BJMS
Borneo Journal of Medical Sciences

CASE REPORT

Anterior Aesthetic Rehabilitation with Injection Moulding Technique: A Case Series

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Received: 05 December 2024

Accepted: 06 June 2025

Published: 5 January 2026

DOI: https://doi.org/10.51200/bjms.v20i1.5682

Keywords: *Injection moulding technique, Direct composite, Anterior restoration, Aesthetic*

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ABSTRACT

The injection molding technique has gained popularity for its minimally invasive and time-efficient approach in direct anterior restorations. This case series highlights three clinical cases utilizing injectable resin composite for restoring aesthetics and function in amelogenesis imperfecta, irregularly shaped teeth post-orthodontic treatment, dental caries and generalised interdental spacing. The technique, employing light-cured injectable composite, polymerized through transparent silicone index. The approach ensures optimal composite placement, accurate replication of tooth morphology, minimizes the air entrapment and enhances both the durability and aesthetics of the restoration with a strong marginal seal. The clinical time for the restoration has been considerably reduced thus enhances the patient experience. These cases demonstrate that the injection molding technique is a versatile, provides superior aesthetics, and offers predictable results for anterior direct restorations.

INTRODUCTION

Direct composite restoration is a minimally invasive procedure in restorative dentistry, widely used for its ability to restore both function and esthetics by applying composite resin directly to tooth surfaces (Paschoal et al. 2014). However, achieving optimal contour, symmetry, and natural appearance in certain anterior aesthetic cases can be challenging

with traditional freehand techniques, often requiring extensive chair time and skill, which can lead to inconsistent results (Amaro et al., 2021).

In addition to the freehand technique, other established approaches include the matrix transfer technique and palatally/ lingually guided buildups. The matrix transfer technique, while useful for replicating wax-ups, may lack adaptability during intraoral adjustments and can be limited in achieving seamless integration with surrounding dentition (Bailey et al., 2022). Palatal or lingual guidance using silicone indices provides a stable posterior framework for layering but often requires considerable layering skill to ensure proper facial anatomy, symmetry, and surface texture (Paolone G, 2014). These limitations can affect predictability and esthetic outcomes, particularly in complex anterior cases.

The injection molding technique has emerged as a promising solution to these challenges. By utilizing a specially designed silicone or transparent matrix, this method allows precise placement and contouring of composite resin (Geštakovski, 2019). The matrix guides the resin application, ensuring precise shaping, symmetry, and surface texture, overcoming the limitations of manual shaping (Machado et al., 2024). Indicated for diastema closure, Class IV restorations, veneers, erosions, abrasions, misshapen teeth, discolored teeth, composite bonding, and tooth lengthening, the technique offers superior esthetic outcomes (Terry et al., 2022). It effectively closes gaps between anterior teeth, restores fractured teeth, improves alignment and color in veneers, and repairs worn-down teeth from conditions like acid reflux or bruxism (Jabrane et al., 2024). The procedure involves case selection, impression and diagnostic wax-up, matrix fabrication, tooth preparation, resin injection, curing, and final polishing (Geštakovski, 2021). This systematic approach reduces error potential, chair time, and enhances predictability (Tekçe, 2022).

This article showcases the efficacy of injection molding through three diverse cases, highlighting its ability to address challenges in conventional methods and achieve consistent, high-quality esthetic and functional results.

CASE PRESENTATION

Case 1: Management of anterior teeth discoloration due to Amelogenesis Imperfecta

A 34-year-old male presented with concerns about the poor appearance while smiling due to discoloured upper front teeth since childhood. Similar teeth were presented with hypersensitivity exacerbated by cold drinks. He had a family history of amelogenesis imperfecta (AI) and have not received any prior treatment. Medical history was not significant. Examination revealed moderate yellow stained enamel surfaces of all teeth indicated amelogenesis imperfecta (Figure 1A). All the anterior and posterior teeth were affected with yellowish brown discolouration. From the results of clinical and radiographic evaluations indicated that the patient in the present case had hypocalcified form AI. All the teeth are misshapen, and spotted. Occlusion and vertical opening are rapidly affected by attrition. The insufficiency of the enamel makes the teeth extremely sensitive to contact and thermal stimuli (Seow, 1993). The treatment plan aimed to manage caries and tooth discoloration, improve aesthetics, and alleviate hypersensitivity. Following a detailed discussion with the patient, resin composite veneering using the injectable technique was selected for the anterior teeth. Although bonding to AI-affected enamel can be challenging due to altered enamel prism structure and reduced mineral content, predictable adhesion is still achievable, particularly when bonding is performed primarily to dentin or when enamel is selectively etched and appropriately

conditioned. Furthermore, modern adhesive systems and injectable resin composites, with their favorable mechanical properties, offer a minimally invasive yet durable restorative solution. In contrast, due to the extensive structural loss and functional demands in the posterior region, full-coverage metal-ceramic crowns were chosen to provide strength, stability, and long-term durability.

