

Article

Clinical Significance of Accurate Transfer of Provisional Resin-Based to Permanent Lithium Disilicate Glass Ceramic Dental Restorations

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Abstract: Smile reconstruction is, yet, a challenging procedure for dental practitioners. A stable and satisfactory aesthetic result demands a meticulous procedure, which involves many clinical and laboratory steps. The purpose of this article is to present a case of aesthetic reconstruction in the anterior region with a successful 14-year recall. A 40-year-old female patient came to the dental clinic complaining about her smile appearance. Lithium disilicate glass-ceramic full-coverage restorations for the six upper anterior teeth were the selected treatment plan for this case. The key to this successful result was the used therapeutic methodology, where the characteristics of the provisional restorations were copied to the final restorations. In this article, the therapeutic methodology is presented step by step and all the clinical and laboratory steps are explained thoroughly. The patient has visited the dental clinic annually as arecall visit. The final result from the 14-year recall visit revealed that the aesthetic result was stable, the restorations were intact and there were no signs of gingival infection or dental decay. Consequently, the presented therapeutic methodology leads to a successful and long-term result.

Keywords: Aesthetic reconstruction, Lithium disilicate glass ceramics, Composite provisional restorations, Treatment plan

1. Introduction

The patients' demand for high-quality aesthetic restorations has increased throughout these years [1]. Moreover, smile reconstruction with ceramic restorations remains a challenge for dental practitioners. Reasons lie in communication problems with both the patients and the dental laboratories and the plethora of ceramic materials emerging in the market, with different handling properties and indications of use [2]. Glass ceramics have been the materials of choice for anterior restorations, as they have favorable physical and mechanical properties accompanied with optimal aesthetics [3,4]. Since different types of ceramic materials have different indications and require different clinical procedures, clinicians are left to make decisions that could jeopardize treatment success. Communication, on the other hand, is crucial for restorations in the aesthetic zone. Adherence to an evidence-based restoration protocol eliminates communication problems with patients and dental laboratories [5]. In this direction, examination and recording of the initial situation, meticulous treatment planning, and commitment to a restoration protocol can lead to a successful result with prolonged maintenance [6,7]. The case presented in this article describes a therapeutic approach to anterior aesthetic restorations based on a protocol of transferring provisional restorations' elements into the final restorations. The result has been re-evaluated after 14 years of restoration service.

2. Case Presentation

A 40-year-old female patient came to the dental clinic in the September of 2006, complaining about her smile appearance. Clinical examination revealed composite resin restorations in the upper central incisors (11 and 21) and the upper left lateral incisor (22). The restorations suffered from poor morphology, discoloration, and increased surface roughness (Fig. 1). The patient stated that she was not satisfied with her teeth's appearance and desired an improvement in the esthetics of the anterior region of her denture.



Fig. 1. Initial clinical appearance of the patient.

Fig. 2. Diagnostic wax-up on the fabricated casts.

Thorough intra-and extra-oral examinations were the first step followed by a radiographic examination of the frontal teeth before setting up a treatment plan. The patient's medical history was noncontributory. Accurate alginate impressions (Kromopan, Lascod, Florence, Italy), a facebow record, and baseline photographs were acquired. Using the principles of macro-aesthetic smile design, a diagnostic wax-up was fabricated, where the need to improve anterior guidance emerged [8] (Fig. 2). Lithium disilicate glass-ceramic (IPS e.max Press, IvoclarVivadent, Schaan, Lichtenstein) full-coverage restorations for the six upper anterior teeth (13-23) were the selected treatment plan for this case.

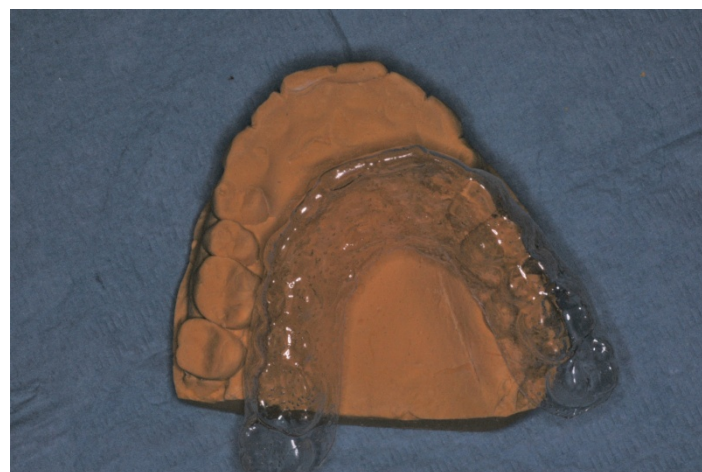


Fig. 3. Silicon index fabricated from the diagnostic wax-up.

