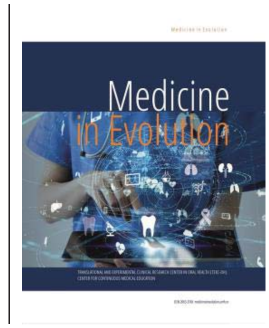
Prosthetic rehabilitation of the upper arch using pressed layered and monolithic ceramics- technical steps



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Abstract

Aims and objectives: the present paper wants to highlight the essential parameters to be considered during the technical steps of the manufacturing process of pressed monolithic and layered full ceramic pressed crowns. Material and method: a complex clinical case was taken in consideration. The patient presented different shades of abutments that required different technical approaches for obtaining the expected aesthetic effects. Specific manufacturing steps were conducted. Results: highly aesthetic and functional reconstructions were obtained that fulfilled the patients demands.

Keywords: monolithic, layered, pressed ceramics, aesthetics, technical steps

INTRODUCTION

Social behaviour can be best understood as a function of people's perception of the world and the way they manipulate their images of the world (1). The aesthetic appearance of a person is closely related to both the facial appearance and the aspect of the dental arches. Prosthetic restorations play an essential role in the natural, pleasant aspect of a person, having to meet at the same time aesthetic functionality. Due to the development of the therapeutic procedures and more efficient evaluation, treatment, and diagnostic possibilities, ideal, optimal restorations can nowadays be manufactured.

Aim and objectives

This presentation is trying to shed light upon essential parameters in the reconstruction of the dental arches, using full ceramic restorations. In the first place, the right choice of material and technique is the key to a successful treatment. Secondly, the technician needs to consider individualization of a prosthetic work in terms of internal colour of the restoration. Before choosing the restorative material, the shade of the prosthetic abutment must be accurately evaluated. For obtaining an individualized match and a real blending in of the prosthetic reconstruction, it is advisable to establish from the beginning if the prosthetic substrate needs to be masked or not and, if necessary, how to accomplish this task (2). Depending on the choice, later different layering techniques of ceramics in different parts of the prosthetic reconstruction are likely to be required. In the third-place cement shade, ceramic thickness, and abutment material of the cast are parameters that must be considered, since they have a major influence on the final colour of full-ceramic restorations (3). The case presented below needed a complex rehabilitation of both arches. In the first stage the upper arch was reconstructed using the lost wax technique and pressed ceramics (lithium disilicate). The technical stages were different, depending on the rehabilitated area, namely monolithic reconstructions were used in the lateral area, and layered copings for the frontal group.

MATERIALS AND METHODS

The preoperative treatment was started by an intraoral scan and a digital smile design (DSD). for oral rehabilitation of the upper arch. The DSD was made according to aesthetic parameters and congruous to the golden rule (Figure 1, 2).

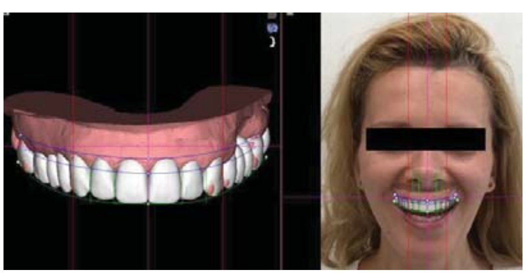

Figure 1. Intraoral scan design

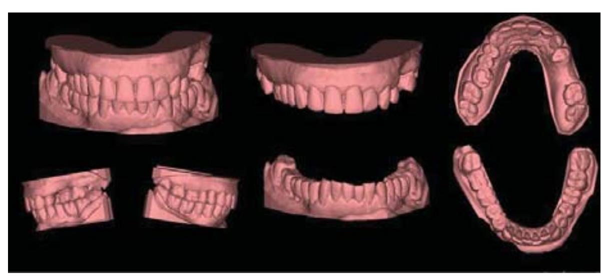

Figure 2. Digital smile

A digital wax-up was made, which was outlined with the help of a 3D printer (figure 3-5). The classical, analogue wax-up was avoided because in terms of number and disposition of occlusal contact points, modern procedures seem to have a significant importance in improved occlusal morphology (4).


