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CLINICAL REPORT

Virtually designed and CAD/CAM-fabricated lithium disilicate prostheses for an esthetic maxillary rehabilitation: A senior dental student clinical report

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ABSTRACT

During their education, dental students seek to be involved in comprehensive esthetic treatment for the rehabilitation of lost, damaged, or discolored tooth structure. Due to technological advances and patient exposure to dental advertising, recent dental school graduates can find themselves under great expectations with limited clinical experience. With the implementation of an oral health and rehabilitation department at the University of Louisville Dental School, dental students have the opportunity to plan treatment and treat such patients under the supervision of faculty with advanced training in prosthodontics and restorative dentistry. The work flow of multiple consecutive lithium disilicate ceramic prostheses using a digital impression, virtual CAD/CAM design, and milled fabrication as planned and executed by a senior dental student is presented. (J Prosthet Dent 2015;■:■-■)

Ceramic materials have long been used in clinical dentistry to mimic the appearance of natural dentition.[1] Heat pressed lithium disilicate glass ceramic, first described by Brodkin et al[2] in 1998, consists of approximately 65% lithium disilicate in the form of crystalline structures[3] and is a relatively strong ceramic with high flexural strength and excellent translucency.[4] It can be etched and bonded to both enamel and dentin[5] and can be used for anterior and posterior single crowns, anterior fixed dental prostheses,[6-8] and laminate veneers,[9] all of which provide excellent esthetics.[10,11]

Digital scanning technology has been introduced as an alternative to conventional impression techniques and materials, and has been incorporated into the curriculum of several dental schools. Clinical evaluation of intraoral digital impressions has shown promising results.[12]

The purpose of this paper is to present a maxillary rehabilitation for a patient within the predoctoral curriculum at the University of Louisville Dental School. The treatment involved lithium disilicate ceramic restorations using a digital impression with virtual computer-aided design/computer-aided manufacturing (CAD/CAM).

CLINICAL REPORT

A 43-year-old healthy man was referred to the Department of Oral Health and Rehabilitation for maxillary esthetic rehabilitation. A comprehensive examination was performed with a complete series of intraoral radiographs. The patient's chief complaint was the color and shape of his dentition, especially his maxillary anterior teeth (Fig. 1).

After completion of his initial phase I dental treatments, caries risk reassessment and periodontal review revealed improved oral hygiene and reduced risk factors for future dental caries or periodontal disease. After careful consideration by the patient, vital whitening therapy followed by indirect ceramic prostheses was selected to address his esthetic concerns. The treatment for each tooth is detailed in Table 1. An implant-

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Figure 1. Before treatment, frontal view.

Figure 2. Pretreatment diagnostic waxing.

Table 1. Prostheses by tooth

Tooth	Indirect Prosthesis	Foundation	Retention
Maxillary right premolars	emax CAD A1 (Implant supported complete crowns)	CAD Custom Zirconia	Resin Cement RelyX Unicem 2
Maxillary canines	emax CAD A1 (Laminate Veneers)	Natural Tooth	Resin Cement RelyX Unicem 2
Maxillary incisors	emax CAD A1 (Complete crowns)	Natural Tooth	Resin Cement RelyX Unicem 2
Maxillary left first premolar	emax CAD A1 (Onlay)	Natural Tooth	Resin Cement RelyX Unicem 2
Maxillary left second premolar	emax CAD A1 (Complete crown)	Natural Tooth	Resin Cement RelyX Unicem 2

supported prosthesis (RN 4.1; Straumann) was designed to replace the missing maxillary right premolars and implants were placed with a conventional protocol.

Diagnostic impressions were made for treatment planning with irreversible hydrocolloid impression material (Jeltrate Fast Set; Dentsply Caulk) and poured with type III dental stone (Buff stone; Whip Mix Corp). Casts were articulated in a semi-adjustable articulator (Model 2240; Whip Mix Corp) with a face bow transfer (Model 8645; Whip Mix Corp). Diagnostic waxing was completed by a dental laboratory (Roy Dental Laboratory, New Albany, Ind) and returned for chairside evaluation (Fig. 2). The approved diagnostic waxing was duplicated and scanned for reference in designing the future definitive prostheses.

