<u>RESTORING HYPOPLASTIC ENAMEL</u>

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The most common anomaly in the primary and permanent dentition is the abnormal formation of the enamel. This underdevelopment of enamel, or enamel hypoplasia, is a cause of concern among patients, parents of children, and the dental professional. (1) Besides being unesthetic, this underdeveloped enamel presents a challenge to the dentist due to the difficulty of restoring the tooth to a natural contour and color. These defects in the enamel are more susceptible to caries and are likely to be sensitive to air, heat, cold, and mechanical stimuli. Even toothbrushing may create a toothache in these teeth. (1) The etiology of hypoplastic teeth includes respiratory diseases, hypoxia at birth, diseases causing high fever, renal insufficiency, hypoparathyroidism, diarrhea, malabsorption and malnutrition. (1) "Hypomineralized defects present the clinician with a challege." (2)

Needleman, et al, found that twenty percent of the primary anterior teeth studied exhibited hypoplastic defects. Twenty-five percent of the maxillary incisors and 10.1% of the mandibular incisors exhibited hypoplastic defects. The locations coincided with enamel formation at birth. One third of the canines had hypoplastic defects, mostly in the middle third of the facial surfaces. (3)

The most abundant protein in enamel formation is amelogenin. Amelogenin is a protein. When there are ameno acid alterations occurring in the amelogenin, mineral defects occur. These mineral defects are

referred to as hypocalcification of the enamel. If the alterations occur in another domain of the amelogenin molecule a decrease in the thickness of the enamel occurs. This is referred to as hypoplastic defects. (4)

The Er:YAG and Er,Cr: YSGG lasers are both capable of cutting hard tissues, and the morphological effects of the Waterlase™ (a) laser irradiation are also similar to those reported for Er:YAG laser irradiation. (7) Due to the hypersensitivity of these teeth, the Waterlase ™ laser is ideal for use in the preparation of hypoplastic teeth for the follow-up restoration. The primary advantage of using the Waterlase ™ is the elimination of the local anesthetic, in most cases, and therefore patient comfort. When compared to the preparation with the dental bur, “patients felt less pain during cavity preparation with the laser system and, in some cases anesthesia was not needed.” Also, studies have shown that patients will experience less anxiety with the laser device. (8)

The Waterlase™ can ablate enamel and dentin more effectively due to the highly efficient absorption in both water and hydroxyapatite. The ability of the Waterlase ™ to remove enamel and dentin was found comparable to the conventional dental handpiece and produces minimal thermal damage to the pulp or surrounding tissues, especially when irradiated with continuous water spray. (6) “When dental hard tissues were irradiated by the Er,Cr:YSGG laser accompanied with a water spray, not only could the temperature be suppressed, but cutting efficiency could be increased.” Furthermore, histologically, “no pulpal inflammatory responses were identified in Er,Cr:YSGG laser irradiated with a water spray." (7) This article will review the etiologies and choices available for the preparation and restoration of hypoplastic teeth.

Hypoplastic enamel: In this article, the term enamel hypoplasia will refer to both the quantitative defect in enamel and the hypomineralization as a qualitative defect presented as identifiable demarcated defects in the translucency of the enamel. The challenge presented to the clinician is the often compromised crown form "which makes defining an appropriate cavity form very difficult. Furthermore, these defective molars are more susceptible to dental caries and tend to be hypersensitive, which leads to increased levels of anxiety for children during dental treatment." (4) The reduction in the hardness of the hypoplastic enamel may explain the difficulty in restoring these teeth, with clinicians reporting loss of both tooth structure and restorative material. (4) The low hardness and modulus of elasticity seen in the hypoplastic areas indicates that the mechanical properties of hypoplastic enamel are similar to, or lower, than dentin. (2)

Etching of hypoplastic enamel: **A*ccording to Seow and Amaratunge the successful bonding of resinds to teeth may be very dependent on the response of the enamel to acid etching. Due to abnormal enamel the standard etching time and/or concentration of acid may not be appropriate for abnormal enamel.*** **(5)**

