AMALGAMATION OF DIGITAL AND MANUAL WORKFLOW FOR THE FULL MOUTH ESTHETIC AND FUNCTIONAL REHABILITATION OF A PATIENT WITH AMELOGENESIS IMPERFECTA TO IMPROVE PATIENT SATISFACTION AND QUALITY OF LIFE - A CASE REPORT

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ABSTRACT

Full mouth rehabilitation is a very challenging and comprehensive treatment protocol for most clinicians. In recent years a shifting trend towards digital workflow has been observed in dentistry, specially pertaining to prosthodontics and smile makeover. It requires intensive understanding of the concepts and fine skills, to execute and establish successful clinical outcomes. Various conditions of oral cavity may require full mouth rehabilitation. One such disorder is Amelogenesis Imperfecta (AI), mainly for 2 purposes: esthetics and preserving the

crown integrity. This disorder represents a group of developmental conditions of genetic origin that affect the structure and clinical appearance of enamel of all or nearly all the teeth in a more or less equal manner. AI is a condition that inadvertently reduces oral health-related quality of life and may cause physiological problems. This case report describes a combined digital and manual workflow to achieve a successful outcome in full mouth rehabilitation of a patient presented with Amelogenesis Imperfecta. It also highlights the completion of treatment procedures in a short span with minimal clinical appointments.

Keywords: Amelogenesis Imperfecta, digital workflow, enamel hypoplasia, esthetics, full mouth rehabilitation, hypoplastic teeth

INTRODUCTION

Amelogenesis imperfecta (AI), is a group of hereditary diseases that affect the tooth enamel in either quality or quantity. The prevalence of this disorder ranges from 1:700 to 1:14000, depending on the population [1–4]. The uncertainty of the exact incidence of amelogenesis imperfecta is what makes the treatment plan difficult and challenging. There are around at least 14 types of amelogenesis imperfecta described by researchers [3-5]. These types are differentiated by their pattern of inheritance and specific dental abnormalities due to mutations in the *AMELX, ENAM, MMP20,* and *FAM83H* genes [4, 6–9]. These genes contain the instructions for synthesis of proteins that are necessary for the formation of enamel. Teeth with defective enamel are abnormally thin or soft, hence weak and easily damaged. The affected dentition may have a yellow or brown color [10–12].

Additionally, amelogenesis imperfecta can occur alone without any other signs and symptoms or as part of a syndrome affecting multiple parts of the body [5, 13–15].

Amelogenesis imperfecta is a condition that involves discolored, pitted or grooved teeth, prone to accelerated wear and breakdown. This condition could possibly affect primary and permanent dentition. It is associated with crown malformation and abnormal enamel density [1, 3, 16, 17]. Depending on the type of AI, clinical features of patients might vary. The classification of AI is primarily on the triad of clinical, radiographic, and histologic appearance of the enamel defect as well as the mode of inheritance of the disorder [18, 19]. AI has been categorized as hypoplastic (autosomal dominant/ autosomal recessive/x-linked dominant), hypocalcified (autosomal dominant/ autosomal recessive), hypomaturation (autosomal recessive/x-

linked recessive/ autosomal dominant) and hypoplastic-hypomaturation types. Hypoplastic AI represents 60 to 73% of all cases, hypomaturation AI represents 20 to 40%, and hypocalcification AI represents 7% **[20–24]**.

The challenging aspects for this case included the soft texture of enamel, the apt selection of dental material for prosthesis, the bonding protocol, the decision of veneer versus full coverage restoration, the masking of the severe discolouration present and the most important one being the time constraint in the complete treatment procedure. This case report presents a successful fullmouth rehabilitation of a patient with hypoplastic AI using a combined digital and manual workflow to achieve the desired outcome in a short span with minimal clinical appointments.

