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Case Report

Case Report on Full-Ceramic Lithium Disilicate Crowns Using a Customized Preparation Technique with Modified Chamfer on the Vestibular Surface and Vertical Preparation on the Oral Surface Across Multiple Teeth

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Abstract: This case report details the clinical use of layered lithium disilicate crowns, employing a customized technique that combines a modified chamfer on the vestibular surface with Vertical-Prep on the lingual surface. This concept was applied on six mandibular anterior teeth (4. 1, 4. 2, 4. 3, 3. 1, 3. 2, 3. 3) trying to achieve mechanical advantage of the vertical preparations alongside the aesthetic accomplishment of the modified chamfer technique. The lithium disilicate material used was characterized by high strength and biologic characteristics of the material made it possible to achieve highly satisfactory esthetic result with the color near to the patient's original teeth. In terms of function, the restorations provided good stability and comfort to the patients and none of the patients complained of any discomfort in the six-year follow up period. Both the crowns were proved to have long term sturdiness without any fractures or wearing and thus this treatment modality can be held as successful outcome. This case also

supports the concept of having a well-developed mode of preparation in tandem with using high quality ceramics in the creation of durable, esthetical dental restorations.

Keywords: glass ceramic, vertical prep, aesthetic restoration.

Introduction

In the present-day restorative dentistry, it is still difficult to get the assessment of both functionality and longevity of the restoration as well as esthetics. It has, therefore, become even crucial to incorporate enhanced materials and other novel methods of preparing them into the manufacture [1]. Lithium disilicate ceramics with enhanced mechanical properties, biocompatibility, and great esthetics have become increasingly popular in the production of dental restorations including crowns [2]. The writing style called the vertical preparation technique (or the verti-prep) has certain advantages in this aspect specifically when using as little tooth material as possible during capping [2]. At the same time, while using a modified chamfer preparation in particular on the vestibular surface, one can achieve an accurate adaptation of the margins of the prosthesis and is consonant with the esthetic Indices [3]. The technique of vestibular chamfer preparation combined with lingual vertical preparation is new, which allows considering their advantages. This mixed preparation concept enhances the health of the existing marginal, while improving the esthetic result of the restoration because it reduces the naked thickness of the ceramic at the vestibular margin [4]. The decision to use layered lithium disilicate crowns in this regard compounds these gains in that the material is inherently translucent and has good color rendition, thus providing a near-realistic look as patients expect [5]. In the clinical case described in this study, this dual preparation technique was used on six anterior mandibular teeth including 4. 1, 4. 2, 4. 3, 3. 1, 3. 2, and 3. 3. The crowns were made using pressed surfaced crowns of layered lithium disilicate, capitalizing on the material strength and aesthetically to the maximum [6]. The idea of the technique was to achieve a vertical preparation on the lingual aspect with a potential of stiffness and resistance and aesthetic finishing on the facial aspect in a chamfered pattern that is also aesthetically pleasing [7]. This case demonstrates the future of applying enhanced preparation methods with superior ceramics to restore teeth [8].

Materials and Methods

The emphasis was placed on the mandibular anterior teeth: 4. 1, 4. 2, 4. 3, 3. 1, 3. 2, and 3. 3 – which need revealed the necessity of stable functionality and a more attractive design. Considering the necessity of an esthetic and long-lasting restoration, vestibular chamfer preparation associated with lingual vertical preparation was applied for the fabrication of the crowns. This approach was supposed to keep all the mechanical advantages associated with the vertical preparation stage while allowing for the best aesthetic outcome as created by the modified chamfer technique [9]. The crowns were fabricated using CAD/CAM technology with dentin-matching lithium disilicate, precisely tailored to fit the morphological features of the patient's teeth. The decision of using lithium disilicate was based on its mechanical strength and or esthetic resemblance to human enamel (Fig. 1) [10]. The restorations were cemented using Variolink Esthetic light-cure resin cement (Ivoclar Vivadent, Liechtenstein) as it has a very good adhesive properties and the esthetic results are always good if lithium disilicate restoration is being used (Figs. 2-4) [11]. The bonding protocol was quite procedural as expected for lithium disilicate restorations. The teeth surfaces were then conditioned with 37% phosphoric acid to provide better bonding between the tooth and the cement while the internal surfaces of the crowns were treated with a silane coupling agent to improve on the chemical bond with the resin cement [12]. The resin cement was then applied on both the etched enamel/dentin tooth surfaces and on the inner sides of the crowns. All the crowns were placed properly and then light-cured for 40 seconds/tooth to allow complete solidification of cement for perfect retention [13]. Any part of the excess cement which could interfere with the occlusion was shaved off carefully and

