Biodenta CAD/CAM Case Report - Urs Brodbeck, DMD, Zurich, Switzerland

Monolithic Zirconia 12unit full-arch reconstruction

Clinician: Urs Brodbeck, DMD, Zurich / Switzerland
Technicians: ARTECO Zurich, Esther Grob MDT & Mario Sisera MDT

Fig 1

Fig 2

A happy patient before and after the insertion of a monolithic 12unit full-arch reconstruction on natural teeth in the maxilla (Fig 1, 2).

Introduction

This 84 year old patient in excellent physical health presented to the office with a history of trauma to the upper front teeth (Fig 1, 3, 4). This trauma has led to the loss of a 3unit bridge from tooth 8 to 10 due to root fractures. The patients panoramic x-ray revealed the involved teeth number 8, 10 and another tooth 12 just represent as root fragments, that are not worth being maintained and are going to be extracted.

The clinical findings show generally a lot of plaque and as well sub-gingival calculous, that is even visible in the panoramic x-ray (Fig 5). Most teeth showed pocket depths up to 6 mm, which should be eliminated before final prosthodontic treatment. In the upper jaw, just four teeth were graded as having a good prognosis. Teeth number 4, 6, 11 & 13 showed enough periodontal attachment and were positive on the vitality test with coldness. In the mandible, all present teeth should be able to be maintained, this after periodontal treatment and future support and maintenance by a dental hygienist.

Fig 3

Fig 4

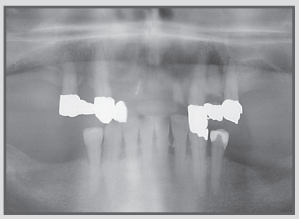

Fig 5

Only proper planning and team approach (dental technician, dentist, dental hygienist) can ensure highly aesthetic results with long-term clinical success.

The patient revealed the wish for a fixed rehabilitation. Therefore, a first treatment plan was made. The upper buccal segments should be restored with two 3unit bridges on the remaining natural teeth. In the front at tooth position 7 and 9, it was planned to insert two implants that should be restored with an implant born 4unit bridge. In the mandible, the dentition was just present up to the first premolar, no further teeth were planned initially. If the patient should experience that his chewing capacity was not satisfying with just one premolar on each side, one could add one premolar more on each side by the use of implants. Studies have shown that with ongoing ageing, the teeth needed for acceptable chewing capacities will reduce (Kayser 1982).

It was planned to incorporate a 10unit temporary resin bridge on teeth 4, 6, 11 & 13. This temporary will allow to treat the periodontium in an optimal way because the existing prosthetic restorations show overhangs and do not allow proper tooth surface cleaning and plaque control. This fixed temporary will also serve during the insertion of the implants and their healing / osseointegrating phase. To fabricate this temporary, first impressions were taken and sent to the lab.

Technical Procedure Part 1

First diagnostics can be made from a personal pre-consultation session with the patient at the laboratory or from several photos of the smile, relaxed lips, and portraits. In this case, we found that the bite had to be lifted, anteriors shortened, change of tooth color was wished, vestible corridors had to be filled up for a full smile.

Pre-treatment: Stone casts of the situation are used for the pre-diagnostic wax up. From the diagnostic wax up we fabricate a PMMA “eggshell”-temporary, which the dentist will reline intraorally after first preparation of the involved teeth (Fig 4). The patient can wear the provisional bridge during pre-treatment time as a prototype, and check the aesthetics and function, which can be improved immediately, or at the final reconstruction if only minor changes are planned (Fig 6).

Insertion of the Temporary

After a first visit at the dental hygienist, the periodontal situation has already improved. In a complex clinical appointment under local anesthesy, the old metal ceramic restorations were first removed. The four vital teeth had to be built up directly with a dentin bonding agent and a composite (Syntac / Tetric Evoceram). As a next step, the root fragments from the teeth 4, 8 & 12 were extracted. The “egg-shell”-temporary provided by the dental technicican was relined in the mouth using a PMMA (TAB 2000, Kerr) after having insulated the teeth and the soft tissues with Vaseline. The religned temporary was finished and polished extraorally. Temrex® (Temrex Corp.) was used as a temporary cement (Fig 7, 8).

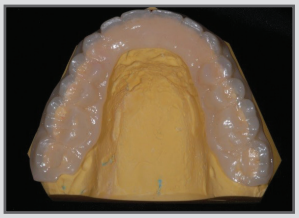

Fig 6

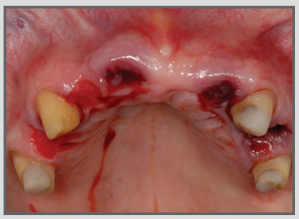

Fig 7

Fig 8

In the following, the dental hygienist could remove all residual calculous, which would not have been possible with the old metal ceramic restorations due to massive overhangs. The patient could as well test the temporary concerning function (chewing, speech) and aesthetics.

