

Case planning for the implant-borne fixed partial denture

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Introduction

Planning and designing implant borne fixed partial dentures (FPDs) of various sizes, and varying degree of complication, is a common task in the modern dental laboratory.

While this relatively new treatment choice has improved the lives of literally millions of patients around the world, certain complications and challenges have unfortunately also arisen. Bone and tissue loss, prosthetically incorrect fixture placement together with a high smile line, peri-implantitis, as well as certain aesthetic and phonetic demands, are probably the most common features contributing to complication.

Tooth loss results in bone loss (Figure 1). A careful assessment of lip line will identify patients who might accept a 'pink' tissue compromise but one must beware of the patients who lift their lip and study ridge morphology because they will be dissatisfied with a compromise despite their inability to show such an area upon the highest of smiles. One must also remember that patients can be educated – 'provide the advantage and disadvantages of treatment and allow your patient to decide'.

Vascularised free flaps, autogenous block/onlay/particulate grafts, xenografts and soft tissue grafts, are some viable options to offer improvement, however, a rule of thumb is that the ridge can be improved in a horizontal but not a vertical direction. In many cases these deficiencies can only be addressed by means of restorative dentistry. These technical and clinical challenges often translate directly into certain functional as well as aesthetic issues. An adequate restoration needs to achieve a satisfactory compromise between the aesthetic demands of our patients, as well as practical and functional aspects, such as access for oral hygiene, which in a study by Serino and Strome (2009) was found to be the major contributing factor to peri-implantitis.

No matter how large or complex the case might be, my standard approach to case planning and design for any implant PFM treatment is always the same.

Pre-operative evaluation and wax up

Usually, case planning begins with assessing the horizontal and vertical space that's available and routinely there is either too much space or not enough. In the more likely event that not enough space is available, I try and fit the teeth in, either by setting them up straight, which can result in a very long and narrow look, or by sticking with the correct tooth size and proportion, and accept a slightly crooked set up, which can

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Figure 1: Pre-op situation of a challenging case



Figure 2: The initial wax-up which was used for the provisional



Figures 3 and 4: The provisional during the first try-in. Despite its initial promising appearance the design didn't work aesthetically. The tooth type that was chosen was too skinny for the case



Figures 5 and 6: The second approach incorporated the slightly bulbous look of the patient's canines, which was more suitable



look quite natural (Figure 2). It is possible that the patient's teeth were originally somewhat crowded so a return to that situation will be perceived as normal.

Smile prototyping using a fixed provisional

When such a daring design needs to be proposed it is best to do so with means of a provisional that accurately reflects the wax up and also properly projects the final outcome in terms of shape, size and position of the new teeth (Figure 3). This is a useful strategy to design the patient's new smile in a more integrated way, to adequately address what is wanted

and what is possible. One shouldn't be too apprehensive of aesthetic disapproval at this stage since it is only normal to find that something might look really good on the model, but that it then doesn't work aesthetically in situ when the patient's facial features are present. In the first case presented in this article, the initial wax up pointed towards quiet strongly extruded laterals and normally positioned centrals.

Both, the wax up and subsequently the first provisional, looked promising but it didn't suit in situ (Figure 4). Although the overall direction was certainly right, the tooth type that was chosen was too 'skinny' in comparison to the patient's



Figures 7-9: After verification of the provisional, it was duplicated in wax and served for the planning wax-up. Note the natural curvature and anatomical detail, which at this stage needs to be absolutely accurate

rather bulbous looking canines. The second provisional needed to emulate this feature (Figure 5). Once the provisional was approved (Figure 6), it was duplicated and served as the third wax-up on the master model, which was subsequently used to make the final PFM framework (Figures 7, 8 and 9).

Anatomical support and correct framework design

Implant fixed partial dentures (FPDs) show a higher frequency of veneer fracture than conventional FPDs (Pjetursson et al, 2004; Tan et al, 2004). Not many aspects of implant superstructure design have been so frequently discussed than the importance of anatomical support. And



Figures 10 and 11: The study of nature is a constant endeavour. We have a large collection of extracted teeth that we frequently consult during build-up and contouring



Figures 12 and 13: The framework is cut back out of the full wax-up using reduction grooves, to determine the ideal anatomical support



Figures 14 and 15: Old, traditional methods usually work the best. The framework is cut and joined passively using GC Pattern Resin



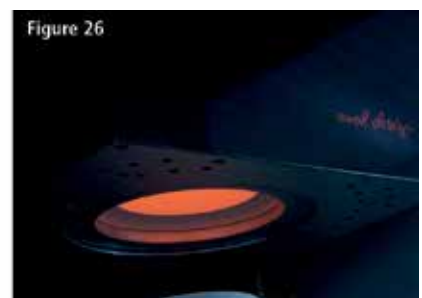
Figure 16: The connectors should be positioned in the lower third of the framework just above the gingiva, with emphasis on horizontal support rather than vertical expansion. This will not only allow for a durable design but also for natural looking interdental separation



