

Digital planning in the contemporary management of amelogenesis imperfecta

Beginning prosthodontic care with the end outcome in mind.

Key learning points:

- when considering any kind of significant irreversible change to the biomechanical and aesthetic arrangement of a dentition, clinicians should begin this process with a clear vision of the end goal in mind, prior to undertaking any operative steps;
- attaining a satisfying treatment outcome relies upon the achievement of a meeting of minds between the patient, the restorative clinician and the dental technician – all stakeholders need to be able to visualise and, where achievable, trial and tailor an intended treatment outcome in order to ensure that treatment expectations can be met; and,
- contemporary tools that may be used to achieve comprehensive restorative planning and communication include the Face Hunter 3D facial scanner, PlaneSystem, and Zirkonzahn.Modifier software, which together offer a complete planning and communication solution according to the Zirkonzahn digital workflow.

Introduction

Amelogenesis imperfecta (AI) is a rare, heritable genetic disorder, from which a global, defective enamel phenotype may arise, which is prone to pain, sensitivity, discolouration and post-eruptive breakdown secondary to widespread enamel hypoplasia, hypomineralisation, or both.¹ Like many dental developmental disorders, AI is associated with a clustering of developmental dentofacial defects, such as microdontia, dento-alveolar disproportion, and orthognathic malformation.¹ The condition pervasively undermines the aesthetic and biomechanical function of a dentition, but further, it also affects socialisation and imparts a substantial lifelong dental treatment burden upon the affected individual.² So distressing are the symptoms, those affected individuals frequently seek out comprehensive restorative-oriented solutions at tertiary care centres³ and at this juncture, comprehensive planning workflows are required in order to establish an achievable, predictable and precise end goal of treatment.⁴

To successfully plan and tailor significant changes to the aesthetic and biomechanical arrangement of any dentition, effective communication regarding the reconstruction is necessary between the tripartite stakeholders (patient, clinician, and dental technician), in such a manner as to achieve consensus between the professional's esoteric understanding of the intended

treatment outcome and the patient's untutored expectations of treatment.⁵

This clinical technique presentation aims to establish how important aesthetic and biomechanical determinants of a pleasing dental reconstruction, such as the locations of the facial midline, inter-pupillary line, ala-tragal line, natural head position and the smile display, may be effectively communicated from clinician to technician, in such a manner as to create an informed and satisfying try-in, or treatment mock-up, which in turn can be used to effectively communicate the intended end goal of treatment to the patient, in a highly visual rhetoric that every stakeholder can understand.

Clinical case

The patient was an 18-year-old male with a confirmed family history of X-linked AI, who was otherwise in good health and non-smoking. Upon initial clinical presentation, a low-caries-risk, complete adult dentition from second molar to second molar was present, which was globally affected by pitted, hypoplastic and hypomineralised AI, dento-alveolar disproportion and an unusual generalised open occlusion, characterised by one occlusal contact at the right first molar region in the maximum intercuspation position (MIP). Historical paediatric management of the dentition involved placement of stainless steel crowns at the first permanent molar sites to protect the emerging dentition from post-eruptive breakdown and loss of occlusovertical dimension during the mixed dentition phase.⁶ On adult presentation, all but the UR6 stainless steel crown remained intact. Oral hygiene was poor, with evidence of plaque-induced chronic gingivitis (**Figure 1**). The patient reported experiencing severe, widespread hypersensitivity upon hot, cold, osmotic and masticatory stimuli, and feeling aesthetically self-conscious. The patient was seeking comprehensive fixed prosthodontic care and was well informed about the nature of such treatment, having witnessed his elder siblings undergo similar treatment.

Initial management

The initial management of the patient's oral health focussed on a preventive strategy to address the aetiology of his gingivitis. Non-operative oral health strategies were advised to the patient and a programme of full-mouth professional mechanical plaque removal (PMPR) was completed, while ongoing supportive periodontal therapy (SPT) was implemented on a four-monthly schedule with a dental hygienist (**Figure 2**).^{7,8}



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FIGURE 1: The patient's initial situation on clinical presentation to the tertiary care referral centre. The dentition is globally affected by amelogenesis imperfecta, associated with dentoalveolar disproportion and an unusual presentation of open occlusion.



FIGURE 2: Initial treatment focussed on patient-driven improvements in oral hygiene, supplemented by professional mechanical plaque removal and ongoing four-monthly supportive periodontal therapy. The patient demonstrated a sustained commitment to oral health behaviour change, as evidenced by the establishment of a robust, pale, pink and stable gingival architecture.