PRESENTATION OF CASE

A 22-year-old male patient reported to the Department of Prosthodontics, Saveetha Dental College and Hospital, with a chief complaint of yellow to brownish discoloration of all teeth since 10-12 years. The patient also reported a dental history of discolored deciduous teeth. No medical history or family history was reported, relevant to the same. On clinical examination intraorally, the patient had a complete set of permanent dentition with no missing teeth. Maxillary and mandibular teeth showed yellowish brown discoloration with normal morphology of crown structure and mild attrition of teeth **(Figure 1)**. The soft tissue of the patient was firm in consistency and firmly attached to the underlying alveolar bone with adequate keratinization.

Figure 1: Intraoral frontal view of the patient showing yellowish brown discoloration

There was no evidence of chipping of enamel and the consistency of enamel was medium (between soft to hard). Smile line of the patient was medium, with a papillary smile. On the basis of clinical examination, a

provisional diagnosis of hypoplastic AI was provided and panoramic radiograph was advised. This radiograph showed the presence of a thin layer of enamel with radio density of enamel more than dentin and

confirmed the final diagnosis of hypoplastic AI.

TREATMENT PLAN AND MANAGEMENT

To protect the crown structure with structural support as well as provide excellent esthetics, a treatment plan was devised which involved full veneer restorations of the entire dentition. The lower left first molar was grossly decayed and hence was extracted. The choice of material used for this was zirconia coping structure layered with ceramic for the maxillary and mandibular arch, owing to the severe discoloration of the dentition.

After obtaining informed consent for the treatment, entire treatment was planned and completed in 6 clinical appointments as follows-

- Appt. 1: Photographs (with patient's consent), Diagnostic impressions with irreversible hydrocolloid (Zhermack, Tropicalgin), Facebow record and jaw relation for diagnostic mounting **(Figure 2)**.
- Appt. 2: Gross tooth preparations and temporization **(Figure 3)**.
- Appt. 3: Final tooth preparations, Master impressions of maxillary and mandibular arches **(Figure 4)** with vinyl polysiloxane material

(Zhermack elite HD+) and temporization. Final Face-bow record and jaw relation

- Appt. 4: Zirconia coping and monolithic trial **(Figure 6)** of digitally designed **(Figure 7)** prosthesis
- Appt. 5: Ceramic bisque trial and corrections followed by final cementation after glazing of prosthesis and maxillary arch impression for night guard **(Figure 8)**.
- Appt. 6: Delivery of the night guard and oral hygiene instructions given.

the existing centric relation was confirmed with a bilateral manipulative technique (Dawson technique). Vertical dimension (VD) at rest (VDR) and occlusion (VDO) was determined. It was deciphered to restore in the existing VD. Intraoral diagnostic impression (Tropicalgin, Zhermack ®) was taken and mounted onto the semi-adjustable articulator (STRATOS 300, Ivoclar ®) with the help of facebow record and inter occlusal records using bite registration paste (Virtual CADbite ®). The diagnostic models were scanned in a lab scanner (Medit T500®) and a digital workflow was planned for the patient. A diagnostic wax up was done for

maxillary and mandibular arches to establish occlusion **(Figure 2)**.

Temporization was performed with gross tooth preparation with poly-methyl methacrylate material **(Figure 3)**, at an existing vertical dimension, was delivered to the patient and was observed for any changes related to the stomatognathic system.

Shade determination (VITA classic shade guide®) was done according to the facial complexion keeping in mind, to mask the existing discolored teeth. The maxillary and mandibular teeth were prepared in the following order: right posterior, left posterior and lastly the anterior teeth were prepared.

Figure 2: Diagnostic wax up

Figure 3: Poly Methyl Methacrylate (PMMA) provisional restoration

Prefabricated provisiona restoration were milled with Poly Methyl Methacrylate (PMMA) based on the diagnostic wax up. The provisional restorations are inserted in the mouth and anterior guidance was determined by all excursive movements from centric relation.

