

Esthetic and functional rehabilitation of crowded mandibular anterior teeth using ceramic veneers: A case report

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The use of ceramic veneers to restore crowded teeth in the maxilla has been widely discussed in the literature; however, the use of this technique in the mandible has received little attention. Therefore, this case report describes the treatment of crowded mandibular anterior teeth using ceramic veneers. The primary treatment challenge in this region is the reduced tooth structure available for rehabilitation. Proper communication between the clinician and dental technician is required to achieve clinical success. This article presents a straightforward treatment plan and restorative technique that includes both the clinical and laboratory sequences necessary for predictable and stable postoperative outcomes. (*Quintessence Int* 2012;43:xxx-xxx)

Key words: ceramic veneer, anterior esthetics, lower incisors, crowded teeth

Certain deficiencies in physiologic facial development, such as improper growth of facial bones and tooth movement in children and teenagers, often escape early detection. As a result, such conditions may lead to esthetic and functional problems¹⁻³ that require modification of the positions of the anterior teeth. In cases of crowded and misaligned mandibular anterior teeth, orthodontic treatment is typically the first option.⁴⁻⁶ This well-established approach generally results in correct dental positioning.⁷⁻¹¹ However, although several innovative materials (eg, ceramic brackets and heat-activated archwire) and techniques

(eg, involving lingual appliances¹² and polymer-based removable devices^{13,14}) have been developed in recent years, some patients are reluctant to undergo orthodontic therapy due to professional and/or social limitations. In such cases, or if orthodontic therapy is not indicated, alternative treatments can be proposed, including direct or indirect resin-based restorations, indirect ceramic restorations, and ceramic veneers.

Direct composite resin restorations, which offer a minimally invasive approach, are indicated for minor tooth modifications in areas without intense occlusal loading.^{15,16} Indirect laboratory-processed composite resin anterior restorations allow for a conservative preparation but have shown limitations in terms of color stability¹⁷ and wear resistance compared to indirect ceramic restorations.¹⁸ In some cases, indirect restorations require extensive tooth preparation and lead to endodontic therapy, particularly when mandibular anterior teeth are involved. The mandibular incisors have a relatively reduced amount of dental tissue,¹⁹ and the operatory sequence for crown preparation may lead to removal of most of the coronal structure, thus compromising the outcome of treatment. However, with the advent of contemporary esthetic

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Fig 1 Preoperative view of the mandibular arch showing crowded anterior teeth.

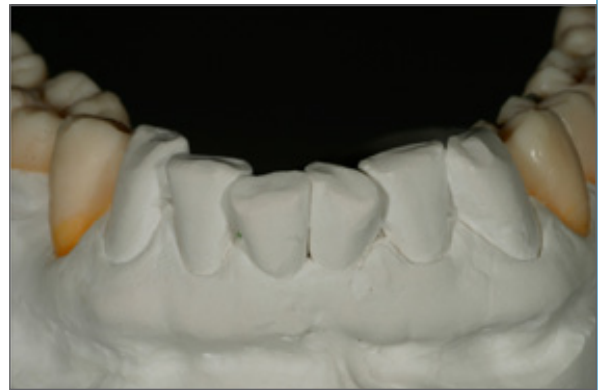


Fig 2 Diagnostic wax-up of the posterior teeth, which increased the vertical dimension of occlusion by approximately 1.0 mm. Worn facets can be seen at the facial and incisal surfaces of the anterior teeth, particularly the canines.

materials and new restorative techniques, clinicians and technicians can now offer optimal esthetic and functional results with minimal loss of tooth structure through the use of ceramic veneers.

This article describes the clinical and laboratory procedures in the esthetic rehabilitation of crowded mandibular incisors using ceramic veneers. Successful communication between the clinician and dental technician is also emphasized in this clinical case report. Proper treatment planning is vital to successfully predict esthetic and functional outcomes and preserve the tooth structure, pulpal vitality, and periodontal health.

CASE REPORT

The 59-year-old female patient reported that she was displeased with her smile, primarily because her mandibular anterior teeth were crowded. At the first appointment, a range of treatment options was presented to the patient. After discussing these options, the patient and clinician decided to proceed with indirect ceramic restorations to provide an immediate esthetic improvement. Ceramic veneers with total (ie, crown) and partial (ie, overlay) ceramic restorations were made for the mandibular posterior teeth. All of the patient's maxillary teeth had been rehabilitated with ceramic crowns 2 years earlier. A nearly exact three-

dimensional preview of the final result was shown to the patient via a wax-up of the preoperative stone cast, which determined whether appropriate modifications could be made to correct the crowding.²⁰ The patient was pleased with the diagnostic wax-up. She also stated that she was aware of the limitations of this restorative approach. The patient signed a consent form indicating that other treatment possibilities had been clearly explained. The clinician also addressed all of her remaining doubts and questions prior to treatment.