A silicon index was fabricated from the diagnostic wax-up to serve for the patient's intra-oral mock-up (Fig. 3). Intra-oral mock-up was conducted using a self-curing composite material (Structur 2, Voco GmbH, Cuxhaven, Germany) (Fig. 4). The patient could see the proposed treatment plan while she could assess the size, shape, and arrangement of the teeth, their contribution to the phonetics and their harmonization in the smile (Fig. 5). Occlusion was checked at all functional pathways (straight protrusive, lateral

protrusive and direct lateral positions) with articulation paper and the necessary adjustments were made to reach optimum anterior guidance [9]. For this purpose, canine disclusion was formulated to replace the existing group function occlusal scheme [10].



Fig. 4. Intra-oral mock-up using a self-curing composite material.



Fig. 5. Control of size, shape, and arrangement of the teeth and their contribution to the phonetics and harmonization in the smile.

With the patient’s written consent to the proposed treatment plan, an impression (Kromopan, Lascod, Florence, Italy) of the intra-oral mock-up was made. This impression served for the fabrication of a transparent cellulite index to verify the restoration’s space during the preparation of the teeth. When tooth preparations were completed (Fig. 6), a first impression (Impregnum™ Penta™ H DuoSoft™, 3M ESPE, St. Paul, MN, USA) using Pentamix™ 3 (3M ESPE, St. Paul, MN, USA) was made for fabrication of provisional restorations with acrylic resin at the dental laboratory. Subsequently, direct interim restorations were made by using a silicone index from the initial cast with a self-curing temporary crown material (Structur 2, Voco GmbH, Cuxhaven, Germany) and were luted with temporary cement (Temp Bond NE, Kerr, Orange, CA, USA) (Fig. 7).

The fabrication of provisional restorations aimed to have the same final restorations and provide predictable clinical performance. For this reason, at the delivery appointment marginal fit (Fig. 8), occlusion (Fig. 9) and aesthetics (Fig. 10) of the provisional restorations were checked and then luted with temporary cement (Temp Bond NE, Kerr, Orange, CA, USA). After a two-week waiting period, the patient was interviewed about the provisional restoration service. The restorations were re-examined with no problems noted, and the patient gave the consent for final restorations’ fabrication. For this purpose, two impressions were made (PRESIDENT, Coltene, Alstatten, Switzerland): one before the provisional restorations removal and a final impression of the prepared teeth.



Fig. 6. Preparations of the upper anterior teeth for the full-coverage ceramic restorations.



Fig. 7. Direct interim restorations made using a silicone index from the initial cast with a self-curing composite material.



Fig. 8. Checking the marginal fit of the provisional restorations.



Fig. 9. Checking the occlusion of the provisional restorations.



Fig. 10. Checking the aesthetics of the provisional restorations.

Laboratory provisional restorations were duplicates of the intra-oral mock-up restorations. All the adjustments were made during the mock-up phase in the fabrication of these restorations. The laboratory steps to duplicate the provisional restorations' characteristics at the final restorations were as follows.

- (1) The cast from the provisional restoration was mounted to a semi-adjustable articulator. To record the modified occluso-incisal relationships, cold-curing laboratory acrylic resin to a doughy consistency was used and a custom incisal guide table was fabricated [11] (Fig. 11). The mandibular movements were clear and well defined, resulting in a three-dimensional envelope of motion defined by the palatal surfaces of the provisional restorations (Fig. 12).
- (2) A silicon putty index was fabricated over the labial surface of the upper and lower casts at maximum intercuspation (Fig. 13). This index served during the formation of the labial surfaces and the orientation of the incisal edge of the restorations.
- (3) The provisional restorations' casts were marked at the long axis of the teeth, the soft tissue peaks, and the vertical overlay on the lower teeth (Fig. 14). These marks served in the formation of the shape and contours of the final restorations.

The ceramic cores of the restorations were tried in to verify the marginal fit, proper orientation, and the remaining space for the layering of the esthetic ceramic material assisted by the use of the silicon index fabricated from the diagnostic wax-up. Additionally, the thickness of the provisional restorations was pre-evaluated before the final impressions (Fig. 15). Pick-up impression was acquired (Fig. 16) and a cast with a gum mask was fabricated. This cast determined to the dental laboratory the position of the soft tissue features. At the dental laboratory, the final restorations were fabricated by transferring all the data from the recordings (Fig. 17).

