Applications of Injection Molding in Dentistry

Delivering transitional and definitive solutions with precision and predictability

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In modern esthetic and restorative dentistry, clinicians are seeking techniques that offer not only visual excellence but also predictability, efficiency, and patient-centered flexibility. Injection molding—a method adapted from industrial processes—has emerged as a remarkably effective technique for fabricating transitional restorations, or even definitive restorations, that accurately reflect the final planned outcome. The technique facilitates the precise transfer of a diagnostic wax-up or digital mock-up into the mouth using high-viscosity injectable composites delivered through a clear, rigid matrix. This results in monolithic, polished restorations with ideal form, function, and contour that are produced with minimal chair time and without irreversible preparation. Injection molding is uniquely positioned to serve both simple and complex restorative needs. It facilitates interdisciplinary communication, provides a tangible diagnostic preview, and enables patients to accept and phase comprehensive treatment based on financial feasibility. The following two case reports illustrate the versatility of injection mounding—one as a functional step in a full-mouth rehabilitative journey and the other as a conservative esthetic solution for a young post-orthodontic patient.[1-4]

Case Report 1: Transitional Restorations as a Precursor to Orthodontic-Orthognathic Therapy

A middle-aged male patient presented with a severely worn dentition and multiple treatment plans from other providers. Most of the plans proposed full-coverage crowns and an increase in the vertical dimension of occlusion; however, this was often without orthodontic intervention (Figure 1 through Figure 4). The patient wanted another opinion, and he emphasized the need to phase treatment over several years due to financial concerns. A comprehensive evaluation was performed, which revealed not only dental wear but also a skeletal and dental Class III relationship, airway limitations, and significant occlusal dysfunction (Figure 5 through Figure 13).

A multidisciplinary approach was recommended that would involve orthodontic therapy, followed by orthognathic surgery and, ultimately, full restorative rehabilitation. However, the patient's severely worn dentition posed a challenge for orthodontic care. The small size of his teeth would make bracket bonding and hygiene maintenance extremely difficult, and it would be nearly impossible for the orthodontist to appreciate the original inclination and ideal final positioning of the teeth. To address these issues and allow orthodontic treatment to begin, the decision was made to proceed

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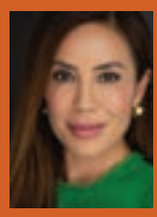

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FIG. 1


FIG. 2


FIG. 3


FIG. 4


FIG. 5


FIG. 6


FIG. 7


FIG. 8


FIG. 9


FIG. 10


FIG. 11


FIG. 12


FIG. 13

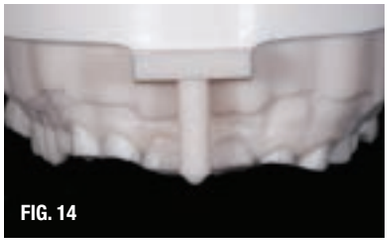
FIG. 14


FIG. 15

(1. THROUGH 4.) Initial presentation of a middle-aged male patient with severe dental wear and a collapsed vertical dimension of occlusion. Previous treatment plans proposed full-coverage crowns without addressing skeletal discrepancies. **(5. THROUGH 13.)** Comprehensive diagnostic records revealed a skeletal Class III relationship, airway concerns, and occlusal dysfunction—all of which supported the need for a multidisciplinary treatment plan. **(14. AND 15.)** Laboratory-designed full-contour wax-up demonstrating natural tooth morphology and axial inclinations, which was intended to guide transitional restorations rather than final esthetics.

with full-arch direct composite restorations using the injection molding technique. This would cover the exposed dentin, restore ideal contours, and serve as a visual and functional guide for the next phase of treatment.

The laboratory was instructed to design full-contour restorations that reflected natural tooth shapes and the patient's current axial inclinations as opposed to a perfected esthetic design (Figure 14 and Figure 15). It was critical that the patient understood that these restorations would be transitional—not final esthetic results, but rather a means to communicate the correct tooth dimensions and orientations to the orthodontist.

Because the patient's current occlusion did not allow sufficient space for the intended length of the teeth, an


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FIG. 17


FIG. 18


FIG. 19


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FIG. 25


FIG. 26


FIG. 27

(16.) 3D-printed model of the full-contour wax-up, which incorporated an anterior deprogrammer to guide orthopedic jaw positioning and facilitate an increase in vertical dimension. **(17.)** Clear, hard plastic maxillary matrices fabricated from the wax-up models, one with all of the teeth and one with every other tooth removed, with injection ports added and the intaglio surfaces cleaned to optimize composite adaptation. **(18.)** Clinical isolation and adhesive protocol: the alternating teeth that wouldn't be treated in the first phase were covered with PTFE tape and the teeth to be treated were selectively etched with 37% phosphoric acid before a bonding agent was applied. **(19.)** Injectable composite was injected through the ports of the every-other-tooth matrix, ensuring complete fill and cervical adaptation tooth-by-tooth before light curing. **(20.)** View of the first phase of restorations placed prior to flash removal, demonstrating accurate form and contour. **(21. AND 22.)** Completion of the full arch of injection molded restorations using the second matrix, which restored ideal tooth dimensions and occlusal relationships. **(23. THROUGH 27.)** Posttreatment views of the finished and polished transitional restorations in place, providing improved esthetics, function, and a stable platform for orthodontic and surgical planning.

anterior deprogrammer was built into the wax-up and incorporated into the injection-molded composite to guide proper orthopedic jaw positioning. From the wax-up, two maxillary models were printed: one with the full arch of teeth (Figure 16) and one with every other tooth removed to facilitate staggered injection. From these models, two hard maxillary matrices (Essix®, Dentsply Sirona) were fabricated to ensure shape retention and limit distortion. To complete the matrices, injection ports were created using a 330 bur, and the intaglio surfaces were steamed to eliminate any debris. (Figure 17).