Figure 1A: Pre-operative intraoral photograph.

A diagnostic wax-up helped visualize treatment outcomes in improving the shape, contour and sizes of anterior teeth. (Figure 1B). After that, clear polyvinyl siloxane (PVS) captured the wax-up model using a non-perforated tray. A separate PVS buccal matrix guided tooth preparation was created to prevent over-reduction of the tooth structure. Equigingival margin with labial reduction of 0.5mm were done for composite veneers. This reduction was indicated due to the presence of secondary caries and intrinsic staining on the labial surfaces, necessitating removal of compromised enamel. Additionally, it allowed for the creation of adequate space for the composite material, preventing over-contouring and ensuring a natural emergence profile, optimal aesthetics, and proper periodontal health. Although the technique aimed to be minimally invasive, the labial reduction was a clinically justified compromise to enhance both the longevity and appearance of the final restorations. The clear polyvinyl siloxane (PVS) stent was tried intraorally (Figure 1C) and inciso-labial vent hole was created (Figure 1D).

Isolation with Teflon (PTFE) tape and selective enamel etching preceded application of bonding agent for adhesion (Figure 1E). The alternate tooth technique was done to confine the composite and to minimize interproximal bonding, shades wetted margins and corrected chromatic discrepancies. Injection molding was done through the stent using injectable composite, followed by excess removal and provisional finishing. Interdental and buccal finishing and polishing were done resulted in refined results.

Figure 1B: A wax up is made in consultation with the patient.

Figure 1C: Try-in EXACLEAR™ stent intraorally.

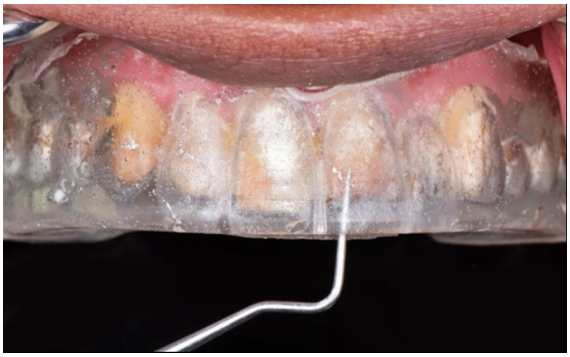

Figure 1D: Create a vent hole in the EXACLEAR™ stent with the tip of dental probe.

Patient was reviewed after six weeks to address minor adjustment and final result exhibited a glossy finish restoration (Figure 1G). Although complete masking of the underlying discoloration was not fully

achieved, there was a notable improvement in both tooth shade and morphology compared to the preoperative condition. The patient expressed high satisfaction with the aesthetic outcome. The injection molding technique was chosen over conventional direct composite layering due to its capacity to produce predictable and efficient results, especially in cases requiring full-surface coverage and morphological correction, as commonly seen in amelogenesis imperfecta. Additionally, injectable composites are particularly well-suited for anterior restorations due to their favorable mechanical properties, including high flexural strength and wear resistance,

Figure 1E: Minimal teeth preparation and isolation of adjacent teeth with teflon (PTFE) tape probe.

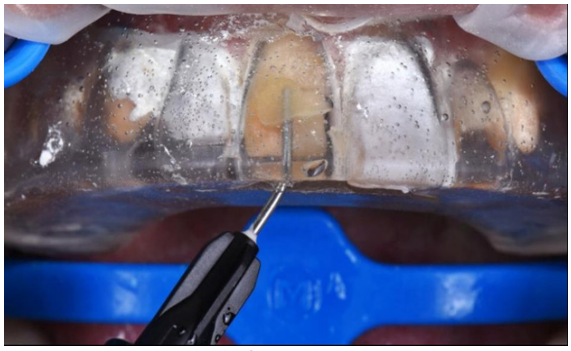

Figure 1F: Injection of composite into the transparent mould through the silicone hole

Figure 1G: Post-operative intraoral photograph.

which contribute to long-term durability and sustained aesthetic performance (Rathod et al., 2024).

