

A Survey of the Oral Status of Children Undergoing Liver Transplantation

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Background: The purposes of this study were to examine the oral tissues and caries prevalence of children undergoing liver transplantation, and to evaluate the relationship between tooth staining and serum bilirubin level.

Methods: Thirty-four children (22 boys and 12 girls) under the age of 6 years with end-stage liver disease were referred from the Liver Transplantation Center at Kaohsiung Chang Gung Children's Hospital, Taiwan. Oral tissues were examined, and photographs taken to determine the green staining of the teeth and gingiva. A questionnaire was completed by their parents. Serum bilirubin levels were collected preoperatively in these children. Student's *t*-test was used to compare the mean decayed, missing, and filled tooth (dmft) difference between night-fed and non-night-fed groups, and to test the relationships between tooth staining and serum bilirubin levels.

Results: The caries prevalence of the 34 children undergoing liver transplantation was 61.8%. The mean dmft score of children 2 to 6 years old who were night-fed was significantly higher than that of children who were not (10.1 ± 1.2 vs. 6.3 ± 1.2 ; $p = 0.038$). Green staining of the teeth and gingiva was found in 61.3% of cases in children with biliary atresia. Total serum bilirubin levels were significantly higher in the green-stained group than in the non-stained group (17.87 ± 2.50 vs. 2.20 ± 0.65 ; $p < 0.01$).

Conclusions: Oral findings of children undergoing liver transplant presented significant green staining of the teeth and gingiva related to high serum bilirubin levels. Children who were night-fed showed an increased risk of developing caries suggesting that oral hygiene instructions should begin as early as possible before liver transplantation.

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Key words: biliary atresia, caries prevalence.

Liver transplantation is becoming a widely accepted treatment for children with end-stage liver disease. The success rates have improved significantly as a result of advances in surgical techniques, improved postoperative care, and mostly due to the use of cyclosporine as an effective immunosuppres-

sive agent.⁽¹⁻⁵⁾ Chronic liver diseases which are indicative for pediatric liver transplantation may include congenital biliary atresia, biliary hypoplasia, metabolic disorders, and acute liver failure.⁽⁵⁾ It is not uncommon to see green-stained teeth and gingiva in the oral cavity of these patients.⁽⁶⁻¹³⁾ Other oral

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manifestations include various degrees of delayed skeletal and dental development, gingival enlargement, enamel hypoplasia, and susceptibility to dental caries.^(6,14-16) However, very few studies have investigated the oral status and changes associated with end-stage liver disease. The purposes of this study were 1) to examine the oral tissues of children undergoing liver transplantation, 2) to investigate the caries prevalence of these children, and its relationship to the bottle-feeding habit, and 3) to evaluate the relationships between tooth staining and serum bilirubin levels.

METHODS

Thirty-four children (22 boys and 12 girls) under 6 years of age with end-stage liver disease were referred from the Liver Transplantation Center at Kaohsiung Chang Gung Children's Hospital, Taiwan from 2000 to 2001 for preoperative evaluation. The research protocol was recognized by the Hospital Research Committee, and an informed consent form for each patient was signed by their parents or guardians. The types of pediatric liver disorders were classified. Dental examinations were performed using an on-site dental chair, mirrors, and explorers under focused light. Dental caries was diagnosed based on the modified method of Rasike (1972) and assessed using decayed, missing, and filled tooth (dmft) and surface (dmfs) indices.⁽¹⁷⁾ A questionnaire completed by their parents was designed to investigate the children's feeding habits.⁽¹⁸⁾ Children were divided into night-fed and non-night-fed groups according to responses to questions concerning the habit and frequency of night-feeding practices. A child was assigned to the night-fed group if the answers indicated a nighttime bottle-feeding habit.

Oral tissues were examined, and photographs taken to determine the green staining of the teeth and gingiva in children with congenital biliary atresia. Photographs were projected on a screen and classified as green-stained and non-stained groups according to consensus reached by 2 examiners. Cases were classified into the non-stained group when the 2 examiners had an opposite opinion. Serum bilirubin levels including TB and DB were tested and data collected preoperatively in these children.

Student's *t*-test was used to compare the mean

dmft difference between night-fed and non-night-fed groups, and to test the relationship between stained teeth and serum bilirubin levels. The level of significance (α) was set at 0.05.