The reevaluation 6 months after the insertion of the temporary bridge showed that the patient exhibited a healthy periodontal situation with maximal probing depth of 3 mm and performed obviously an improved oral hygiene (Fig 9, 10). Plaque was just found distally of the upper premolars. He was perfectly able to speech and to chew. He was quite pleased as well with the aesthetic result, but made the remark that on some pictures taken from his smiling face, one could see that he has missing teeth in the maxilla. And he mentioned as well that the teeth might be a little bit too long. The temporary showed good stability on the four pillars, tooth mobility was not accelerated. The additional use of implants was discussed again and the initial treatment plan overruled. It was decided that the temporary bridge should be copied in a final bridge. Clinical studies have shown that such longspan bridges on few natural teeth with reduced periodontium had a good long-term prognoses, as long as the patient is performing a good oral hygiene (Nyman 1975). Furthermore, it was decided to extend the bridge distally with a premolar on each side. These additional teeth are not going to be in occlusal contact, but will help to improve two findings. On the one hand, the aesthetic could be improved because heavy smiling exhibited black spaces distally of the second premolar indicating missing teeth. On the other hand, this additional tooth represented a better guidance for the use of an interdental brush to clean the distal aspect of the upper premolars.

Fig 9

Fig 10

Fig 11

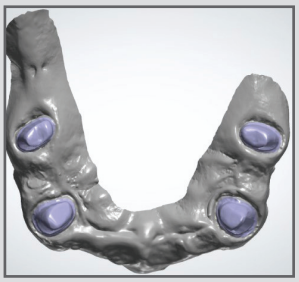

Fig 12

Final Impression

At first, the temporary was removed. Retraction cords were applied to better expose the preparation. During the periodontal treatment the gingiva has retracted. Therefore, the preparations had to be adjusted to the new gingival level (Fig 11). The final preparation showed a round shoulder with a depth of 0.5 mm at the gingival level. It was planned to localize the final restoration margin approximately 0.5 mm intrasulcular after the completion of the procedure. The final impression was taken with an intraoral scanner (TRIOS®, 3Shape, Copenhagen / Danmark, Fig 12) and as well with a conventional polyether impression material (Permadyne, ESPE). We wanted to compare digital and conventional full-arch impressions and find out if digital is already as precise as conventional (Fig 12). The temporary was religned to the new preparation and recemented with Temp Bond® (Kerr, Orange CA / USA). After cementing, an additional digital impression was taken from the temporary situation to transfer the tested occlusion and teeth forms to the lab. The lower-arch and the bite registration was taken as well with the intraoral scanner. All data were sent to the lab via e-mail. The patient was precisely informed about the following procedures in the lab and a first appointment was fixed to see the lab.

Technical Procedure Part 2

We prefer to do a wax up or set up and double scan it after try in, it is also possible to scan the temporary with an intraoral scanner and have it as a base to design the final bridge. In this case, we can see that the provisional reconstruction was still too long, so we copy our provisional for try in wax up but adjust the length.

The tooth-colored wax up is tried in at the laboratory and adjusted, if necessary in cooperation with the patient. The result should be a good mixture of the patient's requests (wishes), our technical know-how and suitable aesthetics (Fig 13, 14).

Fig 13

Fig 14

At this stage, we should be able to advise the patient, understand his demands and transfer it into our wax. The same appointment is used to evaluate the shade, glaze degree and surface texture for our final reconstruction (Fig 15, 16).

Technical Procedure Part 3: CAD

Since we have our outlines now from the wax up, the transfer of the data to our laboratory scanner and into the dental design software (morphing) is made easier (Fig 17, 18). Going too deep into the CAD-Design steps would need a special report itself; so we pass this step with just these advices:

Connectors should be designed as big as possible in order to have higher strength, because the proper design of the interproximal areas and the correct occlusion is the prerequisite for the long-term success of our reconstruction (Fig 19).

Due to the dimensions of the burs at the milling center, we prefer to finish the interproximal areas and the fissures out of the pre-sintered blank before final sintering and coloring in oder to get a perfect copy of our wax up or the temporary reconstruction out of the translucent zirconiumdioxide (Fig 20). In an experienced team of dental laboratory and milling center, adjustments in the green stage are in the most cases not necessary. This step has to be done very accurate with no pressure or heavy grinding because we could also create initial cracks into the pre-sintered material, and on the sintered material as well.