Studies have shown that the hypomineralized enamel did not exhibit the typical etching pattern seen in control enamel. Upon etching, there may be a uniform removal of hypomineralized enamel, rather than the differential etching patterns seen in the unaffected control enamel. (2) This etching of a less organized enamel structure may result in a pattern that is not the classic etched pattern, which may have a detrimental effect on bonding between the restorative/adhesive materials and the affected enamel. (2) "This significant reduction in hardness and modulus creates a very challenging situation for the clinician in choosing the most appropriate restorative material and technique with which to manage this problem condition." (2)

Preparation of the teeth: ***In a study reported by Venezie, et al, sodium hypochlorite was used to pretreat the enamel prior to bonding in a case of Amelogenesis Imperfecta. This pretreatment was initiated to try to enhance the bonding of an orthodontic bracket. The bonding was improved by using a 5% sodium hypochlorite. (6)***

Lasers can ablate enamel and dentin more effectively due to the highly efficient absorption in hydroxyapatite and water. The ability of the laser to remove enamel and dentin was found comparable to the conventional dental handpiece. The erbium laser produces minimal thermal damage to the pulp and surrounding tissues when used with water spray. Cutting efficiency is increased when the Waterlase™ was accompanied by water spray and the temperature was suppressed. In a study by Hossain and Nakamura, et al, it was concluded that; "the Er,Cr:YSGG laser irradiation is favorable to remove carious dental hard tissues or cavity preparation in pediatric dentistry because it does not damage the surrounding tissues." (8)

The Waterlase™ uses HydroKinetic® technology. This laser-energized water "cuts" or ablates soft and hard tissues. Local anesthesia can be eliminated in most cases, which provides a more comfortable procedure for the patient. This saves time and anesthetic use by the dentist. "There is no heat generated because of the water, no vibration, and most importantly, no smear layer because of the cutting action on the surfaces that the laser ablates. Another advantage of the Waterlase™ is its precise pinpoint accuracy in reducing tissues, which in turn makes for more accurate and conservative tooth preparations." (9)

Case 1: 7 year old female: The patient's mother reported that her daughter had a tooth that was sensitive to cold. Upon oral examination of the maxillary left first permanent molar, the discoloration and lack of normal enamel was evident. (Fig. 1) The patient had cavitation of the occlusal developmental pits which, upon probing, were detected to be carious. I explained to the patient and her mother that the Waterlase™ could be used and would probably not necessitate the use of local anesthetic. At the following appointment, the ablation of the caries was performed with the Waterlase™ without the need for local anesthetic. (Fig. 2, 3) A resinomer, Fuji II LC, (b) was used to restore the tooth.(Fig. 4)

Case 2: 5 year old female. The patient had sensitivity to cold on the lower left second primary molar. Oral examination revealed enamel hypoplasia of the entire buccal surface. (Fig. 5) After caries removal with a slow speed handpiece and round bur, the tooth was restored with a compomer. (Fig. 6)

Case 3: 7 year old male. Upon oral examination, the first permanent molar exhibited caries and hypoplastic and hypomineralized enamel. (Fig. 7) An Erbium:YAG laser was used to ablate the carious tissue. During the laser preparation, a carious exposure into the pulp was noted. (Fig. 8) A direct pulp cap was performed utilizing calcium hydroxide. A resinomer, Fuji II LC, was used to restore the tooth. (Fig. 9) No anesthetic was used.

Abstract

The most common anomaly in the primary and permanent dentition is the abnormal formation of the enamel. This underdevelopment of enamel, or enamel hypoplasia, is a cause of concern among patients, parents of children, and the dental professional. The Er:YAG and Er,Cr: YSGG lasers are both capable of cutting hard tissues, and the morphological effects of the Waterlase™ laser irradiation are also similar to those reported for Er:YAG laser irradiation. (7) Due to the hypersensitivity of these teeth, the Waterlase ™ laser is ideal for use in the preparation of hypoplastic teeth for the follow-up restoration. The primary advantage of using the Waterlase ™ is the elimination of the local anesthetic, in most cases, and therefore patient comfort. This article will review the etiologies and choices available for the preparation and restoration of hypoplastic teeth. Three case studies of primary and permanent teeth with enamel hypoplasia and their restoration are included.

Learning Objectives

1) What is most common anomaly in the primary and permanent dentition.
2) What are the most common etiologies of enamel hypoplasia.
3) What are the differences in the enamel of hypoplastic and hypomineralized enamel.
4) What are the advantages of the Waterlase™ in tooth preparations.