the occlusion was checked and adjusted accordingly [14]. The patient was followed up and after various appointments assessing the functions and aesthetics of the restorations. The patient had high satisfaction toward the final esthetics, and no report of fracture or debonding of the restorations was evident in the six-year recall period [15].

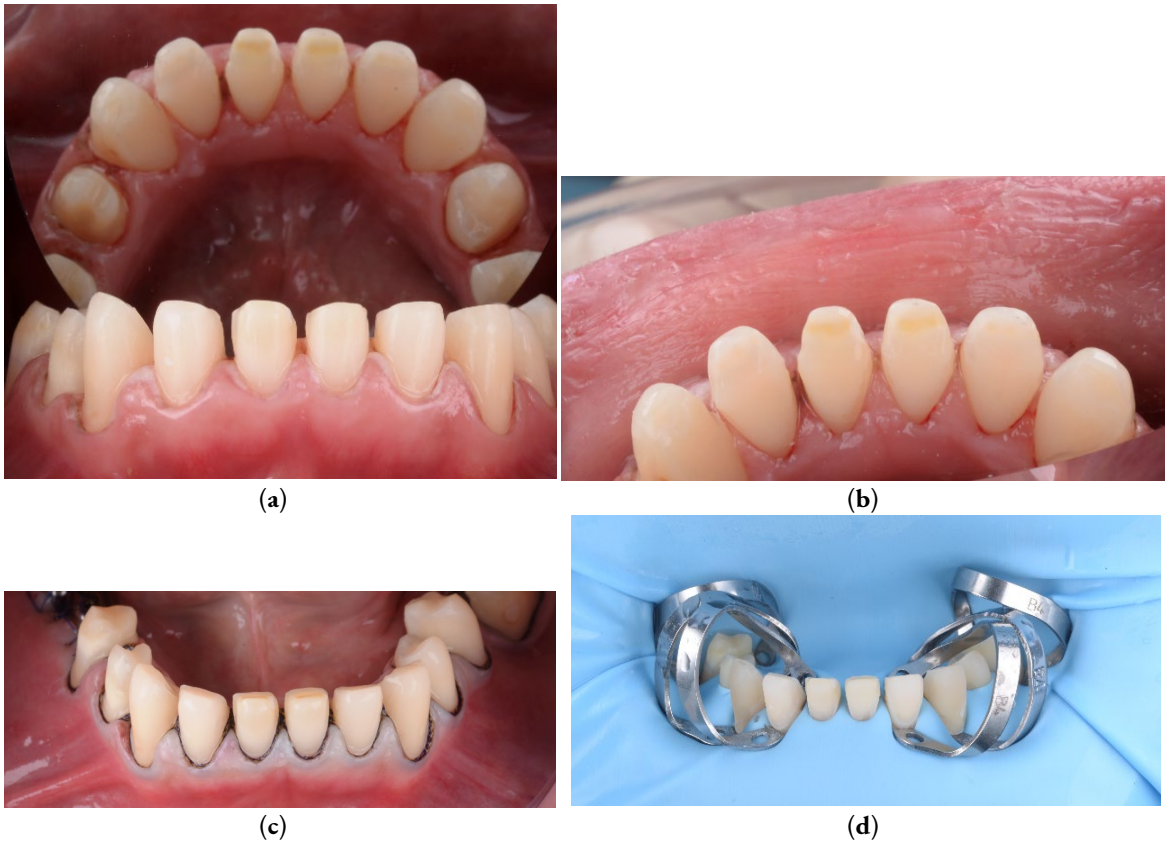
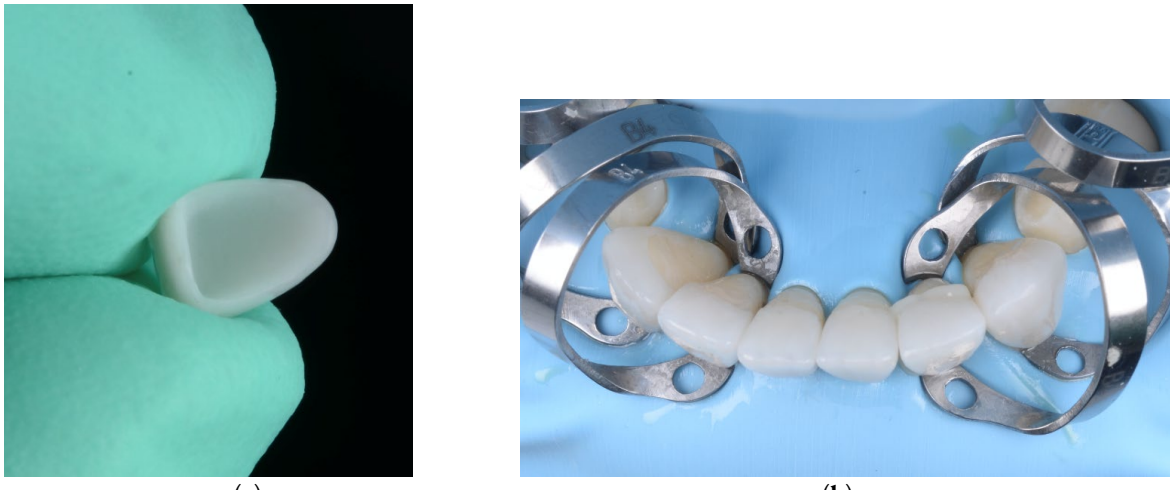
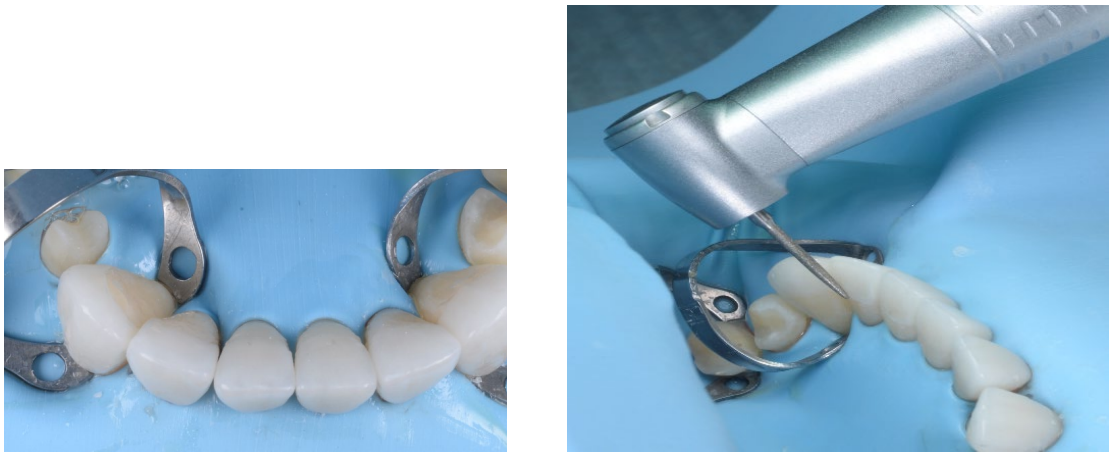