Fig 15

Fig 16

Fig 17

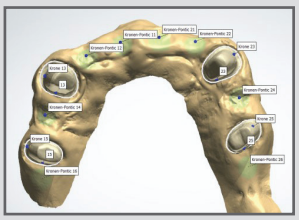

Fig 18

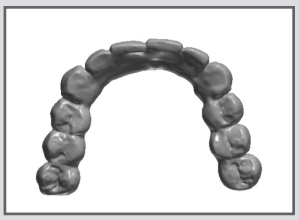

Fig 19

Fig 20

During the sintering process the bridge is left connected to the blank in order to prevent distortions (Fig 21). The pre-sintered and milled Zirconia oxide is about 20% bigger in volume than the wax up and final prosthesis.


Fig 21

We always use pre-colored translucent Zirconia, which we want to have in a little less chroma, darker interdentally and greyish on the incisal areas. The grey color helps us to give the illusion of a low value. All these informations we have to transfer to the milling center, where these colour modifications will be made by hand before the final sintering at high temperature.


Fig 22

Since the following firing temperatures are at least 600°C lower than the sintering temperature, we don't have any distortion of the reconstruction during stain or glaze firings. The frame was finished with diamond burs and stones, establishing final shape, occlusion, contacts, interdental separation and surface texture, then polished to a high shine especially in the occlusal contact areas in order to prevent higher occlusal abrasion of the opposite teeth, if the glaze wears out. The bridge was steam cleaned before staining (Fig 22, 23, 24).


Fig 23

We always want to have the natural dentition (photos) as a guideline for our staining. Depending on the shade selection, we try to get a translucency imitation by adding spot wise a variety of thick grey, blue, pink or violet stain to the incisal section. We avoid broad staining incisaly because it often looks spotted and gives us an unnatural look.

By adding white stain to the shade we get a more on the surface appearing effect (glow or higher value), by adding violet, pink, grey or even black we get the effect of deepness (translucency).


Fig 23: Bridge before and…


Fig 24: after glaze firings

Once we are finished with our contrast-staining, we fire at least two or three layers of glaze before polishing it manually with pumice, rubber wheels and diamond paste.

For the try in at the laboratory the bridge is already finished and ready for cementing (Fig 25, 26). If necessary, the aesthetic and occlusal adjustments can be done and glazed or polished manually.

Final try in at the laboratory includes the following steps:

- Occlusal and proximal contacts
- Interdental space are optically closed, but easily cleanable
- Every pontic needs to be controlled about its gingival contact and if necessary adapted. Proper pressure of the pontics is given if gingiva does turn back from “anemically white” to pink in about two to three minutes.

Finally, the bridge is cleaned, sandblasted inside the crowns with 2 bar pressure and 50 µ alumina oxide, steam cleaned and sent to the dentist for final cementation.

As already mentioned, we had a conventional impression as well in this case. Fig 27 shows the bridge on a printed model. Fig 28 shows the same bridge on a gypsum model made from the conventional impression, where it could be placed in final position with minimal adjustments. In this case, the digital impression and workflow even over a full-arch led to the same final construction as a conventional impression.

Final Cementation

The temporary is removed and retraction cords are inserted to expose again the full preparation. The posts are carefully cleaned by the use of a rubber cup and a pumice paste. Careful intraoral sandblasting is a viable alternative. The all ceramic monolithic Zirconia bridge was tried in again to double-check the findings in the lab try in (Fig 29, 30).

Fig 29

Fig 30

The decision was taken to go for an adhesive cementation to optimize the retention. Another advantage of the adhesive cementation was to optimize the margin quality concerning sealing ability. Since the Zirconia used in this case was quite transparent, all efforts had to be undertaken to avoid micro-leakage associated with black shimmer in the margin area.

Fig 25

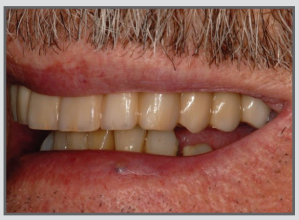

Fig 26

Fig 27

Fig 28

Pre-treatment of the Bridge and Teeth

As the try in of the bridge gave no reason for additional alterations, the bridge was going to be prepared for the final cementation. This conditioning consists of a mechanical and a chemical process. With a black marker, the inner aspect of the four “crowns” of the bridge were stained (Fig 31). Hereafter, the sandblaster was used in a pulsating manner. As soon as all the black stain was removed, the surface was ready for the next step (Fig 32). By doing so, over- or underblasting of the inner surface could be easily avoided. The sandblasting will provide a rough surface that will improve the mechanical interlocking.