Figure 3. Digital wax-up frontal view


Figure 4. Digital wax-up left lateral view


Figure 5. Digital wax-up right lateral view

The impression of the upper arch was taken with Impregum Penta H DuoSoft, the antagonists with Impregum Garant L DuoSoft (3M Espe) (Figure 6,7).


Figure 6. Impression upper arch


Figure 7. Impression - antagonists


Figure 8. intermediate stage in obtaining the analogue maxillary cast

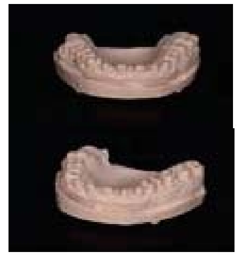
Figure 9. The control cast frontal and later view

The impressions were poured using Rocky Mountain class 4 plaster. Two casts were poured into the maxillary impression: one with removable dies and one – a control cast without removable dies. The cast without removable dies was used for a precise defining of the contact points due to different mobility of dento-parodontal structures (5) vs removable die mobility, necessary in large oral rehabilitation, as in the present case. For mounting, an Artex CR articulator and an Artex face bow (Amman Girrbach) were used (figure 8-12).


Figure 10. Mounted casts

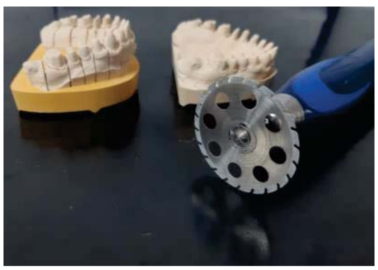
Figure 11. Obtaining the removable dies – maxillary cast

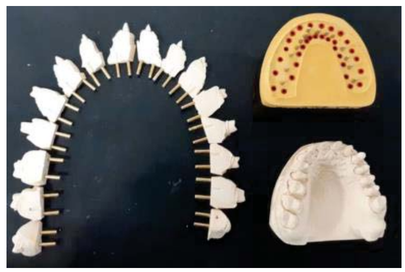
Figure 12. The casts prepared for the scanning

The working cast and the antagonists were scanned using the 3D Vinyl scanner (Smart Optics Sensortechnik GmbH). Scanning also included the mounted casts in the articulator obtaining the intermaxillary relationship. Data was thus converted from analogue to digital, followed by the design stage (Figure 13-19).

The images below show the scanned model with removable dies. Scanning of the soft tissue offers valuable information of the parameters describing the papilla-fill, height, width, and effect of papilla base width on the vertical papillary dimension (6). These parameters will, in turn, offer data about the interdental space and placement of the interproximal contacts, so that the final prosthetic reconstruction will insure an aesthetic outcome.

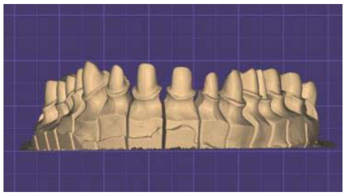
Figure 13. The digital cast with removable dies

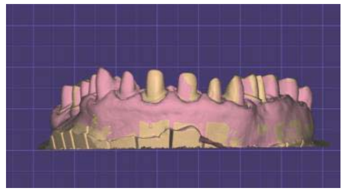
Figure 14. The digital cast with soft tissues included

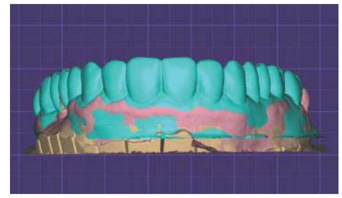
Figure 15. The digital wax up on the digital cast

Starting from the first premolar distally, monolithic reconstructions were used, while in the frontal area layered copings were used for better aesthetic results.