An at-home whitening kit with 15% carbamide peroxide (Opalescence; Ultradent Corp) was given to the patient for use in reservoirs overnight daily for 6 weeks. The maxillary anterior teeth receiving complete crowns were prepared with a chamfer margin of 1 mm all around, 1.5 facial, and 1 mm lingual axial reduction (BR856.31.021, medium chamfer round-end taper; Brasseler). The teeth receiving laminate veneers were prepared with a light chamfer 0.5-mm reduction at the margin (gingival) to 0.8-mm reduction on facial surfaces (incisal) and a 1.5-mm incisal reduction and lingual chamfer 2 mm above the occlusal contact by using a round-ended diamond cutting instrument (BR856.31.012 medium chamfer round-end taper; Brasseler) and a reduction guide.

The soft tissue was displaced with a single cord technique (Ultradent Products Inc). A digital impression of the prepared maxillary teeth and the implants (Straumann RC Scanbody; Straumann) was obtained with iTero CAD software (Align Technology Inc). Additionally, a digital scan of the opposing mandibular teeth and closed jaw record were made (Fig. 3). The scanning data were sent electronically to the scan center of a commercial dental laboratory (Roy Dental Laboratory, New Albany, Ind) to mark the preparation margins, perform a virtual ditching process, print a physical model (Fig. 4), and fabricate the prostheses.

Immediate direct interim restorations were fabricated with an autopolymerizing composite resin material (Integrity; Denstply Caulk). The interim veneers and the onlay were bonded with flowable composite resin (Esthet-X Flow; Denstply Caulk) after a single spot acid etch in the mid-facial enamel. Excess flowable composite resin was removed, and each restoration was polymerized with a calibrated polymerization light (Broadband LED Curing Light; Ultradent Products Inc) on the standard setting. The complete crowns were temporarily luted with a noneugenol cement (TempBond-NE; Kerr Corp). The occlusion was evaluated and adjusted accordingly.

The printed physical model of the complete arch preparations was scanned (CS2 scanner; Straumann), and the data were transferred to the design software (7.0 Software; Dental Wings). The definitive modified diagnostic waxing was also scanned with the same scanner, and the data were transferred to the software and used as a preexisting library definitive design. The scanned waxing was superimposed over the scanned preparation (Fig. 5). The CAD was modified, finalized (Fig. 6), and milled to the anatomic contour from low translucency