To facilitate an understanding of this restorative approach, the diagnostic, clinical, and laboratory procedures are described in detail in this report.

Diagnostic procedures

The preoperative conditions, including the crowded mandibular anterior teeth (Fig 1), anterior guidance, incisal wear, gingival alignment, and bone anatomy, were evaluated. A comprehensive examination of caries was performed, and periapical radiographs of all mandibular teeth were taken to evaluate the periodontal condition. The clinician also examined the occlusion, masticatory muscles, soft tissues, and smile. Impressions of the maxillary and mandibular teeth were obtained using polyvinyl siloxane (Status Blue, Zenith/DMG-Foremost Dental) poured with high-precision dental plaster (type IV Vel Mix White Die Stone, Kerr) according to the manufacturer's instructions to produce the stone casts. The



Fig 3 Progressive wax up of the incisal edges of the anterior teeth. The red line indicates the ideal arch alignment.



occlusal relationship was registered using addition-cure silicone (OBite, DMG), and the facebow was taken. The stone casts were duplicated and mounted on a semi-adjustable articulator in centric relation for the diagnostic wax-up. The original (preoperative) stone casts were used to evaluate the patient's initial condition.

After the clinical and radiographic examinations, the interpretation of the results was vital to treatment planning. Adjunctive periodontal therapy was considered unnecessary since the radiographs revealed a healthy periodontal condition. Further, there were no discrepancies in the gingival architecture (ie, the midfacial tissue height and papilla shape and height). However, analysis of the occlusal plane of the mandibular teeth showed a discrepancy (loss in the vertical dimension of occlusion) between the anterior and posterior teeth.

Wax-up and provisionalization

A wax-up (Life-Like Presentation Wax, Whip Mix) of the posterior teeth was made in the laboratory (Fig 2). Additional space was required in the bilateral posterior region to correct the discrepancy in the vertical dimension of occlusion; therefore, the vertical dimension of occlusion was increased by approximately 1 mm. This modification significantly increased the space available for restorative material, allowing for a more conservative reduction of the anterior teeth.

After the wax-up of the posterior teeth was complete, the optimal positions of the anterior teeth were determined, and the ideal alignment of the incisal edges was waxed up (Fig 3). This process revealed that some severely misaligned areas of the anterior teeth would have to be removed to enable appropriate waxing (ie, to avoid overextension or overcontouring of the final

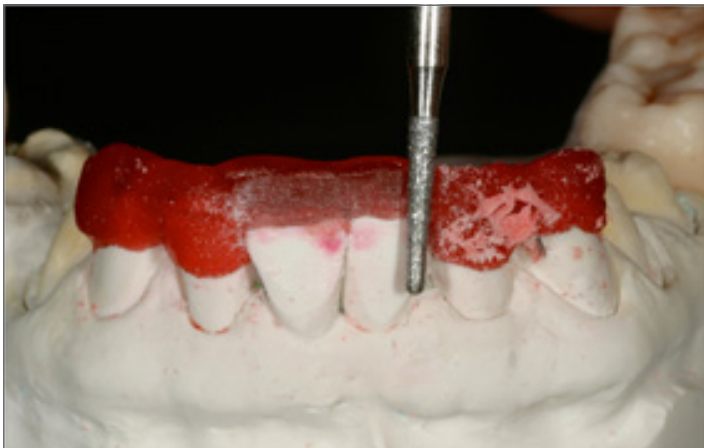


Fig 4 Facial view of the acrylic resin preparation guide. A pencil-shaped diamond bur was used to trim the facial aspect of both central incisors. The guide registers the alignment of the anterior teeth. The waxed-up premolars were removed to avoid damage.



Fig 5 Incisal view of the acrylic resin preparation guide on the stone cast. The facial projection of the central incisors is evident.



Fig 6 Simulation of the anterior tooth preparation.



restorations). For this purpose, the sites of misalignment were marked on the stone cast and primarily included the facial projection of the central incisors and the incisal edges of the left lateral incisor and canine and right central incisor, lateral incisor, and canine. After the wax-up of the incisal edges was removed, the stone cast was lubricated and acrylic resin (GC Pattern Resin, GC America) was placed on the incisal region of the anterior teeth to prevent the resin from reaching the retentive cervical regions. Next, the misaligned sites and

acrylic resin were simultaneously trimmed with a diamond bur (Fig 4). Thus, an acrylic resin guide was fabricated to help register the new dental arch alignment. When the acrylic resin guide was positioned on the intact stone cast, the misaligned tooth sites were evident (Fig 5).

Simulation of the anterior tooth preparations (Fig 6) and the complete diagnostic wax-up (Fig 7) were completed. Addition-cure silicone (Elite HD Putty Soft, Zhermack) was applied to the facial-incisal and lingual-incisal surfaces (Fig 8) of the



Fig 7 Completed diagnostic wax-up.