RESULTS

Of the 34 children undergoing liver transplantation, 91.2% (31) had congenital biliary atresia. The caries prevalence of the 34 children undergoing liver transplantation was 61.8%. The mean dmft scores were 0 ± 0 (0-2 years), 6.67 ± 1.21 (2-4 years), and 10.44 ± 1.16 (4-6 years), respectively (Table 1). The mean score of dmft for children 2 to 6 years old who

Table 1. Comparison of the Caries Indices of Children Undergoing Liver Transplantation with Normal Children (mean \pm SEM*)

Age (yr)	Number of Cases	dmft †	dmfs ‡
0~2	13	0 \pm 0	0 \pm 0
(<4)		(0.62 \pm 1.57)	(NA) [¶]
2~4	12	6.67 \pm 1.21	12.17 \pm 2.64
(<4)		(0.62 \pm 1.57)	(NA) [¶]
4~6	9	10.44 \pm 1.16	23.67 \pm 5.94
(4)		(2.18 \pm 3.11)	(NA) [¶]
(5)		(3.47 \pm 3.88)	(NA) [¶]
(6)		(4.58 \pm 4.29)	(NA) [¶]

Abbreviations: SEM*: standard error of the mean; dmft †: decayed, missing and filled teeth; dmfs ‡: decayed, missing and filled surfaces; ¶: control group as reference 19.

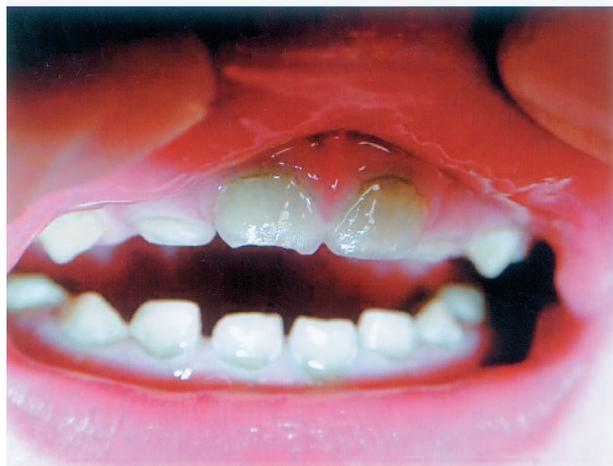


Fig. 1 Green-stained teeth and gingiva of a biliary atresia patient undergoing liver transplantation.

were night-fed (n=11) was significantly higher than that of children who were not night-fed (n=10) (10.1 ± 1.2 vs. 6.3 ± 1.2 ; $p=0.038$). Green staining of the teeth and gingiva was found in 61.3% (19/31) of the children with congenital biliary atresia (Fig. 1). TB and DB were significantly higher in the green-stained group than in the non-stained group ($p=0.003$ and $p=0.002$, respectively) (Table 2).

Table 2. Relationship between Green Staining of the Teeth and Gingiva and Serum Bilirubin Levels of Children with Biliary Atresia (mean \pm SEM)

	Green-Stained (n=19)	Non-Stained (n=12)	Test statistics
TB [†]	17.87 \pm 2.50	2.20 \pm 0.65	$t=4.893$ $p=0.003^*$
DB [‡]	11.37 \pm 1.87	1.38 \pm 0.48	$t=4.174$ $p=0.002^*$

* Statistically significant.

Abbreviations: TB[†]: total serum bilirubin; DB[‡]: direct serum bilirubin.

DISCUSSION

As shown in Table 1, congenital biliary atresia accounted for 91.2% of pediatric liver transplants in this center compared to 40%-70% in other centers.⁽⁵⁾ The affected children are often plagued by long-standing cholestasis and life-long jaundice. Other indications for pediatric liver transplantation include metabolic disorders associated with cirrhosis, fulminant hepatic failure, malignant tumors without extrahepatic metastases, and chronic liver disease leading to decompensated cirrhosis.⁽⁵⁾ The types of liver transplants may include whole graft, reduced-size graft, split-liver graft, living-donor graft, and auxiliary transplantation. Early treatment with liver transplantation and immunosuppressive therapy (cyclosporine) after surgery provides a cure for such end-stage liver disease.

In this survey, the caries prevalence for the liver transplant children was 61.8%. The mean dmft scores of patients 2 to 6 years old were much higher when compared with the respective mean dmft scores of Taiwanese children (Table 1).⁽¹⁹⁾ Morisaki et al. found rampant caries in 5 of 7 patients with congenital biliary atresia in their survey.^(8,12) Enamel

hypoplasia was generally found in most of these cases and was considered to be a predisposing factor for caries.^(6,8,10) However, enamel hypoplasia may occur in children who have a history of unfavorable general health or nutritional problems in early infancy as in the chronic liver diseases shown here. This might not fully account for the higher caries indices in these children 2 to 6 years old. The present study showed that children who were night-fed had significantly higher dmft scores than children who were not. A prolonged night bottle-feeding habit is the other contributing factor causing tooth decay. The term "early childhood caries" describes this type of rampant dental caries in infants and toddlers, which is strongly related to the nursing habit.⁽²⁰⁾ It also highlights a number of issues, especially parental overindulgence of a child with a life-threatening disease.