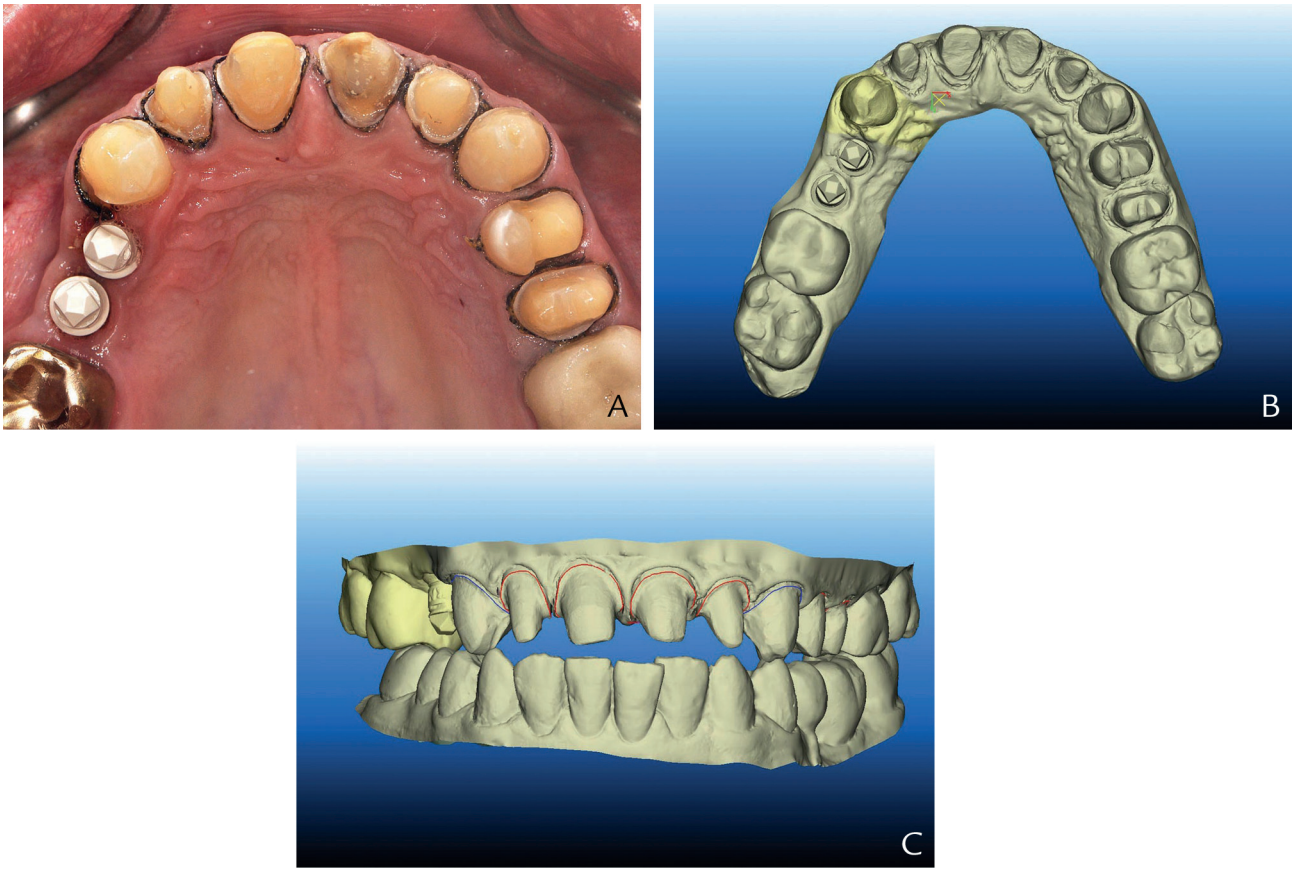

Figure 3. Prepared maxillary teeth and digital impression. A, Occlusal view. B, Frontal view of digital impression. C, Occlusal view of digital impression.

milling blocks (LT e.max CAD, Vita A1; Ivoclar Vivadent) at a milling center (Straumann Arlington).

A trial insertion of the definitive milled restorations at the precrystallized (blue phase) stage was completed to verify the marginal fit, internal adaptation, overall esthetics, and patient satisfaction (Fig. 7).[13] Two screw-retained custom zirconia abutments were inserted and periapical radiographs made to verify complete seating. All restorations were evaluated individually and collectively, and interproximal and occlusal contacts were adjusted with a fine grit diamond rotary instrument (BR8856.31.012 fine chamfer round-end taper; Brasseler). After adjustments, the restorations were returned to the dental laboratory for sintering, glazing, and polishing.

At the definitive insertion appointment, the 2 screw-retained zirconia abutments were reinserted, and periapical radiographs made to verify complete seating. The zirconia abutments were then tightened to 35 Ncm, and the access openings were covered with single-component resin sealing material (Fermit; Ivoclar Vivadent). Marginal adaptation, restoration fit, interproximal contacts, and occlusion were verified individually and collectively with a translucent evaluation paste (RelyX Veneer; 3M ESPE). Adjustments were made with a fine diamond rotary instrument (BR8856.31.012 fine chamfer round-end taper; Brasseler) and polished with a chairside lithium disilicate ceramic polishing kit (Dialite LD; Brasseler). After approval by the patient, all internal bonding surfaces of the restorations were etched with 10% hydrofluoric acid for 25 seconds and silanated (Porcelain Dental Etchant Prep Kit; Pulpdent Corp). The restorations were cemented one at a time with a translucent resin cement (RelyX Unicem 2; 3M ESPE) according to the manufacturer's recommendations. Any remaining enamel was etched with 37% phosphoric acid for all partial ceramic crowns, including the veneers and the onlay. All excess cement was removed from the margins and polymerized with the polymerization light on the standard setting. The completed restorations can be seen in Figures 8 and 9. An occlusal device was provided to protect the restorations. Phase II reviews were completed, and the patient was placed on 6-month recalls.