Fig 8 Silicone guide positioned on the lingual surface of the waxed-up stone cast.



diagnostic wax-up to fabricate the silicone preparation guides. These guides were used as a reference for the intraoral tooth preparation.

Provisional restorations were fabricated from the waxed-up stone cast (Fig 9). In cases of rehabilitation with ceramic veneers, the provisional restorations are usually connected to each other to form one piece, thus improving their stability. However, in the present clinical case, the provisional restorations were not connected to enable better oral hygiene.

Clinical procedures

The rehabilitation was initiated by preparing the posterior teeth for ceramic crowns (left first premolar to left second molar, right premolars, and right second molar) and for overlay (right first molar) restorations. Subsequently, the posterior provisional restorations were relined, adjusted, and temporarily cemented (Rely X Temp NE, 3M ESPE).

Prior to preparation of the anterior teeth for ceramic veneers, the misaligned teeth were prepared with the appropriate



Fig 9 Provisional restorations fabricated from the diagnostic wax-up.



Fig 10 Primary preparation of the facial surface of the central incisors using the acrylic resin guide.



diamond burs for each region (Komet, Brasseler) through the use of the acrylic resin guide (Fig 10). This process enabled the reproduction of the ideal arch alignment simulated on the stone cast. Next, the silicone guides were used during the reduction of the incisal, interproximal, and facial surfaces to confirm sufficient tooth removal and uniform thickness for the ceramic veneers (Fig 11). The preparations were conservative, and the reduction of two-thirds of the gingival lingual surface was not required. To favor the emergence profile of the ceramic restorations, chamfer finish lines were placed subgingivally (0.5 mm into the healthy sulcus) in some proximal

cervical areas, while the facial and lingual margins were supragingivally positioned. Even with careful treatment planning and the use of the guides, the central incisors required preparation extending into the dentin to achieve proper alignment in the mandibular arch. For this reason, immediate dentin sealing was performed using a self-etching adhesive system (Clearfil SE Bond, Kuraray) according to the manufacturer's instructions.

The double-cord technique was used to provide an appropriate marginal impression (UltraPak no. 000 [Ultradent] followed by Knitrax no. 00 [Pascal]). This technique is associated with a single-stage impres-



Fig 11 Silicone guide used to confirm sufficient space for the ceramic veneers.

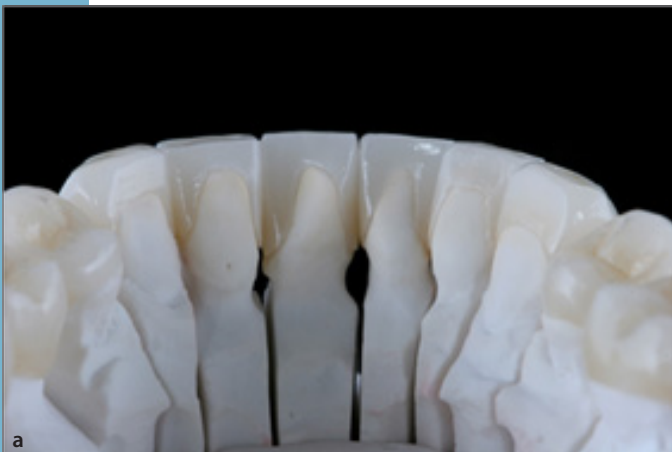


Fig 12 (a) Lingual view of the completed ceramic veneers. (b) Stone cast showing the preparation of the central incisors. Note that the preparations were expulsive to favor the insertion of the ceramic veneers.

sion, which was performed using an addition-cure silicone material (Virtual, Ivoclar Vivadent). The provisional restorations were relined, adjusted, and temporarily cemented (RelyX Temp NE).

Ceramic restorations

Registration data, molds, diagnostic wax-ups, and images were sent to the laboratory. It is crucial to transfer all clinical information to the technician for the construction of the ceramic restorations.

A leucite-reinforced glass-ceramic material (IPS Empress Esthetic, Ivoclar Vivadent) was selected for the anterior and posterior restorations (Fig 12). This material is sus-

ceptible to acid treatment, which provides micromechanical retention to the intaglio surface²¹ and allows for effective bonding to dental tissues via adhesive cementation. This ceramic system also shows excellent esthetic value and desirable mechanical properties, even at a minimal thickness (0.6 mm).²² Compared with its predecessor (IPS Empress), IPS Empress Esthetic has a smaller grain size and the leucite crystals are more homogeneously distributed,²² which enhances the mechanical properties of the ceramic.²³



Fig 13 Two-week postoperative views of the definitive restorations.



Fig 14 The 18-month follow-up revealed excellent (a) gingival health and (b) smile harmony.