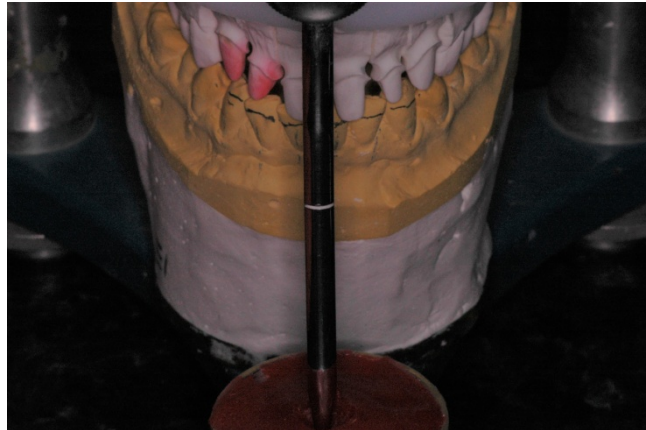


Fig. 11. Custom incisal guide table used for this case.

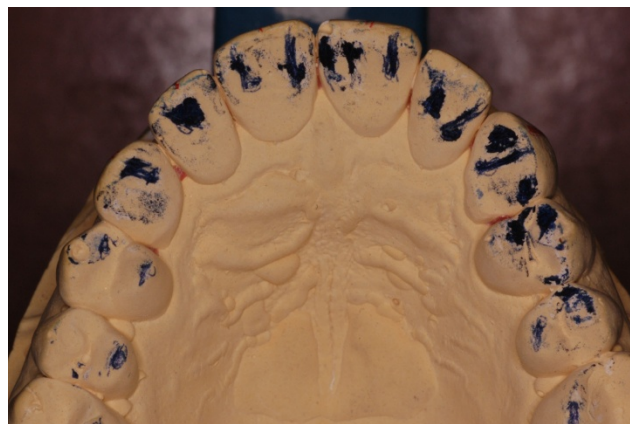


Fig. 12. Mandibular movements resulting in a three-dimensional envelope of motion, defined by the palatal surfaces of the provisional restorations.

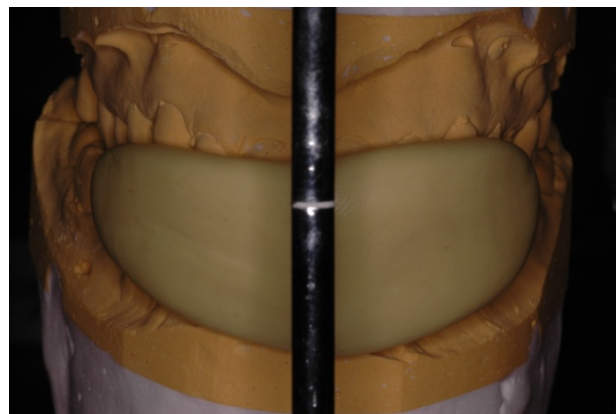


Fig. 13. Silicon putty index fabricated over the labial surface of the upper and lower casts used for the formation of the labial surfaces and the orientation of the incisal edge of the restorations.

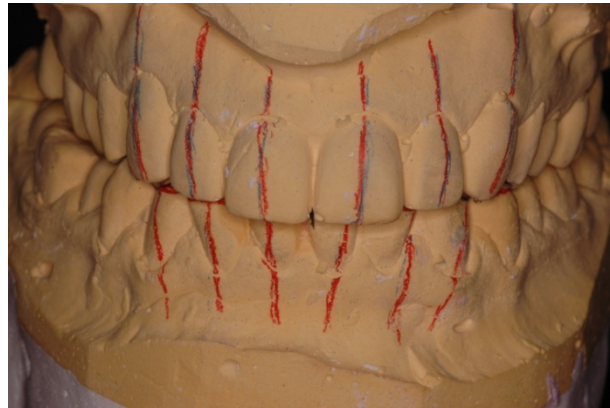


Fig. 14. Marks on the provisional restorations' casts at the long axis of the teeth, the soft tissues peaks, and at the vertical overlay on the lower teeth.