DISCUSSION

Glass ceramics, especially lithium disilicate, have shown high esthetic potential when planned correctly.[14] The

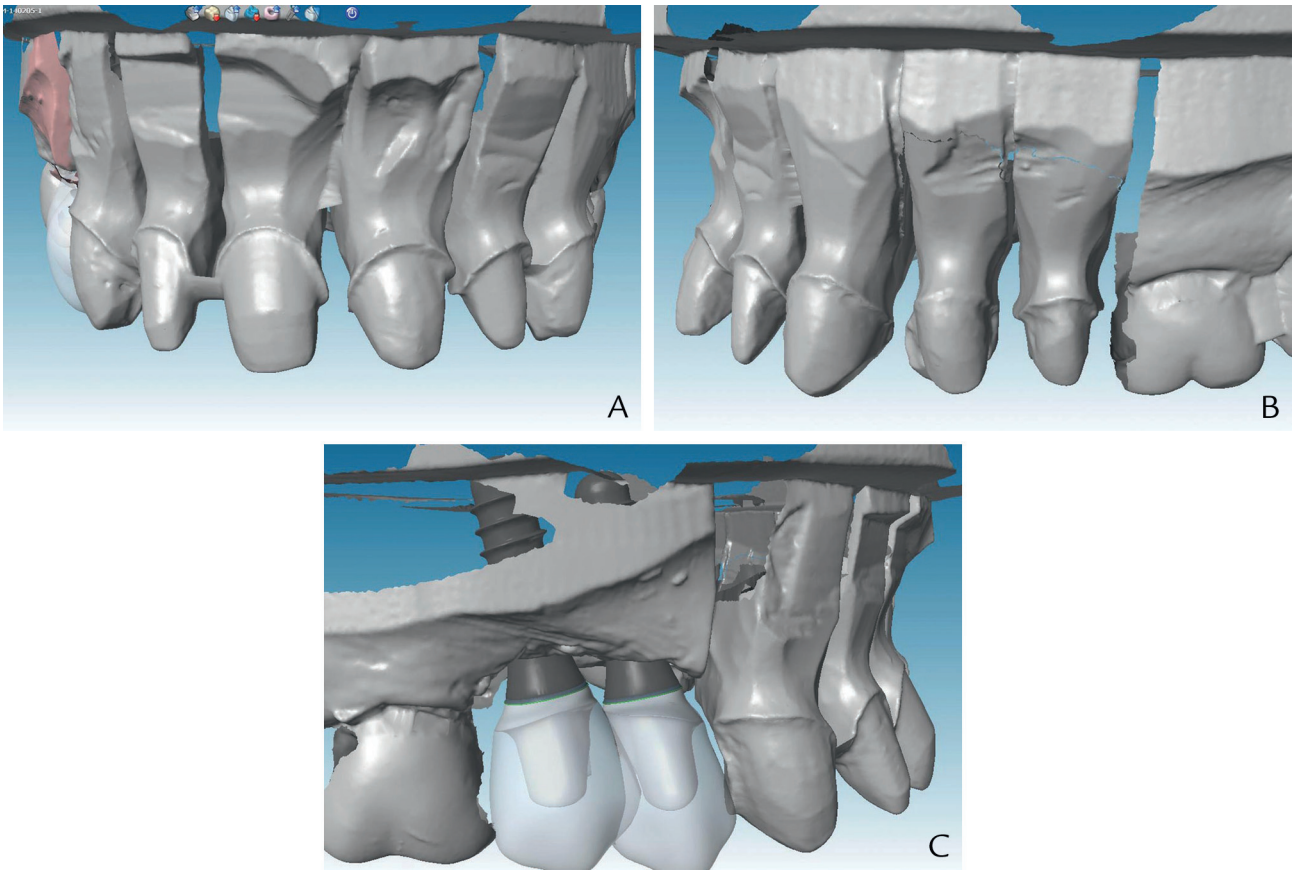

Figure 4. Virtual master cast. A, Frontal view. B, Left lateral view. C, Right lateral view.

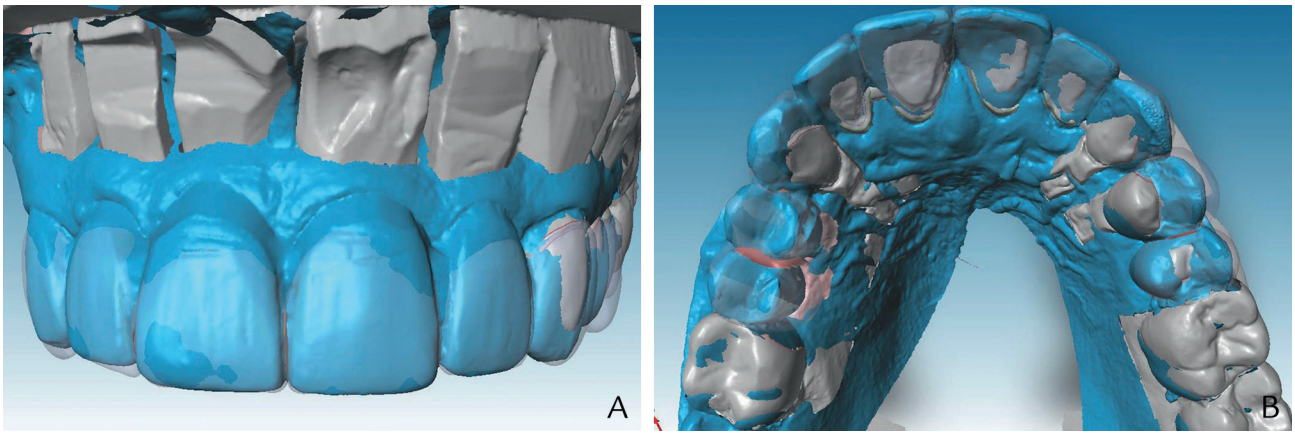

Figure 5. Scan of maxillary diagnostic waxing. A, Frontal view. B, Occlusal view.

contour, shade, and form of all restorations were clinically acceptable as mimicked from the scanned and superimposed digital duplicate of waxing. However, the breadth and depth of color should be compared to both laboratory hot-pressed and feldspathic-layered ceramic restorations. The previously mentioned techniques allow artistic detailing and surface characterization by an experienced laboratory technician or ceramist to provide fine details lacking in CAD designing software. The CAD software limitations and the low translucency monochromatic blocks may have restricted the esthetic potential of this maxillary rehabilitation.

During dental student instruction, it must be emphasized that this is an alternative method to conventional impression technique, not a complete replacement, and that such a comprehensive treatment

