# A Case Report of Green Pigmentation in the Permanent Dentition

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#### ABSTRACT

Intrinsic green discoloration of teeth is an uncommon condition which mainly affects the primary dentition. Children can be teased about this, resulting in a loss of selfesteem and problems with social integration. The purpose of this paper was to present a case of green pigmentation in the permanent dentition caused by hyperbilirubinemia during infancy and an intermediate restorative approach to mask the esthetic deficiency arising from this. (J Dent Child 2012;79(3):189-92)

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Intrinsic green discoloration of teeth is an uncommon condition which can affect both the primary and permanent dentitions. Dental tissues are susceptible to intrinsic pigmentation during formation, which is frequently caused by medication (notably tetracycline) and systemic conditions at birth, such as hemolytic disease of the newborn, erythroblastosis fetalis, and hyperbilirubinemia.<sup>1-4</sup>

During hyperbilirubinemia, bilirubin is distributed and deposited in different tissues around the body. Soft tissues such as skin have a high cell turnover rate, causing the pigmentation to immediately disappear. In mineralized tissues such as teeth, however, it becomes permanently trapped, as those tissues lose their metabolic activity at maturation. If serum bilirubin is deposited during dental formation, it can result in discoloration ranging from a mild yellow to a darker green shade.<sup>5-8</sup> It was previously thought that deposition of biliverdin rather than bilirubin led to development of the green discoloration. However, analysis of affected primary teeth has found bilirubin to be the cause of dis-

Drs. Chambers and O'Morain are senior house officers, Dr. Keightley is specialist registrar, and Dr. Welbury is professor, all in the Department of Child Dental Health, Glasgow Dental Hospital and School, Glasgow, Scotland. colouration.<sup>8</sup> If concentrations of serum bilirubin exceed 30 mg/dL, then obvious green discoloration of the teeth will occur.<sup>9,10</sup>

There are a number of causes of green teeth reported in the literature, including biliary hypoplasia, cholestasis associated with sepsis, hemolytic disease, bile duct occlusion, cytomegalovirus infection, and erythroblastosis fetalis; however, the most common appears to be biliary atresia.<sup>6,9,11</sup>

Biliary atresia has an incidence of approximately 1:10,000 live births worldwide and is the result of progressive bile duct destruction from an inflammatory disease of unknown cause. It is related to the persistence or lack of remodeling of the embryonic ductal plate and consists of both intrahepatic and extrahepatic biliary atresia. This damage causes obstruction of bile flow, leading to progressive conjugated hyperbilirubinemia. If left untreated, this can result in cirrhosis and hepatic failure.<sup>12,13</sup>

Although most cases in the literature describe how the discoloration of teeth mainly affects the primary dentition, any teeth forming during the neonatal period may be involved. It has also been postulated that the extent of discoloration and its intensity are directly related to the duration and severity of the pathology, respectively.<sup>3,8,10,14-17</sup>

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The purpose of this paper was to present a case of green pigmentation in the permanent dentition caused by hyperbilirubinemia during infancy and an intermediate restorative approach to mask the esthetic deficiency arising from this.

#### **HISTORY**

A 7<sup>1</sup>/<sub>2</sub>-year-old female was referred for consultation regarding her discolored teeth in August 2010. She was born at 36 weeks gestation via emergency Caesarean section following spontaneous rupture of the membranes. She weighed 2.12 kg and required 2 days of phototherapy for neonatal jaundice. At 9 weeks old, she was admitted to the hospital due to prolonged jaundice, which was noticed at an infant checkup visit. A full workup for neonatal hepatitis was carried out, which revealed a conjugated hyperbilirubinemia of 3.6 mg/dL. A liver biopsy was performed, which confirmed the diagnosis of extrahepatic biliary atresia.

Her condition worsened over the next 2 years (serum bilirubin level of 24 mg/dL, unconjugated 3.3 mg/ dL), and she developed chronic liver disease. A liver transplant was carried out in August 2005 at 2 years, 4 months old, and she recovered well. Bilirubin levels returned to 0.4 mg/dL after the operation, indicating an acceptable balance between production and excretion.

On presentation to the Child Dental Health Department, the patient was in the early mixed dentition with no active caries present. Her oral hygiene needed improvement, and she previously had primary teeth extracted under general anesthesia due to caries. Her permanent first molars had been fissure sealed. There was a generalized green pigmentation of all her erupted permanent teeth with a chronological dark green band affecting the incisors' cervical margin (Figure 1-3).

After providing oral hygiene instructions and improving her tooth-brushing skills, we decided to place Belleglass veneers on the maxillary incisors. Belleglass is a lab cured polymer resin material that does not require any tooth preparation prior to bonding, and an opaque layer was incorporated into the veneers to mask the underlying green pigmentation. The margins were placed supragingivally to facilitate cleaning; as the patient had a low smile line, this did not detract from the appearance (Figure 4).

