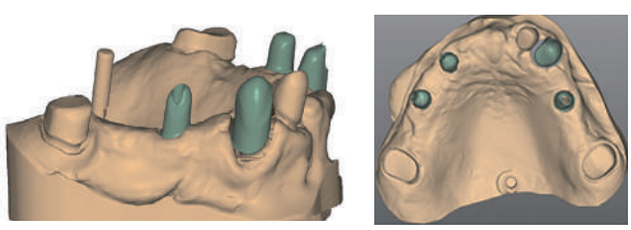


Fig 10. Design of the primary telescopes and the travel prosthesis in the Exocad software.

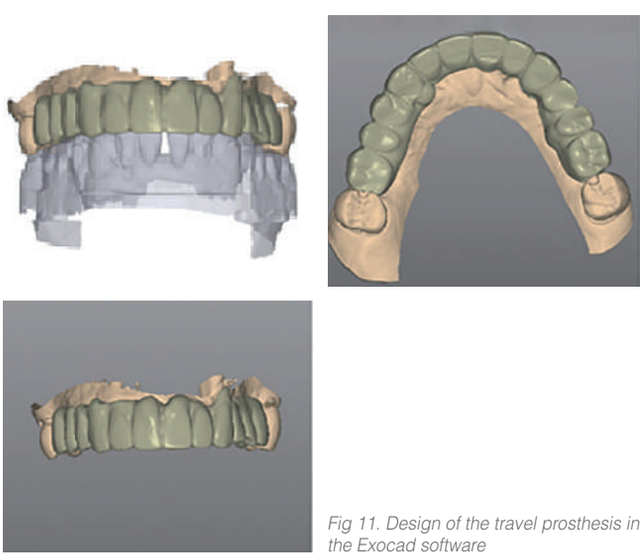


Fig 11. Design of the travel prosthesis in the Exocad software



Fig 12. Milled travel prosthesis based on the vertical dimension and shape of the initial situation ready for insertion

Laboratory preparations for the second clinical treatment session

Based on the digitally produced mock-up, the primary copings are fabricated in the laboratory from zirconium dioxide, gold electroformed copings (abutments) (Fig 13) and an NEM (tertiary framework) (Fig 14).



Fig 13. Fabricated secondary crowns with the electroplating bath technique

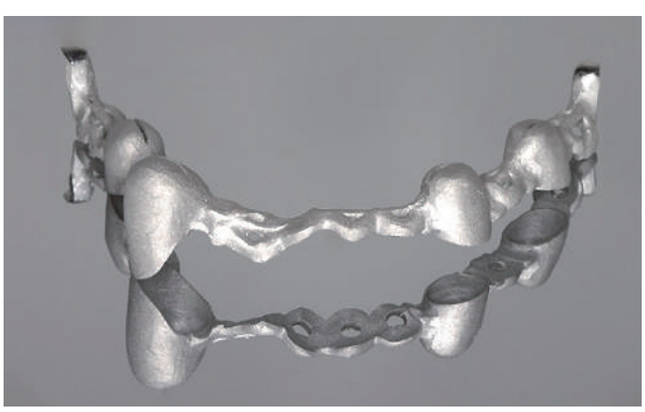


Fig 14. Manufactured tertiary framework (NEM) with the laser melt technique

The primary coping is bonded to the metal base on the model or on tooth 23 intraorally. The advantage of this type of bonding is that cementation does not take place in the mouth, which eliminates the risk of inaccurate bonding. In addition, excess cement is prevented, which reduces the risk of peri-implantitis. Barely visible excess cement can accumulate in the cervical area of the primary part, which in the concept described may force the galvanocrowns to bend up.

The intraoral joining of the components

First, the primary copings are placed in the mouth and screwed or cemented to the implant (Fig 15). It is important to note that the screw channels must be tightly closed. In the double crown technique, the volume of the open screw access can lead to a pumping effect. Thus, when the matching electroformed part is pressed onto the cavity, the air presses against the electroformed gold. Then the electroformed copings (Fig 16) are bonded to the tertiary framework in the mouth without tension (Fig 17).



Fig 15. Clinical situation after extraction of tooth #22, which was not worth preserving, and after insertion of the primary telescopes made of zirconium oxide.



Fig 16. Secondary galvanocaps after positioning on the zirconium oxide primary telescopes



Fig 17. Bonding of the secondary plating caps to the tertiary framework in the mouth to avoid stresses after conditioning of both elements.

Insertion of the travel prosthesis

After bonding the secondary electroformed copings to the tertiary framework, the primary zirconium copings remain in the mouth. In order to provide the patient with an interim restoration based on these abutments, a so-called travel prosthesis with the esthetics and function of the final restoration is fabricated, which also serves as a reference for this (Figs 18,19).



Fig 18. Digital impression of the initial situation as a mock-up and simultaneous determination of the vertical dimension



Fig 19. Checking the static and dynamic occlusion of the travel prosthesis after insertion

Insertion of the definitive prosthesis

The third clinical treatment appointment is always successful, as the insertion always goes smoothly. Apart from minimal bite corrections, there is no need for any changes (Fig 20 to Fig 24).



Fig 20. Clinical situation before insertion of the final restoration



Fig 21. Final restoration ready for insertion



Fig 22. The final prosthesis can be inserted without tension and with the desired retention force without any problems, thanks to a consistent procedure





Fig 23. Checking the static and dynamic occlusion of the final restoration after insertion



Fig 24. Occlusion

CONCLUSION

The double crown concept with ceramic primary and galvano secondary components offers numerous advantages over conventional restoration methods. The combination of ceramic and galvano alloy enables high stability and durability while achieving natural esthetics. In addition, the technique is minimally invasive and requires little tooth structure loss. One RCT showed a favorable survival rate of a primary crown made of zirconia compared to primary crowns made of Co-Cr.[17] However, another RCT showed that crowns made of glass-ceramic or glass-fiber-reinforced composite material have insufficient strength, resulting in a high fracture rate.[18] Therefore, when selecting ceramic materials for the fabrication of double-crown-supported RPDs, a high-strength zirconia ceramic should be used for the long-term success of a prosthesis.[19]

Overall, the double crown concept with ceramic primary and galvano abutments is a promising method for restoring teeth. It offers an optimal combination of esthetics, functionality and longevity and is an attractive option for patients who want a high-quality restoration. Until now, the fabrication of double crowns required expert knowledge and involved many complex steps in the dental laboratory. This workflow with CAD/CAM has made it possible to simplify the steps and reduce material costs.[20]

One of the biggest advantages is the higher precision and accuracy of the digital impression. Another advantage of digital impression taking is the time saved. Compared to traditional impression taking, which requires impression material to be applied to the teeth and cured, digital impression taking can be completed in a matter of minutes. This not only saves time for the dentist, but also for the patient, who has to spend less time in the dental chair.

In addition, digital impression taking with IOS also offers more comfort for the patient. Since no impression material is used, the unpleasant feeling of pressure and gagging is eliminated. The method is therefore particularly advantageous for patients with a strong gag reflex.[19] Patients with microstomies can also be treated in this way .[21]

Another advantage of digital impression taking is the ability to edit and analyze the 3D models of the teeth and jaw on the computer. This allows for better planning and execution of treatments, as the dentist can examine the models closely and identify potential problems in advance.

The use of digital impression taking in the double crown concept significantly shortens the duration of therapy, while being more precise, convenient and enabling better planning and execution of treatments.

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