Case 2: Management of Unfavorable Anterior Teeth Shape Post Orthodontics Patients

A 34-year-old female patient, dissatisfied with the irregular and disharmonious shape of her anterior teeth following orthodontic treatment. The initial assessment revealed that her central and lateral incisors had irregular shapes with black triangles presented disrupting her smile (Figure 2A).

Figure 2A: Pre-operative intraoral photograph i) smile view ii) frontal view iii) closed up view.

The treatment plan focused on reshaping and contouring these teeth using injectable resin composite that is minimally

invasive. A diagnostic wax-up and clinical mock-up were performed to visualize the outcome, with adjustments made according to the operator and patient's preferences (Figure 2B). An impression was taken using clear polyvinyl siloxane (PVS) without any reduction of the existing teeth. The procedure followed steps similar to those in Case 1.

Figure 2B: A diagnostic wax up is made in consultation with the patient.

Five weeks after the initial treatment, a follow-up review was conducted to evaluate the results and make any necessary adjustments. During this review, minor adjustments and polishing were performed to refine the appearance of the veneers. The final result was a set of anterior teeth with a glossy finish that enhanced the patient's smile (Figure 2C and 2D). The patient expressed high satisfaction with the outcome, noting a significant improvement in the aesthetics of her smile.

Overall, this case highlights the effectiveness of injectable moulding techniques in addressing post-orthodontic aesthetic concerns that involves black triangles and irregular tooth shape.

Figure 2C: Post-operative introral photo i) frontal view ii) close up view.

Figure 2D: Post-operative extraoral photo i) frontal view ii) right lateral view iii) left lateral view.

Case 3: Management of Anterior Teeth Spacing Post Orthodontics Patients

A 31-year-old male patient was referred from the Orthodontic Department for management of the residual anterior space following orthodontic treatment. The patient expressed concern regarding the aesthetic impact on his smile and sought an enhanced, more harmonious appearance. The initial examination revealed a generalised spacing

between the upper right and left canines, accompanied by visible brown and white discoloration attributed to fluorosis (Figure 3A and 3B).

Figure 3A: Initial presentation showing localised anterior spacing with brown and white spot discolouration.

Figure 3B: Pre-operative smile view.

The treatment plan prioritized, on the reshaping and contouring of the affected teeth. A diagnostic wax-up (Figure 3C) and clinical mock-up (Figure 3D and 3E) were conducted to simulate the expected outcomes, allowing for iterative adjustments based on the patient's feedback. An impression was recorded using clear polyvinyl siloxane (PVS) without altering the existing tooth structure (Figure 3F). The treatment adhered to protocols akin to those used in a prior similar case (Figure 3G – 3K).

A follow-up assessment conducted up to one year post-treatment show intact restorations with superior outcome. (Figure 3L). The composite used in the injection moulding procedure demonstrates excellent colour stability. Minor modifications were implemented to elevate the aesthetics, yielding a refined and naturalistic finish. The patient expressed significant satisfaction, observing a marked enhancement in the appearance of his smile.

This case highlights the transformative potential of injectable moulding techniques in addressing complex post-orthodontic aesthetic challenges, showcasing a seamless integration of form, function, and patient-centered care.

Figure 3C: Conventional laboratory wax-up.

Figure 3D: Chairside mock-up using bis-acyrl material (Protemp).

Figure 3E: Mock-up smile view.

Figure 3F: Clear polyvinyl siloxane (Exaclear) adaptation to working model.

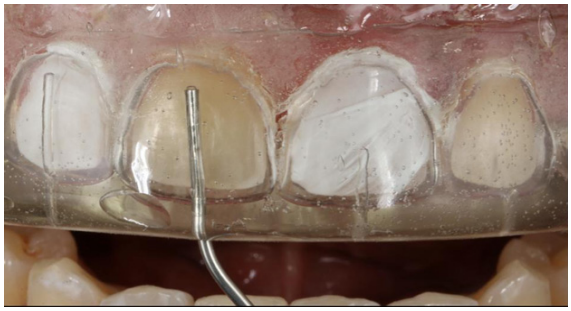

Figure 3G: Alternately teflon isolation to prevent the flow of material to adjacent tooth.

Figure 3H: After injection of flowable material.