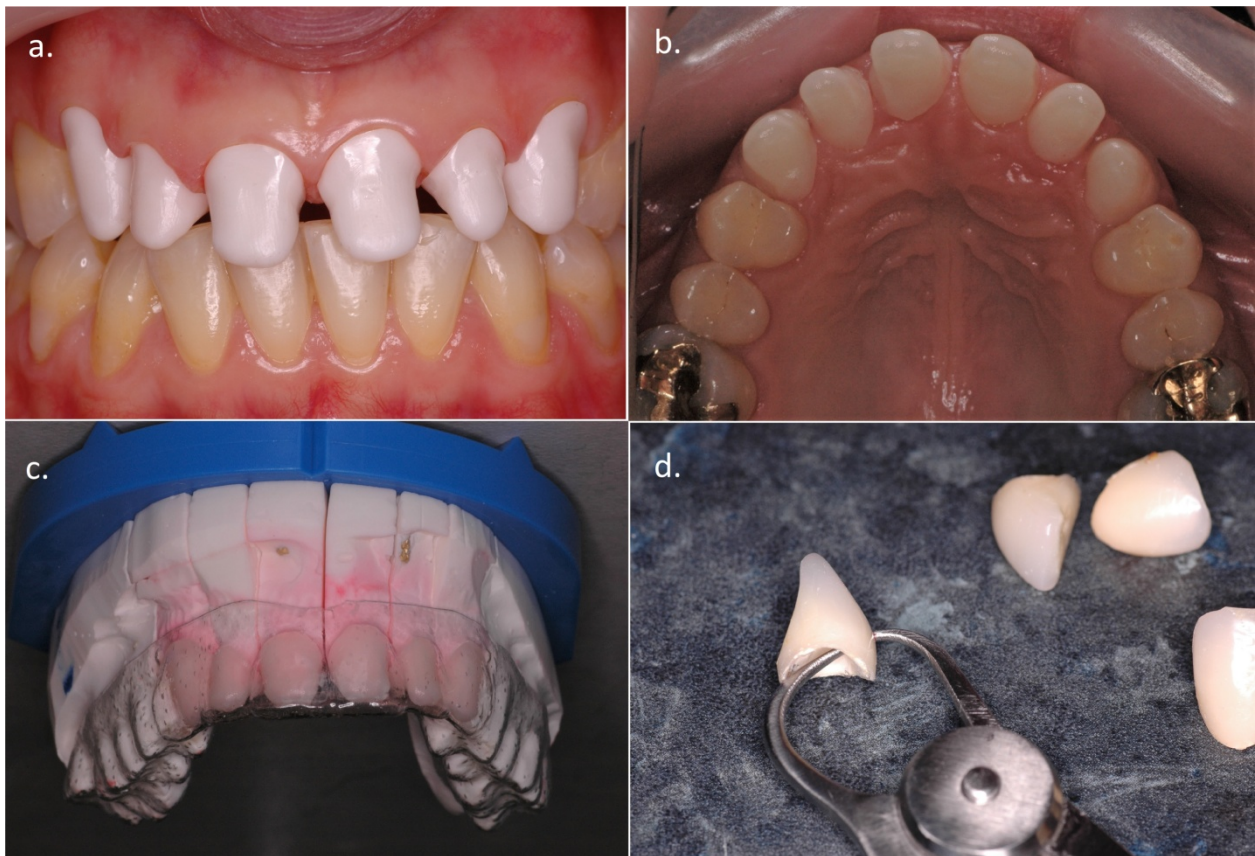


Fig. 15. Ceramic cores of the restorations from the labial (a) and occlusal (b) view, the use of the silicon index fabricated from the diagnostic wax-up to verify the remaining space for the layering of the esthetic ceramic material (c) and the measurement of the thickness of the provisional restorations before the final impressions (d).

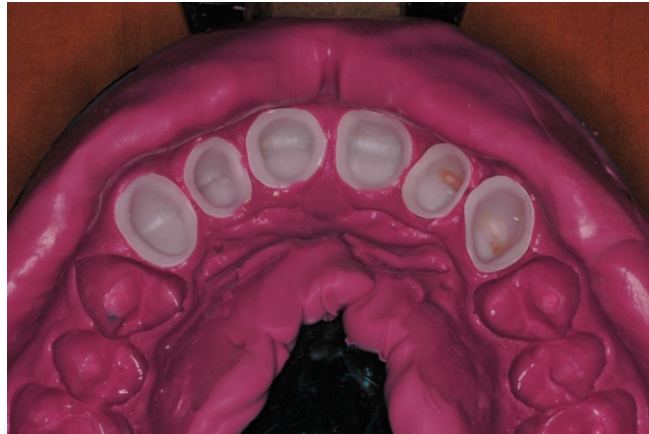


Fig. 16. Pick-up impression of the ceramic cores of the restorations.



Fig. 17. Transferring tools of data of the recordings to the final restorations, which were made at the laboratory.

The next appointment was the bisque try-in, where internal and marginal fit, esthetics, and anterior guidance were examined (Fig. 18). Occlusion was checked at all functional pathways with articulation paper, and the marks were matching the occlusion marks of the provisionals (Fig. 19). The restorations were sent to the dental laboratory for the final glaze before the delivery appointment.