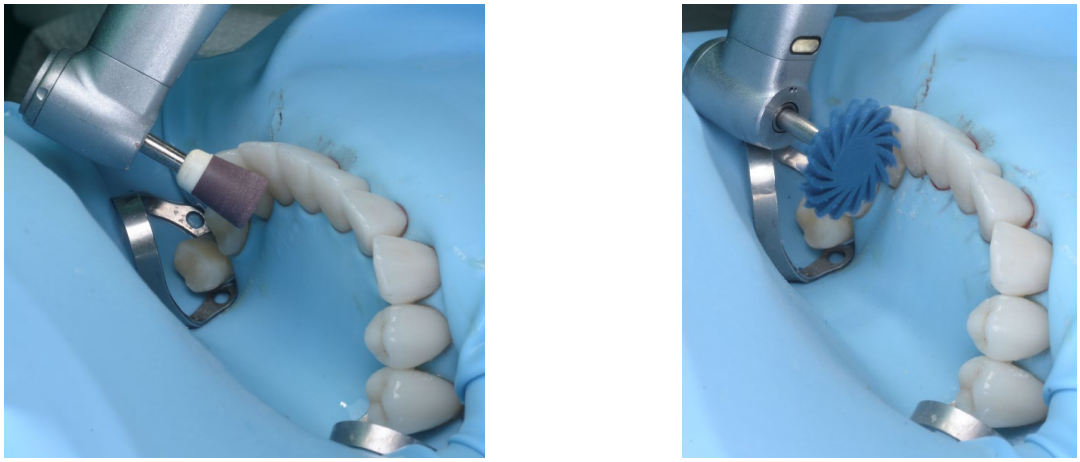
Figure 1. (a) The appearance of the dental units after the preparations on the lower anterior group: a modified chamfer was prepared on the labial surface, while verti-prep was performed on the lingual surface. (b) The appearance of the vertical prep preparations on the lingual surfaces of the dental units in the lower anterior group. (c) The appearance of the restoration after the insertion of gingival retraction cords for impression taking. (d) Isolation to secure the fixation of the lithium disilicate prosthetic restoration.





