Digitally guided tooth reduction in the contemporary management of amelogenesis imperfecta

Balancing biological cost with the demand for restorative space.

Introduction

Indirect prosthodontic restorations are biologically expensive due to their inherent requirement for restorative space.[1] Particularly in young teeth, every precaution should be taken to avoid or minimise tooth reduction, where possible.[2-3] However, when tooth reduction is deemed to be clinically indicated, contemporary methods may be applied to identify and guide tooth reduction in such a manner as to conserve tooth structure and arrive at a minimally invasive tooth preparation with precision and control. This clinical technique article illustrates how to conservatively eliminate anticipated interferences, relative to a visualised end goal of treatment, as a step prior to conventional tooth preparations for crowns. It should be noted that this step is not a replacement for conventional crown preparation, but rather an adjunctive procedure. Such digital approaches have evolved from a classic, conventional approach to prosthodontic treatment.[4-6]

Clinical tips

- As has been previously published in detail,[7] at the dental laboratory, a three-dimensional (3D) virtual patient is 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).
- On the basis of a facially driven smile design, with a patient-centred outcome in mind, contours of the underlying dentition that will impede the achievement of an idealised prosthodontic outcome are identified (**Figure 1A**) and planned for preparation with a custom digitally designed tooth reduction guide (**Figure 1B**). This guide is fabricated in a flexible, machinable polycarbonate material (Temp Premium Flexible, Zirkonzahn Srl, Gais, Italy) (**Figure 1C**).
- The tooth reduction guide is tried into the mouth to confirm complete seating and to assess the extent of the anticipated interferences clinically (**Figure 2**).

FIGURE 1: Starting with the end goal in mind, a facially driven digital smile design reveals that the underlying tilting, drifting, rotations and maxillo-mandibular relations of the natural dentition will preclude the development of harmoniously contoured definitive restorations. A tooth preparation guide may be designed and milled at this early stage to assist in conservatively eliminating anticipated interferences, in a highly controlled workflow.

FIGURE 2: Initial seating of the preparation guide on the dentition allows the clinician to visualise the intended outcome of this treatment step.

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FIGURE 3: Pre-operative marking of the preparation guide with a visually contrasting colour prior to tooth reduction.

FIGURE 4: The appearance of the guide following the tooth reduction procedure. The clinician should stop the procedure the moment the contrasting ink has been displaced.

FIGURE 5: Evaluation of the clinical situation before and after the planned tooth reduction, highlighting the subtle and conservative but clinically meaningful changes that have been made, prior to tooth preparations for indirect restorations.

The external contours of the guide correspond to the planned final contours of the definitive restoration. Regions of the underlying dentition that protrude from the guide windows represent interferences, which must be selectively reduced to achieve the intended outcome. Importantly, this will act as a preliminary reduction, as an initial step prior to conventional tooth preparations for crowns.

- Before initiating tooth preparation with diamond burs under copious water coolant, highly visible contrasting marks should be applied to the window perimeter of the preparation guide adjacent to the identified areas of interference (**Figure 3**). These visual cues enhance intra-operative visibility and reduce the risk of over-preparation, which can occur when the guide's reference contours are obscured by the coolant spray.

- Tooth structure is reduced until it conforms precisely to the contours of the preparation guide. The removal of the contrasting marker ink, caused by direct contact with the rotating diamond bur, indicates that the target reduction depth has been achieved. This visual endpoint ensures accurate, conservative preparation aligned with the contours of the planned definitive restoration (**Figure 4**).

- Upon removal of the tooth reduction guide, a subtle, conservative but clinically meaningful elimination of anticipated interferences may be confirmed (**Figure 5**). The guided reduction procedure has simplified the subsequent process of tooth preparation for indirect restorations, at the next step of the treatment plan.

- Subsequent conventional tooth preparations can now be implemented as minimally as possible, as interferences have been eliminated with control and precision.

Conclusions

Classic approaches to prosthodontic treatment are evolving in the era of digital dentistry, where higher levels of control and precision may be efficiently achieved as they relate to the development of treatment outcomes that are important to patients. The application of tooth reduction guides, developed on the basis of a facially driven digital smile design, assists clinicians in achieving highly refined outcomes, while minimising the biological cost of indirect dentistry.

CRediT author statement

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