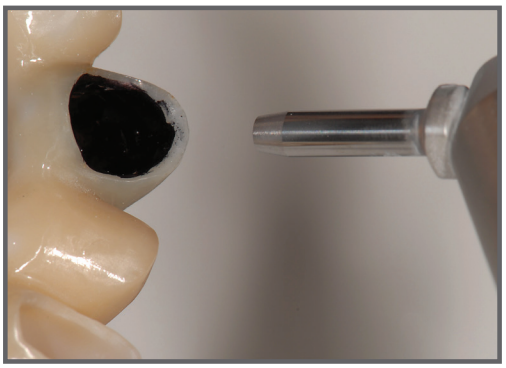

Fig 31

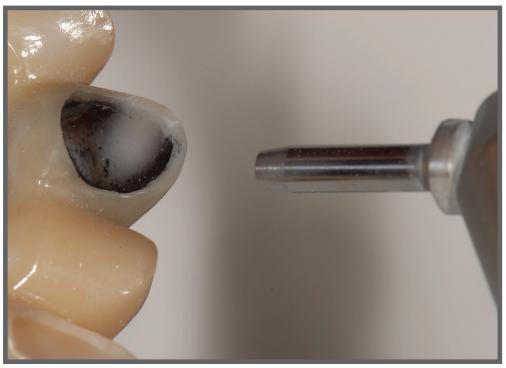

Fig 32

In the next step, a Phosphatmonomer (MDP) containing adhesive (Monobond Plus, Ivoclar Vivadent, Schaan / Liechtenstein) was applied as a chemical pre-treatment. This MDP will chemically bond to Metalloxides such as Zirconia via Phosphate bindings. After one minute, the MDP containing adhesive will be dried by the use of an air syringe. The next step was the application of the final dual curing resin cement (Multilink Automix, Ivoclar Vivadent, Schaan / Liechtenstein).

Intraorally, retraction cords were placed again to prevent irritations from the gingiva and possible sulcus fluid. As there was no enamel left on the prepared teeth, Phosphoric acid was not used in that specific case. As a dentin bonding agent, Multilik DBA was applied according to the manufactures instructions (Fig 33).

Afterwards, the bridge was filled with the cement and brought with high pressure into the final position. The excess cement can be slightly precured with a polymerization lamp for easier removal (Fig 34, 35).

After total excess removal, all four posts have been exposed to polimerization light, each spot for 60 seconds. Careful inspection should garantee overhang free margins. As a last step, the retraction cords were removed. The patient was reinstructed in the use of interdental brushes (Fig 36).

Fig 33

Fig 34

Fig 35

Fig 36

One week later, the patient had to show up for a first control (Fig 37, 38). A final panoramic x-ray was taken to check the margins for cement remnants and as documentary (Fig 39). The x-ray shows as well the full Zirconia contour of the bridge with a total absence of sintered ceramics. Ceramic chippings are often reported in many clinical studies for Zirconia and Porcelain-fused-to-metal (PFM) as well. With this Zirconia monolithic built up chippings in the posterior and anterior area will be reduced significantly for sure.

Once again, the patient was informed and instructed in oral hygiene: only adequate perfect cleaning and regular visits at a dental hygienist will lead to a long-term success.

Fig 37

Fig 38

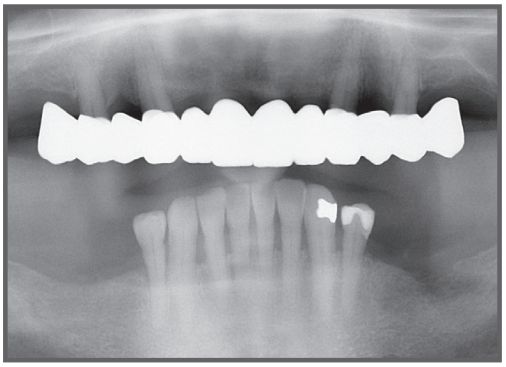

Fig 37

Fig 38

Summary

Monolithic Zirconia with a state-of-the-art dental technique can provide excellent aesthetics for the posterior as well as for the anterior zone (Fig 40). Digital and conventional impressions are both a viable method to provide records for a bridge production. Fundamental knowledge of ceramic nature and CAD/CAM procedures are absolutely mandatory to provide an optimal strength for a full-arch bridge. The clinician has to understand adhesive cementation. Zirconia and dentine posts have to be conditioned in the appropriate way. Long-term success is more likely with optimal oral hygiene and regular visits at a dental hygienist.

ARTECO Zurich
Esther Grob MDT & Mario Sisera MDT

Dr. med. dent. Urs Brodbeck