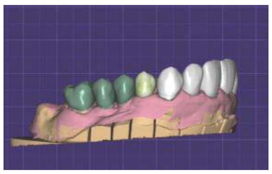
Figure 16. Biogeneric calculation and morphology left side


Figure 17. Biogeneric calculation and morphology right side

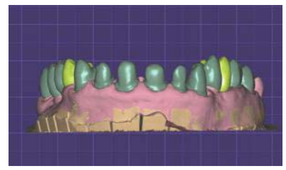
Figure 18. Predefined design of the copings- frontal group frontal view

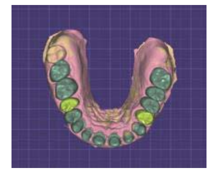
Figure 19. Predefined design of the copings – frontal group occlusall view

The wax patterns for the frontal were obtained by milling using ProArt CAD wax and CAD CAM technology (Figure 20-23).

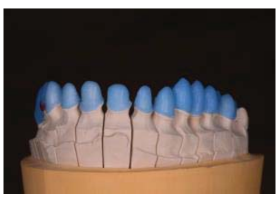
Figure 20. Milled copings in the frontal area

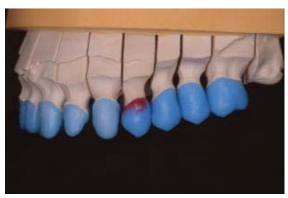
Figure 21. Milled full contour wax patterns in the lateral area- left upper arch

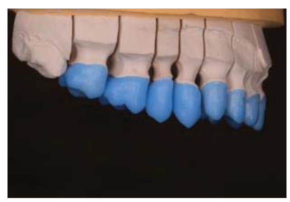
Figure 22. Milled full contour wax patterns in the lateral area- left upper arch


Figure 23. Occlusal view of the milled wax patterns used for rehabilitation of the upper arch

Wax patterns were checked on the working cast and prepared for investing and pressing using the e.max system (Ivoclar Vivadent) (Figure 24-26).


Figure 24. Wax patterns prepared for investing


Figure 25. Pressed copings/ full contour reconstructions


Figure 26. Wax pattern ready to be pressed- discoloured abutment 1.5

For pressing, in the frontal area MO 0 ingots were chosen. In the lateral, medium translucency (MO) was chosen for the discoloured abutment 2.4. that was rehabilitated going through the same manufacturing steps as for the frontal teeth, by pressing a coping that was afterwards layered. The rest of the lateral abutments were restored by using high translucency ingots (HT) for pressing monolithic reconstructions.

Casting rods (3 mm diameter and 0.6 cm length) were placed onto the occlusal surface (non-functional buccal cusp) of the wax patterns and were attached on the conformer’s cylinder, at an incline of 450, avoiding sharp angles. 100 grams IPS PressVest Premium (Ivoclar Vivadent) powder was mixed manually with 16 ml of liquid and 11 ml of distilled water in the mixer's vacuum tank. A homogenous consistency was obtained by means of a vacuum mixer.

For the pigmented abutment (1.5.) an MO ingot was used so that even the thinnest parts of the crown the material was able to mask the substrate. In the lateral area the HT translucency ingot that we used, rendered the full contour restorations an appropriate translucency. The final staining and, glazing was done selectively, only limited to the aesthetically relevant zones (7).

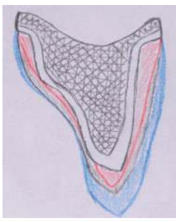
Figure 27. Scheme of the layers black-abutment, white-coping, red- deep dentin, dentin, blue-enamel transpa incisal 1, opal effect 1


Figure 28. Deep dentine B1


Figure 29. Dentine B1


Figure 30. Transition dentine


Figure 31. Transpa


Figure 32. Opal effect

In the frontal area, in order to obtain B1 final restorations, MO 0 ingots were used to obscure the A3.5 shade of the abutments. The copings were layered with e.max Ceram (Ivoclar Vivadent). For the cervical area Power dentine/ Deep dentin B1 was used. B1 dentine was used in the middle third of the teeth. A transition area between the middle third and the incisal third of each frontal tooth was obtained by mixing the dentin of B1 with Opal effect 4 and Transpa incisal 1. Over the transition layer only transparent ceramics was used for light absorption and translucency: Opal effect 1, Transpa incisal 1 (in the incisal half), Transpa blue (in the proximal areas of the tooth, to render a bluish tint to the tooth), and Opal effect 4 to obtain the halo effect. For light reflection Opal effect 4 was applied over the dentin, in the middle third of the restored front teeth (Figure 27-32). After the sintering, surface processing followed aiming to obtain the desired texture followed by polishing.