(**c**) (**d**)

Figure 2. (**a**) The thickness of the lithium disilicate restorations that were to be fixed and adapted to the surface of the dental units prepared with the two types of preparation: vestibular - modified chamfer and lingual vertiprep; (**b**) The appearance of the restorations at the moment of fixation: the restoration was secured on the dental unit 3.2 ; (**c**) The appearance of the restorations after fixation with a dual-cure luting resin cement (Variolink Esthetic LC, Ivoclar Vivadent, Schaan, Liechtenstein) was enhanced by finishing the accessible restoration margins with a red-coded diamond bur (Komet, Lemgo, Germany) (**d**) The finishing of the surface where the vertiprep preparation was performed and polished using the OptraFine Diamond Polishing System (Ivoclar Vivadent, Schaan, Liechtenstein).



(**a**) (**b**)

Figure 3. (a), (b) The finishing was done at the marginal closure on the lingual surface of the restorations in the lower anterior group with finishing cup (Astropol F, Ivoclar Vivadent, Schaan, Liechtenstein) and rubber polishing disc, (Diacut Shofu, Kyoto, Japan).

Figure 4. The final appearance of the layered lithium disilicate restorations after finishing and fixation.

Results

In terms of the aesthetic appearance of the face as well as in vital functionality, this clinical case represents a positive result. Just after the placement of the analyzed restorations, the patient reported a high satisfaction with their esthetic characteristics. They revealed that the veneered lithium disilicate crowns were of a natural-looking opacity and shade. This proved in agreement with the patient's aesthetic expectation during more follow-up visits after placement of the restorations since they blended well with the natural dentition.[16] Functionally, the crowns gave stability and comfort to the patient and the patient complaint was free of sensation problems or improper biting. Both vestibular chamfer and lingual vertical preparation were included in the clinical procedures that contributed to improved fit and retention of the crowns signed for sustained durability levels (Fig. 1) [17]. After 6 years, all restorations did not exhibit any sign of fracture, chipping or wear away even when tested with the occlusal loading. The maintenance of this kind of performance over the long-term suggests that the tactic of treatment—as well as the use of layered lithium disilicate crowns along with the pre-treatment preparation methods—can thus be deemed largely successful from the prosthetic perspective [18]. The permanent nature and practical advantage of the restorations also support the validity of this method in accomplishing long-term restorative objectives that address function in addition to facial looks. [19].