At the clinical appointment, the teeth were isolated using a lip and cheek retractor (OptraGate®, Ivoclar). Polytetrafluoroethylene (PTFE) tape was placed to block out the alternating maxillary teeth that would not be restored in the initial phase with the every-other-tooth matrix. For the teeth to be restored first, the exposed enamel was etched with a 37% phosphoric acid etchant (ETCH-37™ w/BAC BISCO) (Figure 18), after which a universal adhesive (All-Bond Universal®, BISCO) was applied in two coats, air thinned, and light cured (Bluephase® G4, Ivoclar). The every-other-tooth matrix was then seated. Next, an injectable composite (G-ænial™ Universal Injectable, GC America) was slowly injected through the ports using long dispensing tips, ensuring full seating at the cervical margins and a complete fill of


FIG. 28

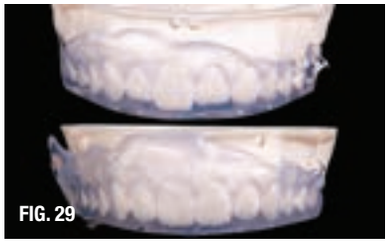
FIG. 29


FIG. 30


FIG. 31


FIG. 32

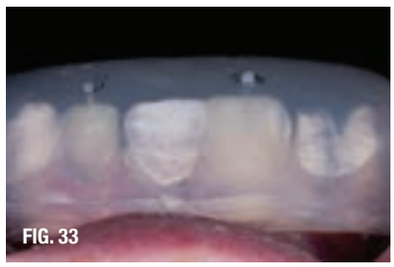
FIG. 33


FIG. 34


FIG. 35


FIG. 36

(28.) Digital smile design created from clinical photographs and intraoral scans, offering a visual preview of the proposed esthetic outcome. **(29.)** A 3D wax-up and alternating-tooth model were used to fabricate clear silicone matrices for staggered injection molding. **(30.)** Pretreatment isolation with retraction cord and surface preparation with 27-µm aluminum oxide air abrasion to enhance adhesive bonding. **(31. THROUGH 35.)** Stepwise etching, bonding, and injection of composite into the matrices, tooth by tooth, using the same adhesive and restorative protocol as in the first case report. **(36.)** Close-up comparison of the pretreatment view and the final polished restorations demonstrating symmetrical, lifelike enhancement of the smile with preservation of natural enamel and future treatment flexibility.

each matrix void. Each tooth was restored and light cured individually (Figure 19). Once all of the initial alternating maxillary teeth were restored and the excess flash was removed (Figure 20), they were blocked out with PTFE tape, and the remaining teeth were prepared and restored in the same fashion using the maxillary full-arch matrix (Figure 21 and Figure 22). With the maxillary teeth restored, the entire staggered injection protocol used was repeated to restore the mandibular teeth.

The restorations were polished using a silicone wheel, a high gloss finishing wheel, and a felt wheel (FlexiBuffs, Cosmedent) with polishing paste (Enamelize™, Cosmedent). Within a few hours, the patient left with ideal tooth size, improved function, and enhanced esthetics—all while preserving future treatment options. With a new vertical dimension and anatomical references in place, the orthodontist could now begin treatment with confidence, and the patient had a tangible preview of the final destination (Figure 23 through Figure 27).

Case Report 2: Esthetic Enhancement for a Post-Orthodontic Adolescent

A 15-year-old male patient presented after orthodontic treatment with peg-shaped lateral incisors and generalized enamel hypoplasia. He and his parents were eager to improve the esthetics of his smile but were understandably hesitant to pursue porcelain restorations due to his age and future dental development. Therefore, injection-molded composite restorations were offered as a conservative, esthetic, and transitional solution.

> **"The final restorations preserved enamel, maintained future treatment flexibility, and gave the patient an immediate boost in confidence."**

After a comprehensive set of clinical photographs and intraoral digital scans was obtained, a 2D digital smile design was created, reviewed with the patient, and

approved (Figure 28).[5] The final design was converted into a 3D wax-up, from which two maxillary models were fabricated: one complete one and one with alternating teeth removed to support the staggered injection protocol. Then, from these models, two clear silicone matrices were fabricated (Figure 29).

On the day of treatment, teeth Nos. 7 through 10 were isolated with retraction cord and air abraded with 27-µm aluminum oxide powder (Figure 30). Following the same adhesive protocol and using the same materials described in the first case, injectable composite was delivered into the matrices and light cured, tooth by tooth (Figure 31 through Figure 35). Upon completion, the restorations were polished to a high shine, which resulted in a symmetrical, lifelike enhancement of the patient's smile (Figure 36). The final restorations preserved enamel, maintained future treatment flexibility, and gave the patient an immediate boost in confidence.

Conclusion

Injection molding offers clinicians an elegant blend of precision, efficiency, and flexibility. Its minimally invasive nature makes it an excellent option for both provisional and definitive restorations, and its reproducibility allows for consistent communication between clinicians, laboratories, and patients. Whether used as a tool to bridge interdisciplinary care, facilitate phased treatment for financial reasons, or meet esthetic demands with conservation in mind, injection molding is now a cornerstone technique in modern restorative dentistry. These two cases underscore its value across both ends of the clinical spectrum—from complex full-mouth rehabilitation to youthful smile enhancement—and demonstrate that predictable outcomes can be achieved with a thoughtful, well-executed approach.

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