Figure 33. Sintered layers – frontal view


Figure 34. Sintered layers – lateral view


Figure 35. Dimanond burs used for surface texture


Figure 36. Discs and Polishing wheels

Glaze and stain were used to obtain the final glossy, smooth appearance of the restorations (Figure 33-45).

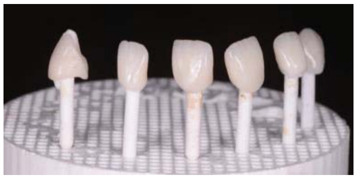

Figure 37. Glaze applied before sintering

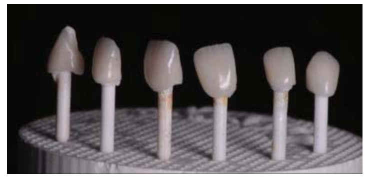

Figure 38. Sintered glaze buccal view

Figure 39. Sintered glaze oral view

Figure 40. The for upper incisors after glazing

Figure 41. Final aspect of the restoration abutment 1.5

Figure 42. Aspect of the restorations in the lateral are- left arch

Figure 43-45. Final aspect of the monolithic and of the layered restorations on the working cast frontal and lateral view

DISCUSSIONS

Lithium disilicate (LS2) is a glass-ceramic, sold by specialized commercials as ingots, ready to be heat pressed to obtain metal free restorations. This particle-filled glass material allows manufacturing of cores that are veneered using translucent fluorapatite ceramic (19–23% of fluorapatite crystals ($Ca5(PO4)3F$) embedded in a glassy matrix) (8). As an alternative, monolithic reconstructions can be obtained using the pressing technique this type of reconstruction indicated for the areas where the mechanical and not the aesthetical demands prevail.

Zhao et al. (9) shows in his study, that the mechanical resistance of veneered copings registered lower fracture load values compared to monolithic restorations. Different researches (10-17) show that monolithic restorations have improved fracture strength and fatigue resistance, that enables their use in the posterior areas, for tooth supported single crowns, for 3-unit brides as well as for implant supported reconstructions. Not the same features and indications are available for layered restorations.

Lithium disilicate fixed reconstructions have showed to have wear and abrasiveness parameters highly related to the polishing procedures. The values are close to those of the enamel but higher than those found for noble alloy (gold) restorations (18). Specific, more aggressive surface characteristics have been reported after grinding, glaze coating and fluorapatite ceramic veneering. Thus, several studies (19-23) showed increased roughness and wear in antagonist teeth but also of the prosthetic restoration per se. Song et al (7) showed that glazing of monolithic posterior restorations is not indicated on the occlusal surfaces if aesthetic considerations do not prevail and that meticulous polishing procedures should compulsorily succeed any occlusal grinding.

Biocompatibility of lithium disilicate material was demonstrated over and over in vitro and in vivo studies (24-26). Lithium disilicate insures low plaque retention, as well as adhesion and proliferation of human epithelial cells and human gingival fibroblasts in the absence of any inflammatory reactions of the soft tissues.

CONCLUSIONS

Lithium disilicate is one of the most versatile metal free materials, widely used because of the high aesthetic requirements it possess, as well as for the improved mechanical performance and good bonding strength to dental tissues (27). It is a material often used for fixed implant or tooth supported single or plural dental reconstructions. Lithium disilicate ceramics can be utilized for tooth supported structures (inlay, onlay, overlay, tabletops, veneers, crowns, foxed partial dentures) as well as on implant-supported restorations (28)(29).

A 10-year study found an 83.5% survival rate of monolithic lithium disilicate single dental reconstructions (30).

In the lateral area for table-tops and occlusal veneers on premolars and molars lithium disilicate has shown obvious advantages, e.g.: adhesive bonding strength, low wear and abrasive potential and high load-at-fracture. The improved mechanical resistance at reduced thickness of the restoration (1–1.5 mm) which translates into reduced hard tissue preparation, enhances thus a biological approach (31-36).

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