Discussion

The vestibular chamfer and lingual vertical preparation techniques along with the layered lithium disilicate crowns present a new paradigm shift in the restorative dentistry, with the provision of providing an enhanced aesthetics and functionality of the dental restorations. This case therefore illustrates how this double preparation method works, outlining a number of benefits for its use and possibly some issues which may be of relevance for clinical practice [20]. Among other benefits, shown also in this case, was the improved esthetical result obtained due to the use of single lithium disilicate crowns with veneering. It was easy to achieve a different level of transparency because the material is already translucent and it can replicate the natural enamel, which is very important in the anterior areas where esthetics plays a significant role [21]. The role of the vestibular chamfer preparation in this case was most important in creating an exact marginal fit in addition to the ability to produce aesthetic restorations. This is in concordance with other studies that post that margin design plays a crucial role in determining the outcomes of aesthetic restorations [22]. From a functional standpoint, the restorations provided clinically acceptable and comfortable performance throughout the entire six-year observation period. The lingual vertical preparation helped in maintaining the mechanical integrity of the crowns, in a manner that focused on the 'cores' of the teeth. This is in concord with the known benefits of using vertical preparation techniques which are known to be conservative on the tooth structure and increase retention and longevity of the restoration [23]. However, it is necessary to note possible shortcomings of this work though the observed success indicates its effectiveness. Lithium disilicate ceramics are highly strong and durable restorative material but its success largely depends on the right skill and technique of the operator and another crucial factor which is the handling of the material. Any change in preparation or bonding parameters may cause problems affecting the durability of the restoration. Fortunately, in this study, such issues were not encountered, and the crowns remained entirely free of fractures or wear, even during long-term follow-up. [24]. This case also underlines the relevance of patient satisfaction in rating of restorative outcomes. Overall, the patient level of satisfaction was high both from aesthetic and functional point of views which gives a clue that the treatment was successful. Considering the absence of any complications and long-term retention of the restorations, it could be proposed that this approach could be used similarly in situations, when both esthetical and functional results are critical [25].

Conclusions

Therefore, by incorporating the vestibular modified chamfer and the lingual vertical preparation with the layered lithium disilicate crowns the concept is highly appealing in the field of restorative dentistry. Thus, this approach achieves the twofold goal of being aesthetically appealing and mechanically sound and makes this procedure a beneficial contribution to the spectrum of restorative methods. That is why future research and clinical application should go on further in this method and realize the potential of this material comprehensively as well as consider the extensive use for various kinds of restorative problems. The longevity observed in this disparity serves as evidence that, when properly applied, this technique is capable of delivering long-lasting and satisfactory outcomes for patients [26].