Cementation and follow-up

The ceramic restorations were individually tested to ensure correct adaptation, size, and color match. After occlusal/incisal and interproximal adjustments, the intaglio surfaces of the ceramic restorations were acid etched with 10% hydrofluoric acid for 60 seconds and ultrasonically cleaned in distilled water for 3 minutes. Silane primer (Rely X Ceramic Primer, 3M ESPE) was applied to the etched surface for 1 minute and then air dried until no signs of visible moisture were observed. A single-component adhesive system (Excite, Ivoclar Vivadent) was applied, followed by

a gentle blow of air, and left uncured. The indirect restorations were cemented using luting cement (Variolink Veneer, Ivoclar Vivadent) according to the manufacturer's instructions, with the same adhesive system (Excite) applied to the intaglio surface. Excess cement was removed after setting, and all tooth surfaces were photoactivated for 60 seconds using a light-emitting diode light unit (Bluephase, Ivoclar Vivadent) at 1,000 mW/cm².

After cementation, care was taken to guarantee that no excess cement remained between the teeth. In addition, the occlusion was checked for centric relation and

protrusive and lateral movements, and any isolated interferences were removed. In this way, an esthetic and functional solution to crowding and misalignment was provided (Fig 13). After 18 months of clinical control, healthy gingival tissue had been maintained and the rehabilitation continued to be stable (Fig 14).

DISCUSSION

The greater the mesiodistal length, the greater the amount of enamel in mandibular incisors; the enamel thickness in the interproximal region ranges from 0.44 to 1.28 mm.¹⁹ Since the clinical stability and longevity of ceramic veneers depend on preservation of the enamel structure²⁴⁻²⁷ to provide more stable adhesion,^{28,29} knowledge of these characteristics is essential to perform minimally invasive intra-enamel preparations. The minimum thickness that current ceramic systems require for ceramic veneers varies between 0.6 and 1 mm; thus, tooth preparation must be accurately performed in association with proper treatment planning. In addition, periapical radiographs can be taken to estimate the enamel thickness at the interproximal and incisal surfaces. Such a process predicts the maximum possible reduction without tapering the dentin. However, care must be taken to evaluate enamel thickness solely by means of radiographic analysis due to the possibility of distortions.³⁰

Generally, orthodontic therapy should be instituted prior to the veneer restoration of crowded and misaligned teeth. The predictability of the periodontal, functional, and esthetic results of orthodontic therapy is well documented in the literature.^{7-11,31} However, the orthodontic approach does not always provide optimal esthetic results due to modifications in tooth morphology resulting from the treatment itself, particularly in terms of tooth shape and size. In addition, the stability of orthodontic treatment outcomes, especially in cases of crowded teeth, has been questioned.¹¹ The limitations of the orthodontic approach, as well as its potential for treatment relapse,

have led to the use of tooth preparation and restorative dentistry. Further, the patient's age and the amount of time required for orthodontic treatment may contribute to the decision to use ceramic veneers instead.

Ceramic veneers can recreate natural tooth dimensions and proportions, thus eliminating the potential for relapse. However, prior to selecting this restorative approach, important aspects of the treatment must be thoroughly considered, particularly when used for mandibular anterior teeth. Selective and strategic removal of tooth structures must be conducted, and pulpal violation must be avoided. Since the pulpal chamber size physiologically decreases with time, the limits of the tooth preparation are influenced by the patient's age and must be considered on an individual basis. The procedure demands utmost accuracy because of the size of the teeth and the visibility of the preparation margins. Therefore, the use of ceramic veneers for mandibular anterior teeth requires cooperation between the clinician and technician to achieve adequate treatment planning.^{26,32,33} Numerous studies have demonstrated the predictability and long-term stability of ceramic veneer treatment when it is appropriately planned and accurately performed.^{25,34,35} It is important to emphasize that the maintenance of periodontal health is essential. Since misalignment of the mandibular anterior region can be accompanied by differences in the gingival margins,^{36,37} negligence in treatment planning and/or clinical procedures can result in an invasion of the biologic width.

In certain cases of severely misaligned anterior teeth, tooth preparation may require dentin exposure, as in the present clinical case. In these situations, immediate dentin sealing is essential to protect the dentin-pulp complex, prevent postoperative sensitivity, and increase the bond strength between the resin cement and tooth structure.³⁸⁻⁴⁰ However, there is a limit to the correction of teeth misalignment. In general, when the teeth are severely misaligned, invasive preparations may lead to coronary destruction and endodontic therapy. In such cases, an exclusively orthodontic approach or one associated with restorative techniques must be considered as a first treatment option.

CONCLUSION

This case report described the restorative treatment of crowded mandibular anterior teeth using ceramic veneers. The diagnostic, clinical, and laboratory procedures were presented. Although crowded mandibular anterior teeth can pose a treatment challenge, properly planned and well-executed ceramic veneers provide predictable and long-lasting esthetic results.

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