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Case Report

Direct Nanocomposite Veneers on Six Anterior Teeth Affected by Hypoplastic Amelogenesis Imperfecta

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Abstract

Hypoplastic amelogenesis imperfecta (HAI), arises from the defective formation of the enamel matrix during the secretory stage of amelogenesis. It is characterized by a thin, fully mineralised enamel layer that radiographically contrasts with dentine. Restorative treatment in young adolescents with HAI is intended to improve the aesthetic appearance and function of affected teeth while maintaining the maximum amount of tissue structure in preparation for later more advanced treatment. A conservative and cost-effective treatment option for young individuals with teeth affected by HAI are direct nanocomposite veneers. Currently there are no recommended treatment protocols for treating anterior teeth affected by amelogenesis imperfecta. This case report describes the management of the six anterior maxillary teeth affected by HAI using direct bonded nanocomposite veneers with FiltekTM Z350 XT. The initial bonding of direct nanocomposite veneers to six maxillary teeth affected by HAI was successful. The aesthetic appearance of the teeth was improved and the hypersensitivity significantly decreased. The eight-week follow up evaluation of the six nanocomposite veneers revealed no complications. The short-term success of the six direct FiltekTM Z350 XT nanocomposite veneers at the eight-week post-op evaluation suggested that the same treatment protocol could be applied to the four mandibular anterior teeth. Nanocomposite veneers were performed on the four mandibular anterior teeth at the eight-week post-op appointment. The selection of material that is used to veneer teeth affected by HAI should be based on sound scientific evidence of the handling and mechanical properties of the material. This case report concludes that the treatment protocol used was suitable for the placement of direct nanocomposite veneers on anterior maxillary teeth affected by HAI. Additionally, the FiltekTM Z350 XT is a suitable nanocomposite material that showed excellent finishing properties and aesthetics. Furthermore, Scotchbond XT proved to be a suitable adhesive for bonding FiltekTM Z350 XT direct nanocomposite veneers to the teeth affected by HAI. However, the long-term success or failure of the nanocomposite veneers will be reported with longer follow up.

Keywords: Hypoplastic Amelogenesis Imperfecta; Nanocomposite Veneers; Filtek™ 350 XT

Abbreviations

HAI: Hypoplastic Amelogenesis Imperfecta

Introduction

Amelogenesis imperfecta is a genetic anomaly affecting the structure and appearance of tooth enamel. This disorder can affect the entire dentition, including the primary and secondary teeth. One of the subtypes, hypoplastic amelogenesis imperfecta (HAI), is characterized by a thin, fully mineralized enamel layer that radiographically contrasts with dentine [1,2].

Enamel is highly mineralized and has a complex and organized micro-structure of rods and interrods [3,4]. These structural units are produced by the ameloblasts during the secretory stage of ame-

logenesis. They comprise of hydroxyapatite crystals with intervening enamel proteins, differing only in the orientation that they are deposited. The enamel proteins maintain spaces between adjacent hydroxyapatite crystals promoting their appositional growth [5]. Once the full thickness of enamel is secreted, the ameloblasts transition into the maturation stage where they undergo cyclic changes to mineralize the enamel matrix. Here no new hydroxyapatite crystals are added, but through the degradation and removal of enamel proteins and addition of ions, growth in the width and thickness of the crystals occurs. Mineralization of the enamel structure and consequent mineralization to roughly 96% [3,6]. The HAI phenotype arises from defective formation of the enamel matrix during the secretory stage [7].

Enamel defects are debilitating as once amelogenesis is complete, the ameloblasts are lost during the eruptive process and no new enamel can be secreted [8]. Patients with enamel defects, especially affecting the anterior teeth, present with aesthetic complaints due to discoloration [9-11]. Furthermore, the poorly mineralized and deficient enamel predisposes to tooth sensitivity, plaque accumulation, rapid tooth wear and caries [1,12,13].

Restorative treatment in young adolescents is intended to improve the aesthetic appearance and function of affected teeth while maintaining the maximum amount of tissue structure in preparation for later more advanced treatment [14,20]. A conservative and cost-effective treatment option recommended for teeth affected by HAI in young adolescent patients are direct nanocomposite veneers [19,21,22].