Figure 17: The already trimmed and seated PFM framework after gold bonder application (Aurofilm Metalor)



Figures 18-20: A soft tissue mask aids to determine the position of the pink and white areas



Figures 21 and 22: An index is used for the first build up, in order to stick as closely as possible with the design of the prototype

Figures 23 and 24: The soft tissue mask is removed and the gingival area is then polychromatically layered

Figures 25 and 26: Proper firing is essential with any implant borne restoration. The Dekema Oral Design edition is equipped with a stone muffle for increased heat penetration, which ensures through fusion of the ceramic



Figure 27: Following the method from beginning to end ensures that the ceramic is properly supported by the framework



Figure 28: Note the congruency between wax up and final result



Figure 30: The implant borne fixed partial denture (FPD) before try-in

yet, inadequate anatomical support is still often found to be the main reason for fracture related failure of implant-borne restorations (Shirakura et al, 2009). One of the most effective ways of achieving ideal anatomical support is by using the actual wax up for the final framework by evenly cutting it back, with the aid of reduction grooves, in the same way a tooth would be prepared in the mouth (Figures 12 and 13). Ideally the connectors for any bridgework should be positioned in the lower third of the framework towards the gingiva, with strong horizontal reinforcement rather than vertical expansion (Ubassy, 2008)(Figure 16). This will not only allow for a durable design but also for realistic interdental separation. After all, the trick with any bridgework is to make it look as if it is made of single units.

Framework preparation and veneering

Once the framework has been cast and the fit verified, the reduction amount as well as the anatomical support are

checked yet again, with the help of a number of indexes. A gold bonder (Metalor Aurofilm) is applied to improve bonding strength and to add a warm chroma to the restoration (Figure 17). A soft tissue mask is made, covering the framework, to guide which areas need to be opaqued pink and which white, and also to assist during build up (Figures 18 and 19). In order to stick as closely with the prototype as possible, a lingual index is used for the dentine build up (Figure 21). After the traditional cut-back all attention is dedicated to achieving a natural build up while staying within the anatomical boundaries (Figure 22). Once this has been done the soft tissue mask is removed and a number of gingiva powders are applied in order to imitate the missing tissue and to conceal the defect in that area (Figures 23 and 24).

Firing and finish

As discussed, in order to address the higher frequency of



Figures 31-34: An individual result like this one can be characterised by the shape, size, rotation and shade of the restoration. These parameters need to be carefully refined step by step, in order to keep the unpredictability of the outcome at a minimum

veneer fracture on implant FPD's vs. conventional FPD's, anatomical support is one remedy, proper firing of the ceramic to ensure homologous fusion of the ceramic, is another (Figures 25-28). My protocol is to fire any implant restoration about 10 degrees higher (910°C/creation classic) with an increased holding time as well, especially for the first bake. It is necessary to frequently check the

furnace calibration as well as the vacuum to ensure constant results.

Final integration

Once the implant prosthesis is glazed and polished (dark matter, Uniques) it is ready for try-in (Figure 30). This is part of the usual procedure to make sure everything is



Figure 35: The second case presented in a similar way to the first. Note the inflammatory response the implants prior to restoration



Figure 36: The second, refined provisional in situ to determine the aesthetic direction of the treatment. Note gingival blanching in the region of tooth UR2 and high smile line



Figures 37 and 38: The rotation of the teeth was chosen more for aesthetics reasons rather than space-related discrepancies
 Figures 39 and 40: In fact, the amount of available space was actually too much. A non-invasive platinum foil veneer pictured on the model during fabrication and semi seated in situ, was used to close the gap
 Figures 41 and 42: The final result presents a good compromise, as is often the case with many implant borne restorations, when a lot of bone and tissue loss preceded the commencement of treatment
 Figures 43 and 44: Preoperative view of the third case. Traumatic injury and massive amounts of bone loss were the result of a car crash. The patient presented after a number of bone grafts had already been performed to improve the situation. Note high smile line

on track. During the try-in stage the other parameters that can't be finalised including contact points, occlusion, tissue compression, shade and access for hygiene are assessed. A patient might mention that they want natural looking teeth during the shade take appointment, but what they often really mean is that they want them white or at least much lighter than their own remaining dentition. Getting the shade of a restoration wrong is regarded as a major alteration vs. smaller shade and shape alterations that can be done in the surgery, where we have a ceramic studio setup. It is important that the appointment regime accommodates for this possibility. Understanding and communication between the clinical team and the laboratory is a major ingredient for successful management.

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Figures 45-47: Precise planning is essential in order to deal with the complexity of the defect and to determine the best possible compromise



Figures 48-49: The planning mask in comparison to the final FPD. Accurate projection of the outcome is one thing, precise reproduction another

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Figures 50-52: The final result in situ. Trying to conceal a uni-lateral bone defect is a difficult undertaking. When designing any implant borne FPD it is also of critical importance to provide easy access for hygiene and not just to consider merely aesthetics aspects