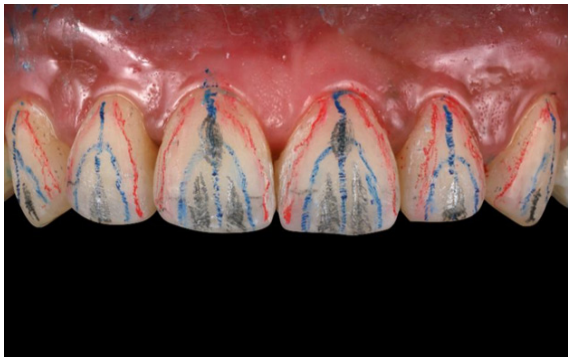

Figure 3I: Finishing phase. Primary anatomy (red line), secondary anatomy (blue line), tertiary anatomy (black line).

Figure 3J: Immediate post-operative finishing and polishing.

Figure 3K: Post-operative smile view.

Figure 3L: 1 year post-operative review.

DISCUSSION

The injection molding technique has proven highly effective in cases requiring minimally invasive approach and aesthetically pleasing anterior restorations, as demonstrated in this case series. For complex conditions such as amelogenesis imperfecta (Case 1), the enamel irregularities and structural weakness were prevalent, the injection molding technique provides a controlled application of composite material (Tekçe, 2022). This allows for both functional and aesthetic improvements, replicating natural tooth morphology while reinforcing fragile enamel structures (Tekçe,

2016). Similarly, in cases involving irregularly shaped teeth and spacing following orthodontic treatment in case 2 and 3, the technique enables the accurate contouring and reshaping necessary to harmonize with the surrounding dentition (Terry et al., 2022). These cases underscore the suitability of injection molding for anterior restorations, particularly in patients presenting with unique morphological challenges.

The suitability of the injection molding technique in anterior restorations is further supported by the specific materials employed, clear vinyl polysiloxane and light-cured injectable composite (Ammannato et al., 2015). The extraordinary transparency allows for enhanced visualization, enabling the clinician to check every detail closely to ensure that there are no air blows or gaps around the margins (Machado et al., 2024). This transparency is particularly advantageous in cases like amelogenesis imperfecta, where accurate reproduction of tooth morphology is vital for both function and esthetics (Tekçe, 2022). Additionally, clear polyvinyl siloxane (PVS) is firm but flexible nature prevents the formation of an oxygen inhibition layer, simplifying the final polishing process and resulting in a smoother, more durable surface. Its flexibility and dimensional stability allow it to capture intricate surface details and maintain accuracy throughout the procedure, reducing the need for post-procedural adjustments (Farias Machado, 2024). In cases involving irregularly shaped teeth post-orthodontic treatment, this stability is crucial for achieving harmonious alignment and contour with adjacent teeth (Türk et al., 2024). Complementing the matrix, light-cured injectable composite offers controlled application and aesthetic versatility, essential for anterior restorations (Jabrane et al., 2024). Its flowability ensures the composite fills the matrix accurately, minimizing air entrapment and creating a seamless restoration with fewer voids (Geštakovski, 2019). Furthermore, the polishability, translucency, and color stability of light-cured composites help these restorations blend naturally with the patient's dentition, particularly in high-visibility areas (Pala et al., 2016). By facilitating precise contouring and delivering natural-looking results, these materials underscore the effectiveness of this technique in managing cases with unique morphological and aesthetic challenges (Peumans et al. 2021).

Compared to traditional non-injectable composites, injectable composites offer several distinct advantages in the context of anterior restorations. Non-injectable composites, which are typically more viscous and require incremental placement, allow for detailed manual sculpting but are often more technique-sensitive and time-consuming (Sengupta et al., 2023). In contrast, injectable composites facilitate a more streamlined and predictable application process, particularly when combined with a clear matrix system. This allows for a monolithic restoration that reduces layering errors and improves marginal integrity (Ammannato et al., 2015). Additionally, the flowability of injectable composites enhances adaptation to the cavity or matrix, minimizing the risk of voids and improving the longevity of the restoration (Ypei Gia et al., 2021). However, traditional composites may still provide superior mechanical properties in term of higher wear resistance and stiffness, which leads to making them more preferable in high-load bearing posterior areas (Ilie & Hickel, 2009). Therefore, while injectable composites are highly suited for anterior aesthetic cases where contouring and translucency are paramount, clinicians should carefully assess the functional demands of each case when selecting the material.