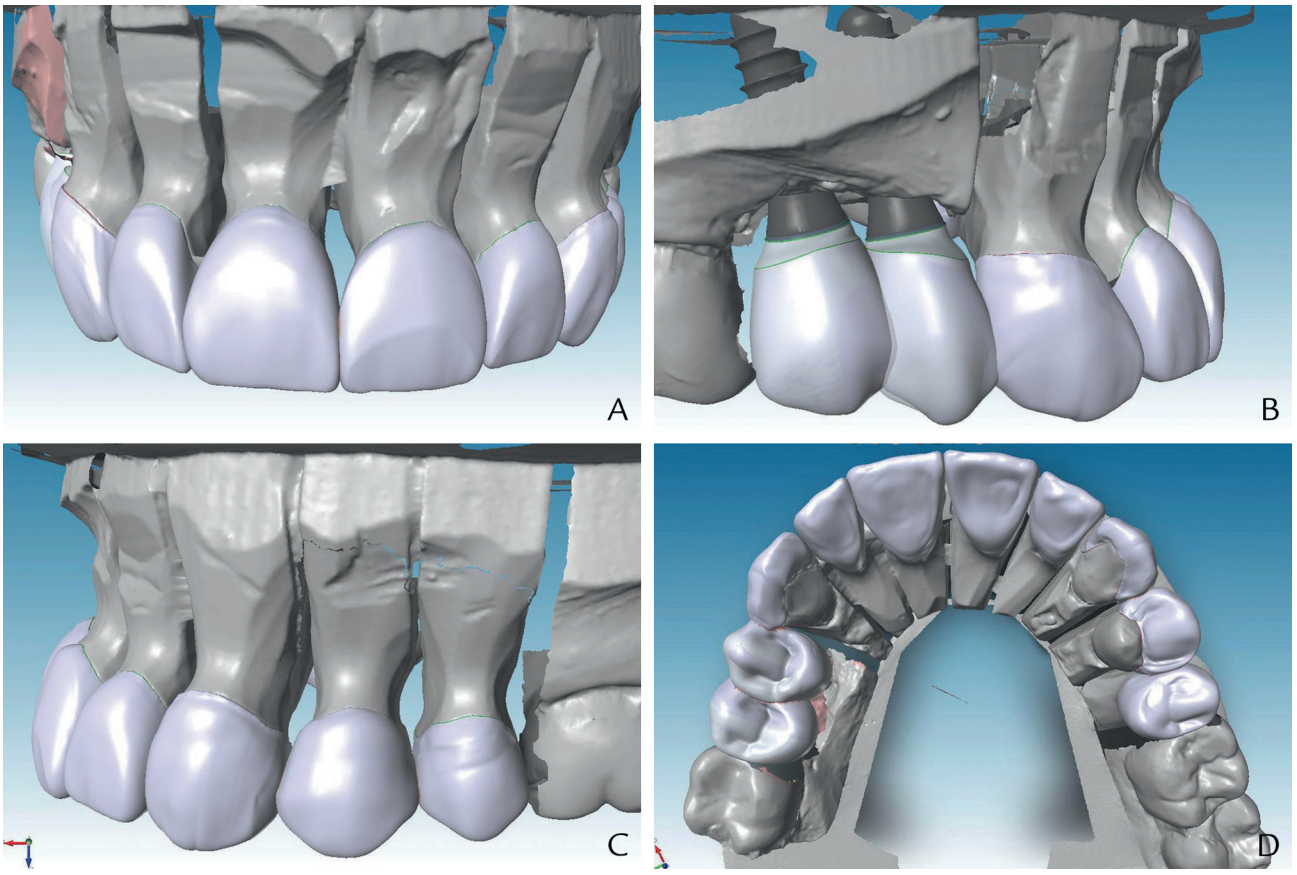

Figure 6. CAD (virtual design) of definitive restorations. A, Frontal view. B, Right lateral view. C, Left lateral view. D, Occlusal view.