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Product References

a. Biolase 981 Calle Amanecer, San Clemente, CA 92673

b. GC America 3737 W. 127th Street, Alsip, IL 60803

Review Quiz

1. The most common anomaly in the primary and permanent dentition is which of the following?

   a. abnormal formation of the enamel *

   b. hyperplastic enamel

   c. hypoplastic dentin

d. sclerotic dentin

2. The abnormal formation of enamel is known as:

   a. hyperplasia
   b. hypoplasia*
   c. hyperbole
   d. hydrocephaly

3. The defects in the enamel caused by hypoplasia, result in the tooth to be more susceptible to which of the following:

   a. sensitivity to cold
   b. sensitivity to mechanical stimuli
   c. sensitivity to heat
   d. all the above*

4. The etiology of hypoplastic teeth includes all the following except:

   a. hyperparathyroidism*
   b. hypoxia at birth
   c. malnutrition
   d. hypoparathyroidism

5. According to the article, the primary advantage of the use of the Waterlase™ is:

   a. less time consuming for the dentist

b. less anesthetic necessary
c. the elimination of local anesthetic, in most cases
d. does not remove the smear layer

6. Lasers can ablate enamel and dentin more effectively due to the highly efficient absorption in :
    a. hydroxyapatite
    b. Water
    c. hydroxyapatite and dentin
    d. hydroxyapatite and water

7. Histologically no pulpal inflammatory responses were identified in which of the following lasers:
    a. Er,Cr:YSGG *
    b. Nd:YAG
    c. $CO2$
    d. Argon

8. Hypomineralization is a qualitative defect presented as identifiable demarcated defects in the:
    a. translucency of the enamel*
    b. radiopacity of the enamel
    c. translucency of the dentin
    d. radiopacity of the dentin

9. The Waterlase™ uses HydroKinetic® technology. HydroKinetic means:

    a. laser-energized water *
    b. laser-energized dentin
    c. laser-energized enamel
    d. laser-energized protein

10. The erbium laser produces:

    a. minimal thermal damage to the pulp and surrounding tissues when used without water spray
    b. maximum thermal damage to the pulp and surrounding tissues when used with water spray
    c. maximum thermal damage to the pulp and surrounding tissues when used without water spray
    d. minimal thermal damage to the pulp and surrounding tissues when used with water spray*

Figure 1

Figure 2

Figure 3

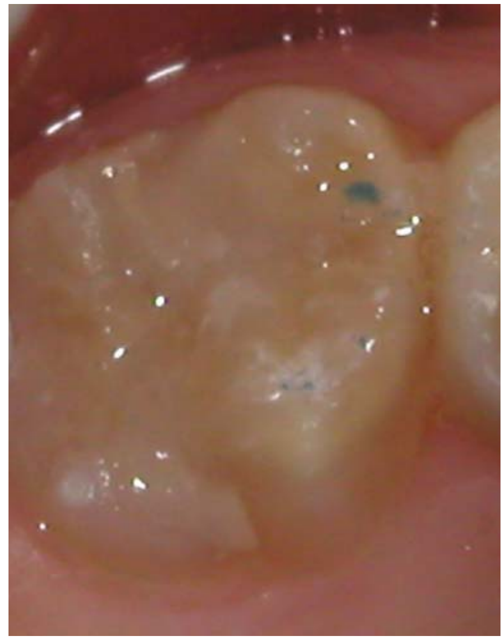

Figure 4

Figure 5

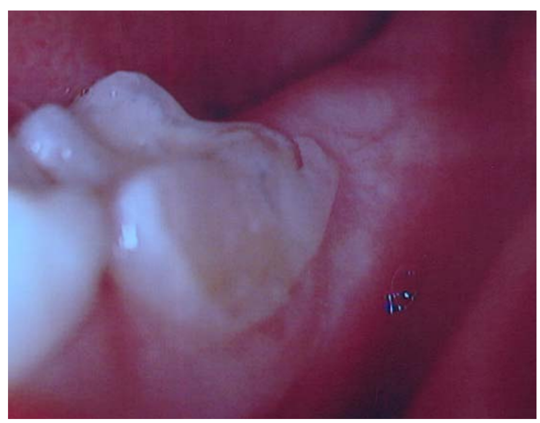

Figure 6

Figure 7

Figure 8

Figure 9