Once satisfied, gingival retraction was performed to expose all equigingival margins of the tooth preparation in the posterior teeth and subgingival margins in the anterior teeth, prior to impression making. The margins were given so as to shift the demarcation of prosthesis and tooth margins below the free

gingiva. For gingival retraction procedure, a double cord technique was used, a #000 first cord and a #00 second cord, with the cords soaked in local anaesthetic solution containing adrenaline (ULTRAPAK ☐ knitted cord). A master impression of the prepared arches was made after meticulous and conservative gingival retraction procedure with two stage putty wash technique (Elite HD+, Zhermack ®) and a final jaw relation was recorded using pattern resin (Pattern Resin LS, GC®) and the existing modified temporaries **(Figure 4)**. Digital design was fabricated with anatomic copings in the maxillary and mandibular right first premolar to left premolar and monolithic zirconia crowns for maxillary and mandibular second premolars, first molars, second molars using 3Shape Trios ® and were milled in zirconia **(Figure 5)**. Zirconia coping trial was done and the jaw relation verified for clearance for the ceramic layering **(Figure 6)**.

Ceramic layering was done with A2 shade (VITA classic shade guide®), using the index of the digital design and temporaries as a guide. Ceramic Bisque trial was done intraorally, for any corrections required in occlusion or aesthetics. The occlusion was examined with T-scan (T-Scan™ Novus™) and a canine guided occlusion was obtained **(Figure 7) [25–28]**.

The esthetics of the prosthesis was determined using the Smile Esthetic Index (SEI) with a score of 5 preoperatively and improved score of 9 postoperatively **(Table 1) (29, 30)**. Once canine guided occlusion was established, final glazing was done and cemented with resin modified GIC luting cement **(Figure 8)**. The drastic improvement of esthetics from preoperative to postoperative smile was evident **(Figure 9)** and close up photographs of anterior teeth were taken to show the emergence profile **(Figure 10)**.
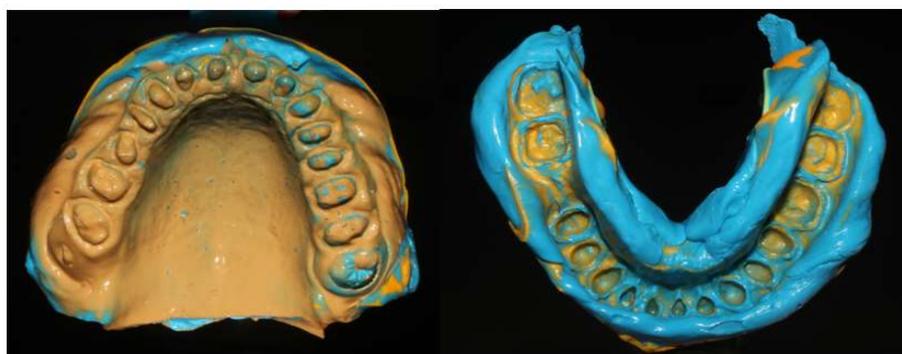