Clinical record making

In order to proceed with the digital planning workflow, a series of clinical records were made, which included pre-operative radiographs, clinical photographs and digital intra-oral scans (3Shape; TRIOS, Copenhagen, Denmark). A photorealistic 3D tessellation, or triangulation, of the facial features was generated in real colours using the Face Hunter scanner (Zirkonzahn Srl; Gais, Italy), while patient-specific occlusal information was captured and recorded using the PlaneSystem (Zirkonzahn Srl; Gais, Italy) (Figure 3). When combined, these records allow for efficient communication from the clinic to the dental

laboratory, regarding the precise spatial arrangement of the pre-operative dentition as it relates to key aesthetic and biomechanical determinants of a harmonised tooth arrangement,⁹ including:

1. **The facial mid-line:** this in turn determines the ideal dental mid-line location.¹⁰
2. **The inter-pupillary line and natural head position:** this determines the ideal occlusal plane of the maxillary anterior teeth as viewed from the patient's front.^{11,12}



FIGURE 3: Identification of the ala-tragal line with black marker in preparation for recording of occlusal-specific information using the PlaneSystem. Three-dimensional facial tessellation scanning, achieved with Face Hunter, permits merging of an intra-oral scan using Zirkonzahn.Modifier software. Key biomechanical and aesthetic landmarks are now conveniently available for reference at the dental laboratory.

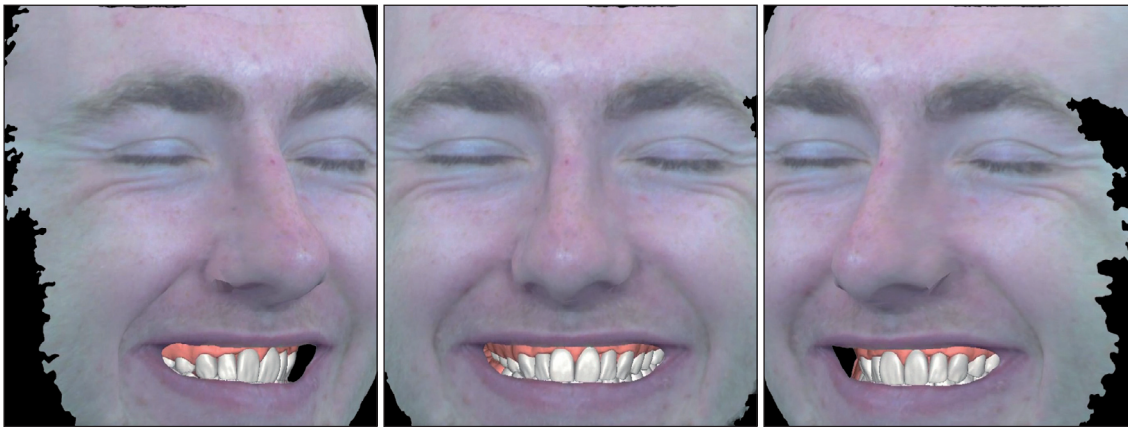


FIGURE 4: With unparalleled access to high-fidelity clinical information, the dental technician can develop an end goal of prosthodontic treatment wherein the contours of the proposed definitive restorations are informed on the basis of the patient's physiognomy.



FIGURE 5: A treatment mock-up may be fabricated in a flexible machinable polycarbonate based on the contours of a final proposed restoration, in such a manner as to be capable of fitting to the contours of the pre-operative situation.

3. **The smile display:** this is a determinant of the incisal edge positions and therefore the ideal tooth lengths and gingival margin locations when viewed from the patient's front and side profiles.¹³
4. **The ala-tragal line:** this is a key determinant of the maxillary occlusal plane as viewed from the patient's side profile.¹⁴
5. **Maxillo-mandibular relationships:** from which incisor inclinations and inter-arch static and dynamic occlusal factors may be determined.¹⁵

Laboratory planning

At the laboratory, the dental technician may merge these digitised records using Zirkonzahn.Modifier software (Zirkonzahn Srl; Gais, Italy) to form a precise 3D rendering of the patient's pre-operative dentofacial situation, with all biomechanical and aesthetic landmarks conveniently available for reference. This offers the technician unparalleled, high-fidelity access to key diagnostic clinical information when compared to conventional analogue-based workflows.⁴

At this stage, an end goal of prosthodontic treatment may be developed wherein the contours of the proposed restorations are informed on the basis of the patient's physiognomy, or rather, their unique and characteristic facial features (Figure 4).⁹ The final proposed design may be fabricated into a snap-on smile try-in, or treatment mock-up, using a flexible machinable polycarbonate (Temp Premium Flexible; Zirkonzahn Srl, Gais, Italy) (Figure 5).

Visualise before you provisionalise

At this early stage of diagnostic work-up, prior to any operative intervention, the clinician and the technician can now communicate to each other and, most importantly, to the patient, in an understandable visual rhetoric, a precise end goal of treatment from which a meeting of the minds may be achieved (Figures 6 and 7).⁵

Conclusions

Given the serious, irreversible and biologically expensive nature of prosthodontic treatment modalities, a precise end outcome of treatment should be visualised in a language that all stakeholders can understand prior to undertaking significant changes to a dentition. Complete digital workflows that allow the combination of dentofacial 3D data are emerging as an indispensable contemporary tool for restorative clinicians.¹⁶



FIGURE 6: Prior to any irreversible and biologically expensive operative intervention, the tripartite stakeholders (patient, clinician and dental technician) of the reconstruction can achieve a precise meeting of the minds in a universally understandable visual rhetoric regarding the intended end goal of treatment.



FIGURE 7: Close-up extra-oral and intra-oral views illustrating satisfying contours of a proposed definitive restoration.

CRediT author statement:

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