Bonded restorations are less invasive with the tooth surfaces requiring minimal or no preparation [23]. Previous publications have highlighted difficulty in the bonding of composite to enamel affected by amelogenesis imperfecta [17,24]. Procedures of deproteinization using sodium hypochlorite to improve the shear bond strength of composite in these cases have reported success [24-26]. However, additional etching to improve bonding of composite to dentine and enamel in teeth displaying enamel defects was shown to be of no benefit [27-29].

The successful bonding of nanocomposite to enamel affected by HAI was attributed to the etch patterns that were similar to the etch patterns of normal enamel [30]. The benefits of bonded nanocomposite veneers include cost effectiveness, conservative approach, improved physical properties, wear resistance, reduced procedural time and excellent aesthetics [21,31-33]. However, these direct nanocomposite veneers are susceptible to chipping, fractures, discoloration, surface roughness and loss of lustre that requires they be polished every six months [15,34,35].

There are currently no recommended treatment protocols for treating anterior teeth affected by amelogenesis imperfecta [18,36,37]. This case report describes the management of the six anterior maxillary teeth affected by HAI using direct bonded nanocomposite veneers with Filtek Z350 XT.

Case Presentation

A 15-year-old South African female patient visited the Oral and Dental Hospital at the University of Pretoria with the main complaint of breaking and discolored anterior teeth. Intra oral examination showed reduced enamel thickness, rough surfaces and patches of missing enamel in the middle and incisal edges of the maxillary incisors and canines (Figure 1). The mandibular incisors and canines presented with a similar pattern of enamel loss and exposed dentine. The maxillary and mandibular premolars and molars presented the early signs of enamel loss with small patches of exposed dentine. The teeth were sensitive due to the reduced enamel thickness and clearly visible exposed dentine with a clear contrast between the exposed patches of dentine and surrounding enamel. The overjet and overbite of the anterior teeth were normal and no loss of vertical dimension was observed. Radiographic examination (Figure 2) confirmed the reduced enamel thickness and contrasting radiodensity of the enamel and dentine. The patient reported that her grandmother suffered from the same condition. According to the patient history and the clinical and radiographic features of the teeth, a diagnosis of HAI was made. After discussion with the patient she was referred to the basic restorative dentistry clinic for direct nanocomposite veneers on her six maxillary anterior teeth. This case report describes the treatment protocol for the placement of direct nanocomposite (Filtek™ Z350 XT) veneers onto the six maxillary anterior teeth affected by HAI.

Materials and Methods

The treatment plan was described in detail to the patient who consented to the proposed procedures. Filtek™ Z350 XT Universal nanocomposite (shade A1B) was chosen using a VITAPAN classical

Figure 1: Hypolplastic Amelogenesis Imperfecta pre-op.

Figure 2: Hypoplastic Amelogenesis Imperfecta panorex.

shade guide (VITA Zahnfabrik H. Rauter GmbH and VITA Co, Bad Sackingen, Germany) under natural light and approved by the patient. There was no need to administer local anaesthetic and the operative field was isolated with cotton rolls and high-volume suction for moisture control.

The enamel surfaces of the six anterior maxillary teeth were roughened using a high-speed rotary instrument (NSK DynalLED M600LG QD, NSK, Tokyo, Japan) and red stripe, flame shape diamond bur ISO 806 314 249 514 012 (Dentsply Sirona/Mailefer, Ballaigues, Switzerland) under copious amount of water cooling. None of the preparations extended inter-proximally.

The enamel surfaces of each tooth were etched with 37% phosphoric acid (Scotchbond™ Etchant, 3M ESPE, St Paul, USA) for 15 seconds using the selective-etch technique. The tooth surfaces were gently rinsed and air dried using a dental three in one syringe. Adper™ Scotchbond™ 1XT Adhesive (3M ESPE, St Paul, USA) was applied onto the prepared tooth surface for 15 seconds, gently air dried and polymerized for 10 seconds, according to the manufacturer's instructions.

Filtek Z350 XT Universal nanocomposite (3M ESPE) was used to veneer the prepared tooth surfaces. The nanocomposite was applied incrementally. and polymerized according to the length and time recommended by the manufacturer. Restorations were finished using a yellow stripe, flame shaped diamond bur, ISO 806 314 249 504 012 (Dentsply Sirona/Mailefer) under copious amounts of water cooling.

The final polishing of the six anterior nanocomposite veneers were achieved by using the Enhance polishing system (Dentsply Sirona, North Carolina, USA), according to the manufacturer's instructions.