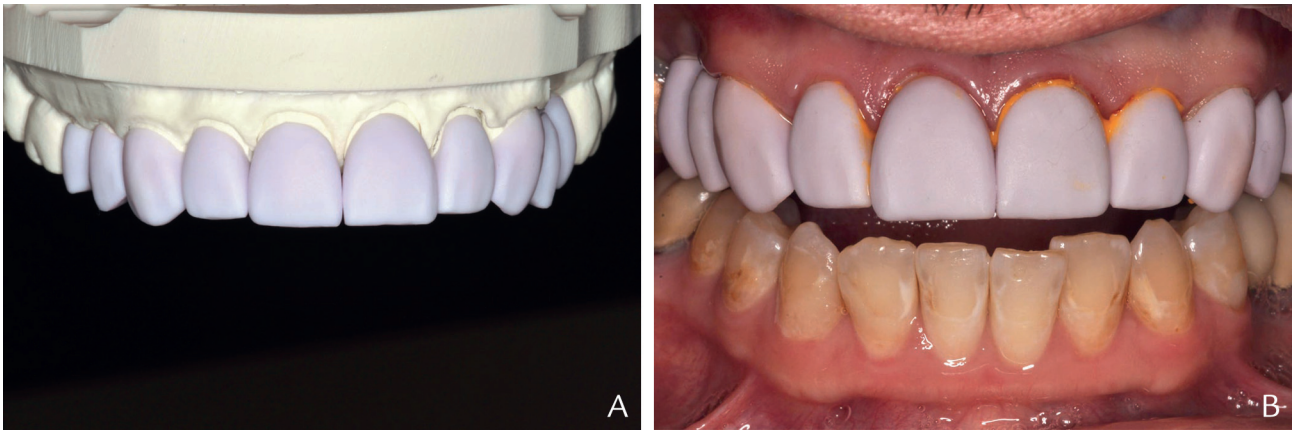

Figure 7. A trial insertion of milled (CAM) restorations at the precrystallized (blue phase) stage. A, Milled restorations on cast. B, Trial insertion at precrystallized stage.

involving multiple crowns in the esthetic zone is not a routine treatment choice among dental students. To provide proper care for patients seeking such treatment at the predoctoral level, assigned predoctoral students must be experienced in fixed prosthodontics and be closely supervised by a qualified faculty member.

SUMMARY

This clinical report presented a digital workflow for multiple lithium disilicate restorations performed with digital fabrication as planned and executed by a senior dental student. The technique not only provides the opportunity to enhance esthetics by using e.max

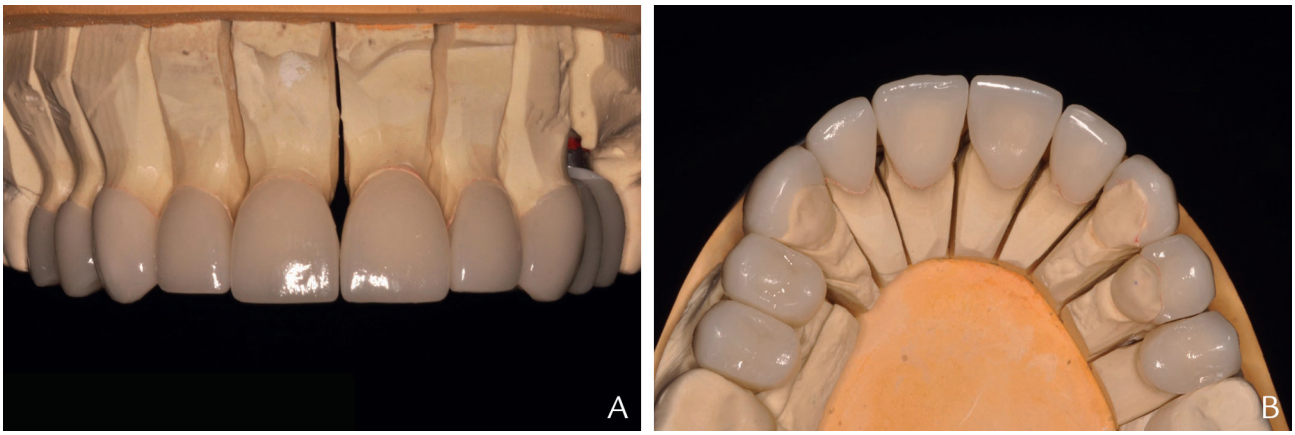

Figure 8. Maxillary final restorations before insertion. A, Frontal view. B, Occlusal view.

Figure 9. Definitive restorations after placement. A, Frontal view in maximum intercuspation. B, Frontal view. C, Maxillary occlusal view. D, Smile after treatment.

definitive restorations but helps in preparing dental students for contemporary dental practices.

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