

Provisional shell crown technique in the contemporary management of amelogenesis imperfecta

Maximising efficiency and clinical control in crown preparation and provisionalisation.

Introduction

The tooth preparation and provisionalisation stage in a complex fixed dental reconstruction treatment plan is inherently stressful for both the patient and the clinician.¹ However, when multiple adjacent tooth preparations are deemed clinically indicated, all stakeholders tend to remain satisfied when the outcome of provisional treatment is biomechanically stable and aesthetically pleasing.² Digital design and meticulous implementation of the plan can ensure that provisional restoration contours closely match the patient-approved predetermined smile design. Similarly, a careful approach during interim restoration with segmental splinted provisional crowns can lead to a stable restorative outcome, with retention security.² This clinical tips article will exemplify the splinted provisional shell crown technique, with a focus on the maxillary labial segment dentition.

Mouth preparation for fixed prosthodontics

■ As previously described,³⁻⁵ at the dental laboratory, a three-dimensional (3D) virtual patient was created through the merging of an intra-oral scan (3Shape TRIOS, Copenhagen, Denmark), a facial triangulation scan (Face Hunter 3D facial scanner, Zirkonzahn Srl, Gais, Italy), and patient-specific occlusal data

(PlaneSystem®, Zirkonzahn Srl, Gais, Italy) on Zirkonzahn.Modifier software (Zirkonzahn Srl, Gais, Italy). A full mouth digital wax-up and patient-approved snap-on smile type mock-up was fabricated, forming the foundation on which treatment is prescribed.

- Facially driven and digitally guided surgical crown lengthening was performed to correct for an uneven gingival display in this specific case, which was detected at the planning stage.⁴
- Digitally guided reduction of anticipated interferences was performed prior to tooth preparations for crowns (**Figure 1**).⁵
- At this stage, the mouth is suitably prepared to proceed to provisional crowns on the prescribed teeth.

Clinical tips

- At the dental laboratory, provisional shell crowns may be milled in a flexible polycarbonate resin (Temp Premium Flexible, Zirkonzahn Srl, Gais, Italy) according to the contours of the patient-approved mock-up. The shells should be splinted in predetermined segments, which in turn define the implementation strategy of the treatment plan (**Figure 2**).²



FIGURE 1: The pre-tooth-preparation situation at the maxillary labial segment following all preliminary mouth preparation steps, including digital diagnostic design, digitally guided crown-lengthening surgery, and removal of anticipated interferences with digital tooth reduction guides.



FIGURE 2: Prior to any intra-oral tooth preparation for crowns, splinted provisional shell crowns are milled at the dental laboratory on the basis of the contours determined in the digital planning steps.

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FIGURE 3: A diagnostic mock-up in bis-acryl is placed onto the treatment segment with a polyvinyl siloxane preparation index, the purpose of which is to indicate to the clinician the final contours of the proposed definitive restorations and to inform tooth reduction space requirements.



FIGURE 4: The clinician prepares standard depth cuts for all-ceramic crowns into the diagnostic mock-up to determine how much tooth preparation depth is required to achieve the desired restorative space.



FIGURE 5: Upon removal of the depth cut mock-up, it can be seen that minimal tooth preparation is required in this specific case, as the majority of the restorative space may be derived from an additive approach to the contours of the existing dentition. Only a removal of circumferential undercuts and formation of a conservative finish line are indicated in this case.

- Based on classic techniques, the clinician transfers the diagnostic wax-up into the mouth in bis-acryl (Protemp™, 3M, St Paul, MN, USA) using a standard preparation index to form a mock-up, the purpose of which is to permit matrix-based tooth reduction (Figure 3).⁶
- Depth cuts are made into the mocked-up teeth to the predetermined restorative space requirements. In this situation, a 1.5-2mm incisal edge space, 0.8mm-1mm facial space, and 0.3mm finish line depth were desired (Figure 4).
- Upon removal of the cut mock-up, it can be seen in this specific case that minimal further tooth reduction is required beyond elimination of undercuts and the creation of a circumferential finish line of 0.3mm depth (Figure 5).
- Tooth preparations for minimal-thickness all-ceramic crowns are completed at the selected treatment segment. Importantly, for the splinted provisional shell crown technique to work successfully, all tooth preparations should be made to a common path of insertion. In general, for the labial segment dentition, a path of insertion that is parallel to the facial midline and perpendicular to the inter-pupillary line tends to result in the best outcomes, in this author's experience (Figure 6).
- The provisional shells are seated onto the treatment segment, ideally with an indexing device, to ensure that the contours of the provisionals remain harmonious in the context of the facial landmarks and the treatment plan. The shells may be relined with a chairside polymethylmethacrylate (PMMA) (Jet™ acrylic, Lang Dental Manufacturing Co., Inc., Wheeling, IL, USA) (Figure 7A). The excess acrylic is trimmed prior to cementation (Figure 7B), and the quality of marginal fit and finish of the provisionals will become apparent in the stability of the periodontal health at subsequent review (Figure 7C).⁷