Composition, Manufacturer and materials used in this case study

Material	Composition	Manufacturer
Scotchbond™ Etchant	37% phosphoric acid	3M, ESPE, St Paul, USA
Adper™ Scotchbond™ 1XT Adhesive	Bis-GMA, HEMA, dimethacrylates, polyalcenoic copolymer, 5nm diameter 10% weight silica spherical particles Solvents: Ethanol and water.	3M, ESPE, St Paul, USA
Filtek Z350 XT Universal nanocomposite	Matrix: Bis-GMA, TEGDMA, UDMA, Bis-EMA Filler: Silica nanofillers (5-75nm) zirconia/silica nanoclusters (0.6 - 1.4μm)	3M, ESPE, St Paul, USA

Table a

Results and Discussion

The initial bonding of six Filtek Z350 XT direct nanocomposite veneers onto the six maxillary teeth affected by HAI was successful. The aesthetic appearance of the teeth was improved and the hypersensitivity significantly decreased. The patient indicated that she was satisfied with the current outcome of the treatment. The eight-week follow up evaluation of the six nanocomposite veneers (Figure 3) revealed no complications and the patient remained happy with the treatment.

Figure 3: Hypoplastic Amelogenesis Imperfecta post op.

Indirect ceramic restorations are the preferred restorations for treating teeth affected by HAI [38]. The use of computer-aided design/computer aided manufacturing (CAD/CAM) of chair-side restorations has also become very popular [39,40]. CAD/CAM materials used for manufacturing these chair-side restorations are glass ceramics, ceramics and composite resin [40]. These restorations exhibit superior aesthetics, mechanics, predictability and longevity, but are not cost effective [40]. Direct nanocomposite veneers are considered a suitable interim treatment for younger patients and offer a reasonable treatment plan option for patients with teeth affected by HAI that cannot afford expensive laboratory fabricated restorations [41,42].

Bonding of restorative materials to defective enamel remains a challenge especially in enamel characterized by a lower enamel mineral composition [46]. The successful bonding of nanocomposite to enamel affected by HAI however is attributed to etch patterns similar to that of normal enamel [30]. The literature confirms that the bond strength of direct nanocomposite restorations to enamel and dentine can be enhanced with use of a suitable bonding agent. [15,20,22,37]. Adper™ Scotchbond™ 1XT Adhesive appears to be a suitable bonding agent that can be used successfully with Filtek™ Z350 XT.

The selection of composite material that is used to veneer teeth affected by HAI should be based on sound scientific evidence of the handling and mechanical properties of the material.

Filtek™ Z350 XT is a nanocomposite restorative material displaying superior microhardness, lower stress shrinkage and improved colour stability with little discoloration [43-45]. Despite research that claims ceramic nanofillers offer only incremental improvements in mechanical properties [47], the results from this study demonstrates that Filtek™ Z350 XT is suitable for direct veneering of teeth affected by HAI. The proposed treatment protocol used in this case report can be recommended for the placement of direct nanocomposite veneers onto anterior teeth affected by HAI, with a normal overjet and overbite.

The short-term success of the six direct Filtek™ Z350 XT nanocomposite veneers at the eight-week post-op evaluation suggested that the same treatment protocol could be applied to the four mandibular anterior teeth. Nanocomposite veneers were performed on the four mandibular anterior teeth at the eight-week post-op appointment. The continued evaluation of both maxillary and mandibular veneers will be reported in future publications. The limitations of this case study include the short eight-week follow up to determine the current success of the direct nanocomposite and the availability of only one body shade of Filtek™ Z350 XT. Although the preferred long-term treatment plan for teeth affected by HAI are ceramic bonded restorations, direct bonded nanocomposite veneers offer a suitable interim treatment option for young patients until they are old enough to receive indirect or chairside fabricated CAD/CAM ceramic or composite crowns.

Conclusion

This case report concludes that the treatment protocol used was suitable for the placement of direct nanocomposite veneers on anterior maxillary teeth affected by HAI. Additionally, the Filtek™ Z350 XT is a suitable nanocomposite material that showed excellent finishing properties and aesthetics. Furthermore, Scotchbond XT proved to be a suitable adhesive for bonding Filtek™ Z350 XT direct nanocomposite veneers to the teeth affected by HAI. However, the long-term success or failure of the nanocomposite veneers will be reported with longer follow up.

Conflict of Interest

No financial interest or any conflict of interest exists.

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