It is therefore important that dentists, as a member of a team for liver transplantation, monitor the dental health of patients. Routine dental care and caries prevention programs need to be planned for those children during pre-liver or post-liver transplantation in order to reduce the risk of systemic infection arising from the oral cavity. Oral hygiene instructions to parents especially for eliminating the night bottle habit should begin as early as possible before liver transplantation.

Green staining of the teeth and gingiva was found in 61.3% of cases with biliary atresia. In this study, serum bilirubin levels (TB and DB) were significantly higher in the green-stained group than in the non-stained group ($p=0.003$ and $p=0.002$, respectively) (Table 2). Green staining of the teeth and gingiva appears to be associated with fetal or neonatal hyperbilirubinemia as a result of chronic liver failure. Stained cases showed various degrees of green staining in the primary dentition suggesting a correlation between the degree of tooth staining and the severity of disease. An extracted tooth of a stained case showed that the deeply stained portion of the root formed prior to liver transplantation was clearly demarcated from that normally formed after transplantation (Fig. 2). A histological study by Seow et al. demonstrated that dentin formed prior to liver transplantation had a larger number of irregular tubules compared to those fewer regular tubules formed after transplantation.^(6,10) Further esthetic problems of stained teeth probably need to be solved

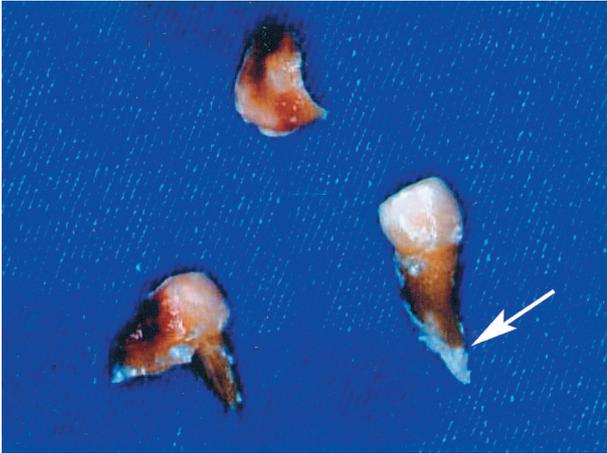


Fig. 2 Extracted tooth showing a clearly demarcated line between the stained and normally colored root (arrow).

by using composite resin, veneered crown, and laser whitening procedures as the children grow older.⁽²¹⁾

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換肝患童之口腔調查

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- 背景：** 本研究的目的是調查換肝患童之齲齒狀況，口腔組織變化。並評估牙齒染色與Serum Bilirubin的關係。
- 方法：** 由高雄長庚醫院肝臟移植中心選取年齡小於6歲之換肝患童共34人。所有患童均接受口腔檢查，並以照相來決定牙齒，牙齦染色與否。我們使用dmft及dmfs來評定牙齒齲齒。要求父母完成一份問卷調查，以了解孩童的餵奶習慣。收集這些孩童換肝前的Serum Bilirubin。以Student's *t*-test來比較孩童餵奶與不餵奶兩組之間的差異；以及探討染色與Serum Bilirubin之間的關係。
- 結果：** 結果顯示6歲以下換肝患童的齲齒發生率有61.8%。2到6歲睡前餵奶的孩童，齲齒指數dmft高於睡前不餵奶的孩童(10.1 ± 1.2 vs 6.3 ± 1.2 ; $p=0.038$)。牙齒及牙齦呈綠染色佔61.3%。膽道閉鎖患童之牙齒及牙齦呈綠染色與Serum Bilirubin Level，有顯著的關係(17.87 ± 2.50 vs 2.20 ± 0.65 ; $p < 0.01$)。
- 結論：** 換肝患童牙齒及牙齦呈綠染色且與血液中有較高Bilirubin值相關。睡前餵奶的孩童這一組有較高的齲齒發生。所以建議在換肝前需要牙科醫師介入改善。
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關鍵字： 膽道閉鎖，齲齒發生率。

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