Fig. 18. Bisque try-in, where internal and marginal fit, esthetics, and anterior guidance were examined.



Fig. 19. Checking the occlusion of the final restorations at all functional pathways with articulation paper, and comparison with the occlusion marks of the provisional restorations.

At the delivery appointment, the restoration was cemented with esthetic light- and dual-curing resin cement (Variolink Esthetic DC, Ivoclar-Vivadent, Schaan, Lichtenstein), according to the manufacturer’s instructions. In particular, the inner surfaces of the crowns were etched with 4% hydrofluoric acid gel (IPS Ceramic Etching Gel, Ivoclar-Vivadent, Schaan, Lichtenstein) for 20 s and then were rinsed with water and air-dried. Ivoclean (Ivoclar-Vivadent, Schaan, Lichtenstein) was applied for 20 s before silanization of the inner surfaces with Monobond Plus (Ivoclar-Vivadent, Schaan, Lichtenstein) for 60 s followed by a gentle air-drying. The prepared teeth were treated with Adhese Universal VivaPen (Ivoclar-Vivadent, Schaan, Lichtenstein) for 20 s and light-cured for 10 s, following a self-etch adhesive strategy. Immediately, the resin cement filled the ceramic crowns and they were luted to the prepared teeth. The excess cement at the gingival margins was removed with a surgical blade after light-curing for 3 s using a LED device (Bluephase Style, IvoclarVivadent, Schaan, Liechtenstein). Subsequently, the photopolymerization was completed after irradiating for 60 s (both labial and palatal surfaces) at 1100 mW/cm² power density. The final clinical appearance is presented in Fig. 20 and 21.



Fig. 20. Checking the marginal fit and esthetics of the final restorations after the final cementation.



Fig. 21. Clinical appearance of the patient with the final restorations.

Instructions were given to the patient regarding oral hygiene and regular follow-up appointments were scheduled. The patient was called in for the scheduled follow-up appointments at 2 weeks after delivery, 6 and 12 months, and, then, yearly. Follow-up progressed up to 14 years, in which the last recorded follow-up appointment was noted (Fig. 22). During this period, the restorations remained intact. Ceramic material detachments or cracks were not detected, and the occlusal scheme was stable. Restorations' color and contour were stable and the soft tissues remained healthy. A slight gingival recession was detected only at the cervical and labial region of the teeth except for 11. The patient was satisfied with the restorations' service throughout these years.



Fig. 22. 14-year follow-up of the clinical case.

3. Discussion

Once restoration of upper anterior teeth is necessary, optimum aesthetics and phonetics, efficient oral function, and long-term survival of teeth and rehabilitation are required. Adherence to a predetermined, evidence-based protocol helps in the smooth execution of the laboratory and clinical stages and leads to a predictable result [5]. Moreover, a thorough recording of the patient's initial status, a tailored treatment plan, and effective decision-making are the keys to success [6,7].

Aesthetics is a subjective area and the best vehicle for communicating to the patient the proposed interventions is the simulation of the outcome via the mock-up technique [12]. Improvements, as well as limitations need to be visualized and discussed through a completely reversible process. Not only aesthetic but also functional factors are determined and assessed in the maxillary anterior restorations with the performance of the anterior guidance predominant. The optimum anterior guidance is a result of unhindered mandibular movements in straight protrusive, lateral protrusive, and direct lateral pathways. This information must be accurately transferred to the final restorations [9]. Thus, a correct transfer protocol of the acceptable elements of the provisional restorations leads to a result without surprises in function, patient acceptance, and restoration longevity. Through this prism, the study models, the diagnostic wax-up, the model produced by the mock-up technique, the model of the prepared teeth for the fabrication of provisional restorations, the master model, and the model having the ceramic cores were mounted on the same semi-adjustable articulator and alternated depending on the laboratory stage and the requirements of the clinical stage.

Furthermore, the material choice requires another caution. Ceramic materials are widely used with different indications. Real-life clinical conditions, on the other hand, do not always comply with these indications. When the performance of ceramic materials was investigated, high survival rates were noted. This result shows that the survival rates after five years of the IPS e.max Press ceramic material range from 94.22 to 96.6% [13,14]. In the present case, the material selection was crucial, considering the alterations in the occlusal scheme. After 14 years of service, the restorations remained intact, leading to the conclusion that the material choice was also successful.

4. Conclusions

In conclusion, the elements of success in anterior aesthetic restoration could be summarized as follows.

- (1) Thorough examination and recording of the initial situation
- (2) Study models, meticulous planning, and selection of restoration material
- (3) A transfer protocol of the acceptable elements of the provisional restorations to the final restorations

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