### DISCUSSION

Hyperbilirubinemia is a fairly common occurrence in neonates that typically results in visible jaundice. It is defined as serum concentrations of bilirubin greater than 1.5 mg/dL. Jaundice, however, is rarely clinically visible until serum concentrations become greater than 7 mg/dL.<sup>2,15</sup> Bilirubin is highly insoluble in water, so it is converted in the liver to a soluble conjugate before elimination from the body. This process is highly efficient under normal conditions, so plasma unconjugated bilirubin concentrations remain low. Almost all plasma bilirubin in the normal state is unconjugated.<sup>18</sup>



Figure 1. Green discoloration evident when patient smile.



Figure 2. Green pigmentation with chronological banding.



Figure 3. Lower first molars and incisors also affected.

During hyperbilirubinemia, bilirubin is extensively deposited throughout the body and can become incorporated into hard tissues. Therefore, any teeth in the formative stages may be affected and become intrinsically stained.<sup>2</sup> Not all infants with hyperbilirubinemia have green teeth, however, and it may be that the level of "unconjugated" bilirubin is more important than "conjugated" bilirubin. No reference to confirm this, however, has been found in the literature to date.<sup>15</sup> Both bilirubin and biliverdin are products of heme catabolism. Under the action of heme oxygenase, heme is broken down to biliverdin. Under normal conditions, biliverdin is rapidly reduced to bilirubin, which is subsequently excreted via the bile duct.

Studies have confirmed that only the calcification of dentin is altered by bilirubin, and histological analysis has shown a defined separation line in the middle layer of dentin—with the outer layer formed before the hyperbilirubinemia phase and the inner layer formed after control of the disease.<sup>6–9</sup> A change in tubule direction and large amounts of interglobular dentin has been observed at this line.<sup>6,10</sup>

Green dentin pigmentation is clearly visible through translucent enamel (Figures 1 and 2) and can cause great anxiety for the families involved and significant peer problems for the child.<sup>1,3</sup> The discoloration is not easily disguised with restorative materials; however, cosmetic improvements to these teeth may increase the chances of normal physical, psychological, and social development of the patient.<sup>1</sup>

To plan for the most appropriate cosmetic treatment, it is important for clinicians to understand that the pigmentation is confined to dentin and dental bleaching is unlikely to be effective. Direct composite veneers could have been placed; however, indirect veneers provide a more uniform opaque layer which is necessary to disguise the green pigmentation. No tooth structure was removed prior to placement of the veneers to ensure the restorative options were not compromised in the long term. Porcelain or Belleglass could have been used to mask the underlying green pigmentation. The latter was chosen, however, as it provided a less bulky restoration due to its improved strength in the thin section. It also has a wear resistance comparable to that of human enamel and is less abrasive on the opposing natural dentition.<sup>17</sup> The same restorative options could be used to disguise green pigmentation affecting the primary dentin. It would be necessary to assess each case on its own merits, ensuring that the patient and parents expressed a desire for an esthetic improvement and together could maintain a high standard of oral hygiene.

Occasionally, green teeth are also affected by enamel hypoplasia, which could be due to the effects of osteopenia and other disturbances of calcium and phosphate metabolism encountered in chronic liver disease.<sup>6,19,20</sup> This would need to be considered when planning treatment, as enamel bond strength would be reduced.

Children with liver disease are at high risk of developing dental caries, possibly due to the need for continuous feeding to compensate for the low intestinal absorption of nutrients.<sup>21</sup> This could explain the high caries rate that resulted in extractions of several primary teeth (Figure 3) and highlights the importance of caries prevention advice from an early age in these high-risk individuals.

The clinical characteristics of these teeth closely match the history of chronic liver disease and hyperbilirubi-



Figure 4. Veeners on upper incisors to improve aesthetics.

nemia. The dark green band present at the cervical margin of the maxillary incisors (Figure 2) was likely to have been created when bilirubin levels reached a high of 24 mg/dL and her chronic liver disease was at its worst prior to the transplant. As the patient matures and more permanent teeth erupt, it will be useful to note at what stage the teeth are not affected by the green pigmentation, thus confirming the chronological nature of the condition.

The esthetics of the anterior teeth were undoubtedly improved by the veneers, and the patient was very happy with her appearance (Figure 4). It would have been unwise to carry out this treatment if oral hygiene and caries levels were not under control. The patient understands that these restorations will need to be replaced as the gingival margins mature with age. It was decided that a provision of veneers at this early stage was necessary to improve self-esteem and assist in social integration.<sup>1,15</sup>

#### **CONCLUSIONS**

Intrinsic green pigmentation of the permanent dentition is rare, and biliary atresia is still the most common cause. Advances in medical care and an increase in the number of liver transplants being carried out will inevitably result in more individuals presenting with green teeth. It is important that these children receive preventive dental care at a young age, and cosmetic treatment should always be considered where possible.

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