Figure 4: Master impression of the prepared arches was made after meticulous and conservative gingival retraction procedure with two stage putty wash technique (Elite HD+, Zhermack ®)
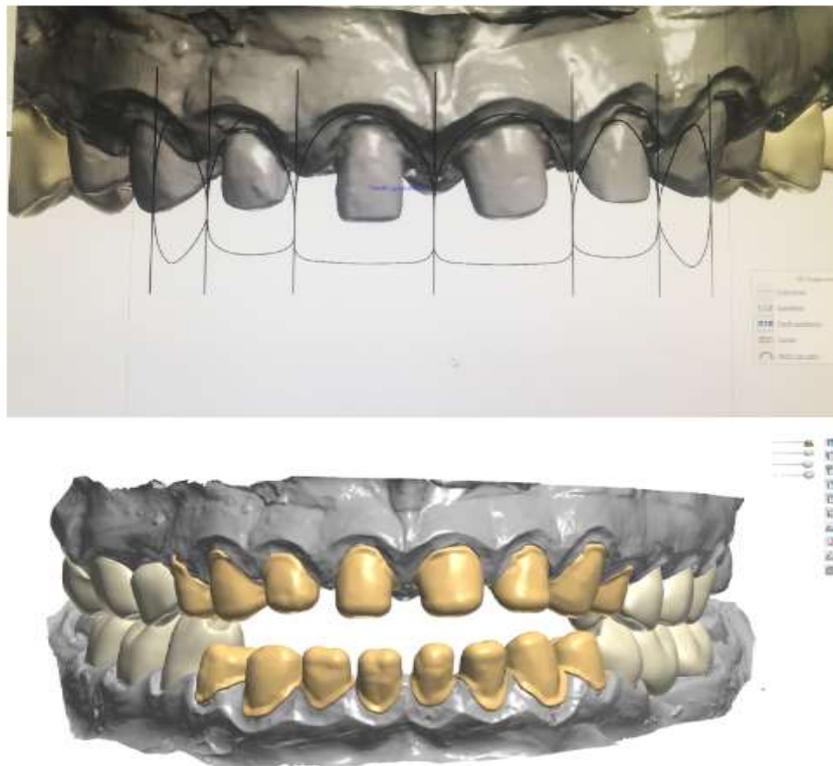
Figure 5: Digital design for anatomic copings in the maxillary and mandibular arches using 3Shape Trios ®

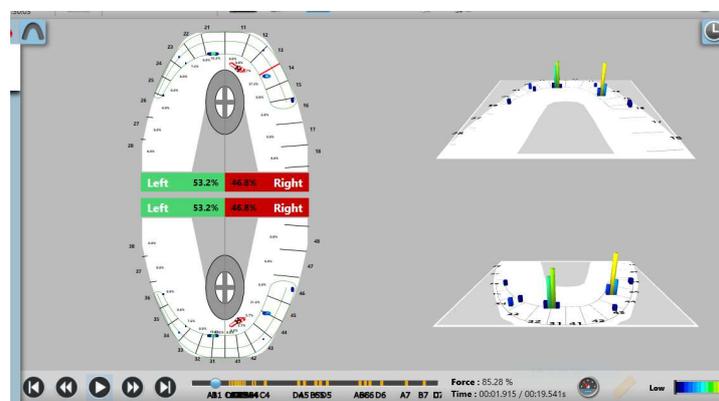**Figure 6: Zirconia coping trial with posterior monolithic zirconia**

Figure 7: T-scan evaluation of the bisque ceramic trial showing non-uniform contacts that need to be equilibrated

Table 1: Smile Esthetic Index (SEI) used to evaluate the esthetic outcome of the final prosthesis

S.NO	CRITERIA	PREOPERATIVE ANSWERS (YES=1, NO=0)	POSTOPERATIVE ANSWERS (YES=1, NO=0)
1	CORRECT SMILE LINE	0	1
2	CORRECT FACIAL MIDLINE	1	1
3	CORRECT TOOTH/ CROWN ALIGNMENT	0	1
4	ABSENCE OF VISIBLE TOOTH DEFORMITY	0	1
5	ABSENCE OF VISIBLE TOOTH DISCHROMY	0	1
6	ABSENCE OF VISIBLE GINGIVAL DISCHROMY	1	1
7	ABSENCE OF VISIBLE GINGIVAL RECESSIONS	1	0
8	ABSENCE OF VISIBLE GINGIVAL EXCESS	1	1
9	ABSENCE OF VISIBLE GINGIVAL SCARS	1	1
10	ABSENCE OF VISIBLE DIASTEMA AND/OR MISSING DENTAL PAPILLAE	1	1
	TOTAL SCORE (SEI)	5	9

Figure 8: Intraoral frontal view in centric of preoperative dentition and postoperative final prosthesis

Figure 9: Preoperative and postoperative extraoral frontal view of the patient smile

Figure 10: Intraoral close up of maxillary and mandibular anterior teeth of the final prosthesis

RECALL AND REVIEW

Patient was recalled after 1, 3 and 6 months. He was advised meticulous oral hygiene instructions to brush twice daily and use floss interdentally. The patient had a high score of 27 preoperatively and a low score of 11 **(Table 2)** suggesting an improvement in oral health related quality of life (OHRQOL) using the OHIP-14 questionnaire **[31–33]**.