Despite its advantages, the injection molding technique is not without limitations. One primary concern is the technique sensitivity; a precise workflow is essential to avoid errors such as incomplete polymerization, air entrapment, or marginal overhangs. Operator experience significantly influences

the outcome, particularly in maintaining the correct pressure during injection and achieving complete curing through the transparent matrix. Furthermore, the material's flowability, while beneficial for adaptation, may result in slight overextensions if not properly managed. Another key challenges in the injection molding technique is achieving adequate isolation, which is essential for the success of adhesive restorative procedures. Contamination with saliva, crevicular fluid, or blood during bonding can significantly compromise the integrity and longevity of the restoration. While rubber dam placement is ideal, it may be impractical in certain clinical situations, particularly when restoring multiple anterior teeth or when dealing with altered tooth morphology, such as in amelogenesis imperfecta (Koppolu et al., 2012). In the present cases, effective isolation was achieved using a combination of a flexible cheek retractor, high-volume saliva ejector, and strategically placed cotton rolls. The use of cotton rolls is particularly advantageous in anterior regions, where they can both displace the lip and absorb saliva in the maxillary anterior vestibule. Notably, their use is more prevalent in anterior (46%) compared to premolars (36%) and molars (32%), highlighting their utility in achieving effective isolation in the anterior region (Lawson et al., 2015). This approach provided sufficient moisture control and soft tissue retraction, enabling reliable adhesion and accurate composite placement without compromising access or visibility.

The success of the injection molding technique is closely tied to the physical properties of the composite resin used. A key requirement is optimized flowability, which allows the material to accurately fill the transparent matrix without trapping air, ensuring seamless adaptation to tooth surfaces and intricate anatomical details (Jabrane et al., 2024). Injectable composites typically have a lower viscosity compared to traditional packable composites, enabling more precise delivery through syringes or dispensers under controlled pressure. Despite their fluid nature, these materials are formulated to possess sufficient thixotropy, meaning they become less viscous under shear stress but return to a more stable state once the stress is removed. This property helps maintain their shape after injection. In addition to flow characteristics, polymerization behavior is critical. Light-cured injectable composites used in injection molding must exhibit a high degree of conversion upon curing to ensure optimal mechanical properties and long-term stability. A high degree of monomer conversion reduces residual monomers, which can compromise biocompatibility and physical strength. Furthermore, many modern injectable composites incorporate nano-hybrid or nano-filled technology, which improves wear resistance and enhances mechanical properties such as flexural strength and surface hardness, which the traits essential for withstanding functional stress in the anterior region (Ilie & Hickel, 2009).

Given its potential, the injection molding technique can be a valuable tool for clinicians, particularly in managing aesthetic challenges in the anterior region. To maximize outcomes, it is recommended that clinicians should undergo adequate training to master the workflow, especially in matrix fabrication, material handling, and light curing. Case selection be guided by clinical indications, reserving this technique for cases where minimal invasiveness, aesthetics, and morphologic control are paramount. Long-term clinical studies be conducted to evaluate the durability, color stability, and patient satisfaction associated with injectable composites compared to traditional restorative methods. Moreover, exploring the biomechanical behavior and wear resistance of newer generations of injectable composites could provide insights for broader clinical applications, including use in posterior teeth or full-arch reconstructions.

CONCLUSION

This case series underscores the advantages of the injection molding technique for direct anterior restorations, especially in managing complex cases like amelogenesis imperfecta and post-orthodontic reshaping and complications. The technique provides precision in composite placement, ensuring a strong marginal seal and minimizing risks of air entrapment, while also enabling accurate replication of natural tooth morphology with minimal finishing and polishing. Importantly, this approach reduces chairside time, offering efficiency for both clinician and patient without compromising aesthetic and functional outcomes. Overall, these cases demonstrate that the injection molding technique is a reliable, time-efficient, and aesthetically superior approach for anterior direct restorations, making it a valuable option in contemporary restorative dentistry.

CONFLICT OF INTEREST

The authors affirm that they have no conflicts of interest, whether financial or of any other nature.

CONSENTS

Informed consent was obtained from all patients before preparing this case report.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the supervisors and staff of the Faculty of Dentistry, Universiti Teknologi MARA, for their invaluable support and assistance. Special appreciation is also extended to the patients, whose participation made this clinical case report possible. We gratefully acknowledge the Director General of Health Malaysia for granting permission to publish this article.

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