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References

1. Zhang, Y.; Lee, J.J.-W.; Srikanth, R.; Lawn, B.R. Edge chipping and flexural resistance of monolithic ceramics. *Dent. Mater.* **2013**, *29*, 1201–1208.
2. Güngör, M.B.; Nemli, S.K. Advantages and disadvantages of different crown systems. *J. Oral Res. Rev.* **2016**, *8*, 33–37.
3. Pjetursson, B.E.; Valente, N.A.; Strasding, M.; Zwahlen, M.; Liu, S.; Sailer, I. A systematic review of the survival and complication rates of zirconia-ceramic and metal-ceramic multiple-unit fixed dental prostheses. *Clin. Oral Implant. Res.* **2018**, 29 (Suppl. 16), 184–198.
4. Leevailoj, C.; Palamara, J.E.A.; Messer, H.H.; Burrow, M.F. Fracture resistance of teeth restored with different bonded ceramic inlay restorations. *J. Dent.* **2002**, *29*, 303–308.
5. Kelly, J.R.; Benetti, P. Ceramic materials in dentistry: Historical evolution and current practice. *Aust. Dent. J.* **2011**, *56* (Suppl. 1), 84–96.
6. Conrad, H.J.; Seong, W.J.; Pesun, I.J. Current ceramic materials and systems with clinical recommendations: A systematic review. *J. Prosthet. Dent.* **2007**, *98*, 389–404.
7. Heffernan, M.J.; Aquilino, S.A.; Diaz-Arnold, A.M.; Haselton, D.R.; Stanford, C.M.; Vargas, M.A. Relative translucency of six all-ceramic systems. Part II: Core and veneer materials. *J. Prosthet. Dent.* **2002**, *88*, 10–15.
8. Valenti, M.; Valenti, A. Retrospective survival analysis of 261 lithium disilicate crowns in a private general practice. *Quintessence Int.* **2009**, *40*, 573–579.
9. Stappert, C.F.; Att, W.; Gerds, T.; Strub, J.R. Fracture resistance of different partial-coverage ceramic molar restorations: An in vitro investigation. *J. Am. Dent. Assoc.* **2006**, *137*, 514–522.
10. Magne, P.; Cascione, D. Influence of post-etching cleaning and silane drying time on the bond strength of composite resin to a feldspathic porcelain. *J. Prosthet. Dent.* **2006**, *96*, 354–361.
11. Palla, E.S.; Kontonasaki, E.; Kantiranis, N.; Papadopoulou, L.; Zorba, T.; Paraskevopoulos, K.M.; Koidis, P. Color stability of lithium disilicate ceramics after aging and immersion in common beverages. *J. Prosthet. Dent.* **2018**, *119*, 632–642.
12. Sulaiman, T.A.; Abdulmajeed, A.A.; Donovan, T.E.; Vallittu, P.K.; Närhi, T.O.; Lassila, L.V.J. The effect of different polishing systems on surface roughness and gloss of different CAD/CAM ceramic materials. *J. Prosthet. Dent.* **2015**, *113*, 389–395.
13. Burke, F.J.; Crisp, R.J.; Cowan, A.J.; Redfearn, P.J.; Hughes, J.A.; Thornhill, M.H. Five-year clinical evaluation of zirconia-based bridges in patients in UK general dental practices. *J. Dent.* **2013**, *41*, 992–999.
14. Ferrari, M.; Cagidiaco, M.C.; Goracci, C.; Vichi, A.; Mason, P.N. Effect of resin luting cement filler content on post cementation. *J. Dent.* **2001**, *29*, 257–262.
15. Papia, E.; Larsson, C.; du Toit, M.; Vult von Steyern, P. Bonding between oxide ceramics and adhesive cement systems: A systematic review. *J. Biomed. Mater. Res. Part B Appl. Biomater.* **2014**, *102*, 395–413.
16. Guess, P.C.; Kuliš, A.; Witkowski, S.; Wolkewitz, M.; Zhang, Y.; Strub, J.R. Shear bond strengths between different zirconia cores and veneering ceramics and their susceptibility to thermocycling. *Dent. Mater.* **2008**, *24*, 1556–1567.
17. Sundh, A.; Sjögren, G. Fracture resistance of all-ceramic zirconia bridges with differing phase stabilizers and quality of sintering. *Dent. Mater.* **2006**, *22*, 778–784.

18. Oyar, P.; Canoglu, E.; Tozlu, M.; Eren, H. Clinical evaluation of two different CAD/CAM fabricated ceramic materials: A randomized controlled trial. *J. Prosthodont. Res.* **2019**, *63*, 342–347.
19. Zarone, F.; Russo, S.; Sorrentino, R. From porcelain-fused-to-metal to zirconia: Clinical and experimental considerations. *Dent. Mater.* **2011**, *27*, 83–96.
20. Veneziani, M. Posterior indirect adhesive restorations: Updated indications and the Morphology Driven Preparation Technique. *Int. J. Esthet. Dent.* **2017**, *12*, 204–230.
21. Politano, G.; Van Meerbeek, B.; Peumans, M. Indirect composite veneers: A review of the literature. *J. Adhes. Dent.* **2018**, *20*, 91–104.
22. Addison, O.; Marquis, P.M.; Fleming, G.J. The impact of aqueous aging on the strength of alumina and feldspathic dental ceramics. *J. Prosthet. Dent.* **2007**, *97*, 381–386.
23. Jevremović, D.; Todorović, A.; Lazić, Z.; Živković, S.; Marković, D.; Mirković, N.; Mihailović, B. A comparative analysis of two CAD/CAM ceramics on the marginal adaptation of all-ceramic crowns. *BMC Oral Health* **2020**, *20*, 1–9.
24. Al-Zordk, W.; Saker, S.; Mously, H.A.; Aboushelib, M. Effect of different surface treatments on the bonding strength and durability of monolithic zirconia restorations. *J. Adhes. Dent.* **2018**, *20*, 259–265.
25. Denry, I.; Kelly, J.R. State of the art of zirconia for dental applications. *Dent. Mater.* **2008**, *24*, 299–307.
26. Kern, M.; Wegner, S.M. Bonding to zirconia ceramic: Adhesion methods and their durability. *Dent. Mater.* **1998**, *14*, 64–71.