The Visual analogue scale (VAS) (1-10) was used to evaluate the patient satisfaction of the patient after the treatment, with 0 (indicating complete dissatisfaction with the treatment) to 10 (indicating total satisfaction with the treatment) **[34, 35]**. The score for which was 9. At 3 months' post cementation panoramic radiograph was taken **(Figure 11)**.

Table 2: Table showing the OHIP-14 score in each domain for the patient in this case report

OHIP-14 DOMAINS	PRE-TREATMENT SCORE FOR EACH DOMAIN	POST-TREATMENT SCORE FOR EACH DOMAIN
Functional limitation	3	1
Physical pain	3	1
Psychological discomfort	6	3
Physical disability	2	2
Psychological disability	6	2
Social disability	4	2
Handicap	3	0
OHIP-14 SCORE	27	11

Figure 11: Panoramic Radiograph at 3 months' post cementation

DISCUSSION

The enamel during organogenesis, changes from a soft and pliable tissue to its final form, this is almost devoid of protein **[1, 36, 37]**. Any deviation from this process can lead to AI **[7, 8, 21, 38]**. The permanent dentition is more commonly affected as seen in the case presented here **[39–41]**. Various studies showed that oral complaints associated with AI are esthetic appearance, extensive loss of tooth structure, dental sensitivity, and loss of vertical dimension **[20, 42–44]**. No standard formula for successful treatment of AI has been demonstrated. Treatment planning for patients with AI is dependent on many factors like the age,

socioeconomic status of the patient, the type and severity of the disorder, and the intraoral scenario at the time the treatment is planned. The skill of a prosthodontist often lies in overcoming the challenges that are faced in the treatment planning and execution with expected results **[45]**. It includes removal of surface stains, reducing sensitivity, maintaining vertical dimension of occlusion, and the esthetics with adhesive techniques/overdentures/porcelain-fused-to metal crowns/fixed partial dentures/full porcelain crowns/inlay/onlay restorations are used for better esthetics of the patients **[1, 46–52]** .

Although many dental prosthetic options are available in this present case we chose. This being said a full coverage restoration in order to protect the soft texture of enamel **[50, 52]**. Zirconia copings layered with ceramic for anterior teeth and monolithic crowns for posterior teeth were the apt selection of material for prosthesis for this patient, as it was essential to mask the enamel discolouration completely **[53–57]**. A porcelain fused to metal prosthesis could exhibit metallic hue and compromise esthetics, which was of utmost importance for this case **[49, 50, 52]**.

Since the bonding protocol is usually extensive for teeth with structural abnormalities, a resin cement with meticulous etching and bonding protocol is generally used **[58–61]**. We went ahead with the conventional permanent Type I GIC luting agent, since the enamel was defective and tooth preparation was on dentin which cannot be etched.

In recent times, the most important challenge in any prosthetic full mouth rehabilitation is the time constraint in the complete treatment procedure. In the present case, the treatment was completed in a short span of 1 month with a minimum of 6 clinical appointments.

CONCLUSION

Rehabilitating a patient with amelogenesis Imperfecta dysplasia with multiple disorders is challenging and requires careful treatment planning. Majority of these patients are very young with high esthetic and functional demands. Fixed rehabilitation of such patients with esthetic dental material would be an ideal choice of treatment. The appropriate treatment protocol for these patients not only satisfies their aesthetic and functional demands but also gives better confidence in life.

ACKNOWLEDGEMENT

SOURCE OF SUPPORT

CONFLICT OF INTEREST

None declared.

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