fifteen years ago, after decades of unchallenged dominance in fixed reconstructions on both teeth and implants, porcelain fused to metal (PFM) crowns got a new competitor: all-ceramic reconstructions. New indications for all-ceramic fixed dental prostheses arose, particularly with the introduction of zirconia as a framework material. Their advantages are as follows:

- since the core of the reconstruction is white or tooth-coloured, it is easier for dental technicians to achieve an artificial tooth with a natural appearance
- rising prices for precious metals have led to higher costs for traditional PFM reconstructions. Metal-free fixed dental prostheses (FDP) therefore have the potential to reduce costs
- zirconia is known to be highly biocompatible and hypoallergenic

On the other hand, chipping of the veneering porcelain on all-ceramic reconstructions is observed more often compared with traditional PFM reconstructions. Metal-free fixed dental prostheses (FDP) therefore have the potential to reduce costs. Zirconia is known to be highly biocompatible and hypoallergenic.

A 60-year-old female patient presented at the clinic wishing to substantially improve the function and aesthetics of her dentition. She had been neglecting her teeth for many years. Despite maintaining good oral hygiene, decades of high occlusal activity, along with gaps resulting from tooth loss, had decreased her vertical dimension dramatically, leaving pronounced areas of abrasion. In centric occlusion, some teeth even touched the opposite gingiva with their cusps. She was highly allergic to a number of materials, so wanted as little metal in her mouth as possible. Figures 1–4 show the initial situation. Note the marginal vertical dimension as well as the pronounced areas of abrasion. Figure 5 shows a panoramic radiograph.

The treatment plan involved increasing the vertical dimension and re-establishing occlusion and function by means of all-ceramic implant and tooth borne reconstructions. This took place in five stages:

- a pretreatment phase combining patient information with instructions on oral and dental hygiene
- replacing the missing teeth by means of implants, with the assistance of guided bone regeneration wherever needed
- raising the vertical dimension by inserting fixed provisional on implants and the existing teeth in the buccal segment
- rebuilding the anterior teeth with direct composite fillings and aligning them by orthodontic means to close the gaps
- fitting of the definitive zirconia-based all-ceramic reconstruction

Figure 6 shows the situation shortly after raising the vertical dimension using fixed implant-borne provisional on and reconstruction of the anterior teeth with composite. Figures 7 and 8 show the clinical situation 4 months after the insertion of the posterior implant-borne provisional (based on provisional PEEK abutments). They reveal the patient's high biting forces. Figures 9 and 10 show the clinical situation shortly before insertion of the final reconstruction.

In the right upper jaw the occlusal force was going to be supported by a zirconia-ceramic cement retained FDP with a distal cantilever (Figures 11–13). Figure 14 shows edge to edge occlusion in the anterior as well as the posterior area.

Figure 15 demonstrates the harmonious appearance of the dentition following an increase of the vertical dimension by about 5mm in the anterior segment; orthodontic pre-treatment in the upper anterior area; and fitting of a metal free zirconia-ceramic reconstruction. However, a few days after the reconstruction had been fitted, the patient came back with a little box filled with veneering porcelain chips (Figure 16). These mostly originated from the FDP in the upper right jaw and the most distal crown in the lower right jaw, which opposed the upper reconstruction. All of the chips were made of veneering ceramic. A thorough examination revealed that the buccal cusps were chipped off. The borderline and presumably the beginning of the crack formation seemed to be exactly at the occlusal contact area. After marking the occlusal contact areas, it seemed that the start of the cracks was located exactly at these locations (Figures 17/18).

Detailed discussion of the case by the team yielded the following possible reasons for this failure:

- the increase in vertical dimension is likely to have led to even higher occlusal forces in a patient who already had extraordinarily high occlusal forces
- during the design stage and following delivery of the reconstruction, insufficient attention was paid to the adjustment of the occlusion and functional contacts
- the two opposing reconstructions were almost entirely implant-borne. It is well known that implants show about a tenth of the mobility compared with a natural tooth, and have much lower tactile perception, both of which are likely to increase the occlusal forces
- even though there have been numerous technical improvements to zirconia-based reconstructions in recent years, chipping of zirconia veneering ceramic is observed more often than with traditional PFM veneering ceramic
- the patient was supplied with a Michigan splint to protect the reconstruction, but unfortunately did not wear it on a regular basis

The resulting treatment strategy was to:

- replace the all-ceramic reconstruction with a porcelain-fused-to-metal FDP
- carefully adjust the occlusal and functional contacts to guarantee a canine guidance for laterotrusion, as well as encouraging the patient to wear her Michigan splint as often as possible

Figure 19 shows the new conventional screw-retained PFM FDPs. A check-up appointment two years later revealed that the strategy was successful: the patient experienced no further chippings (Figures 20 & 21).

What we learned from this case:

- patients with a history of high occlusal forces are at higher risk of chipping veneering ceramics, particularly after the vertical dimension has been raised
- veneered zirconia-based FDPs should be avoided in high-risk cases like the one described above
- implant-borne reconstructions tend to chip more easily than tooth-borne FDPs
- occlusal design and adjustment is crucial for a success outcome
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