FIGURE 6: Appearance of the tooth preparations following formation of a circumferential finish line of approximately 0.3mm depth. Note that all tooth preparations must have a common path of insertion to permit successful implementation of the splinted provisional shell crown technique.



FIGURE 7: The aforementioned provisional shells are seated, and relined with PMMA, ensuring positional accuracy with respect to the patient's facial midline and interpupillary line (7A). The appearance of the shells on the day of tooth preparation is presented in 7B and, following two weeks of gingival healing, a satisfying provisional restoration conducive to periodontal health is illustrated in 7C.

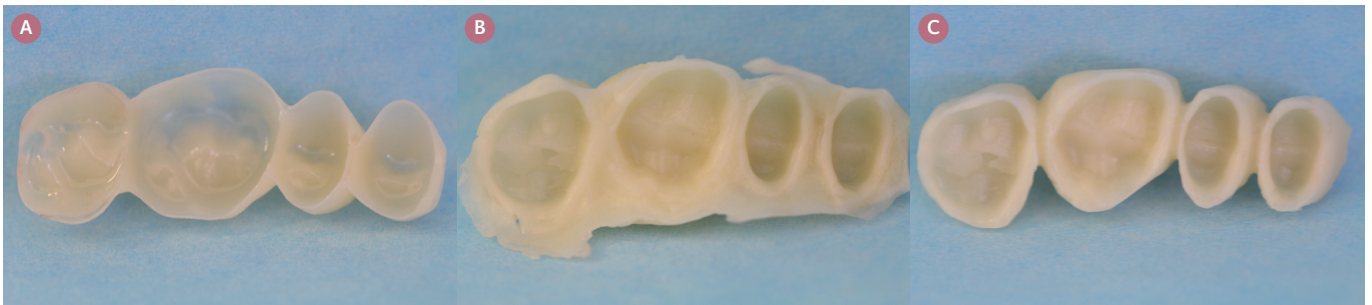


FIGURE 8: Initially, the custom, pre-formed provisional crowns are eggshell thick (8A). Upon relining intra-orally, the shells become over contoured, specifically at their gingival embrasures (8B). Considerable time and attention must be paid towards achieving marginal fit and opening of the gingival embrasures, particularly interproximally, to ensure that control over the periodontium is maintained with this technique (8C).

- When working with the shell crown technique, specific care needs to be taken to ensure that the shells are treated gently prior to their chairside reline, owing to their thin section and low mechanical strength at this stage (Figure 8A). Following reline, excess acrylic naturally splays out beyond the finish line, which is not conducive to periodontal health (Figure 8B). Therefore, considerable time and attention must be paid towards removing over-contoured acrylic at the finish line, and gingival and interproximal embrasures (Figure 8C), prior to cementation of the provisional crowns using standard acrylic trimmers and finishing discs.⁷
- With the application of the provisional shell crown technique, the clinician and patient can proceed through all planned segments of interim treatment with relative comfort, control, retention security and efficiency (Figure 9).²

Conclusion

The splinted provisional shell crown technique offers a pragmatic method to transfer a precisely planned restorative outcome in interim form to the clinical situation, in a phased approach, that can remain within the comfort zone of the patient and clinician. With this strategy, treatment stages can be broken down into smaller steps where due time and attention may be applied to achieving optimal outcomes, such that the clinician remains in control of the treatment plan.

CRediT author statement

David McReynolds: conceptualisation, clinical procedures, visualisation, original draft preparation, writing – review and editing.

Alexander Lichtmannegger: conceptualisation, laboratory procedures,



FIGURE 9: The pre-operative situation (9A-9C) compared to the chairside provisional restoration (9D-9F) illustrates the efficient and controlled full mouth transfer of the intended outcome of treatment to the clinical situation.

visualisation, original draft preparation, writing – review and editing.

Enrico Steger: conceptualisation, supervision, writing – review and editing, funding, resources.

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