

Article

Evaluation of Periodontal Status and Oral Health Habits with Continual Dental Support for Young Patients with Hemophilia

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Abstract: Hemophilia is a congenital disorder associated with impaired blood clotting. Routine dental intervention to prevent oral bleeding in patients with hemophilia is considered important, but its effectiveness remains unknown. In the present study, we evaluated the effect of continual dental support on periodontal status and oral health habits in young patients with hemophilia. Of the 168 young patients with hemophilia who visited our clinic for 5 years, we selected subjects who had visited annually since 2015 and were in the mixed and permanent dentitions. To evaluate the periodontal status of these subjects, Community Periodontal Index (CPI) values in the molars and anterior teeth were measured. In addition, a questionnaire regarding oral health habits, including floss use, frequency of brushing by parents, and attending a family dentist, was administered to the subjects and their parents. In the patients with mixed dentition, the CPI values for the upper right molars and lower left central incisor decreased significantly in later years compared with the first year ($p < 0.05$). In the patients with permanent dentition, only one year recorded a significant decrease in CPI values compared with the first year ($p < 0.05$), localized in the upper right molars. The results of the questionnaire revealed that continual dental support improved dental floss use and the frequency of brushing by parents only in the mixed dentition group. Furthermore, these oral health habits significantly affected CPI values only in the mixed dentition group ($p < 0.01$). These results suggest that continual dental support improves the periodontal condition and oral health habits of hemophilic patients, especially those with mixed dentition.

Keywords: hemophilia; continual dental support; periodontal status; oral health habits

1. Introduction

Hemophilia is an inherited bleeding disorder caused by low concentrations of specific coagulation factors. The most well-known deficiencies are factor VIII (hemophilia A) and factor IX (hemophilia B), both of which show X-linked inheritance [1]. Hemophilia is more common in males [2], with a prevalence of 17.1 cases of hemophilia A and 3.8 cases of hemophilia B per 100,000 males [3]. The number of patients with hemophilia worldwide is estimated at 1,125,000 [3].

According to a 2018 survey, there are approximately 6200 patients with hemophilia in Japan (5100 with hemophilia A and 1100 with hemophilia B) [4]. Every summer since 2008, our hospital has held a comprehensive outpatient clinic for children with hemophilia, at

which pediatricians evaluate coagulation factor replacement therapy, orthopedic surgeons assess hemophilic arthritis, and physical therapists provide rehabilitation. In addition to these medical treatments, we have been providing dental checkups, oral health education, and mechanical tooth cleaning since 2015. We previously conducted a survey in this outpatient clinic and compared hemophilic patients with healthy controls of the same age, which resulted in the periodontal status of hemophilic patients being poorer than that of healthy children [5].

When performing surgical procedures on patients with hemophilia, coagulation factor replacement may be necessary to prevent excessive bleeding [6]. Excessive bleeding from the oral cavity should also be considered in patients with hemophilia, and particular attention should be paid to periodontal tissue, which has a high frequency of bleeding in the oral cavity. Systematic reviews, mostly from the general population, found that the risk of periodontitis is approximately two to five times higher in patients with poor oral hygiene than in patients with good oral hygiene. Oral care habits, including regular toothbrushing and dental visits, can also reduce the risk [7]. However, the impact of regular, continuous dental interventions on the periodontal status and oral health habits of patients with hemophilia is unclear.

We have investigated the periodontal status and oral health habits of young patients with hemophilia for up to 5 years. In the present study, we analyzed the effects of continual dental support on periodontal status and oral health habits in young patients with hemophilia and compared the results in a mixed dentition group and a permanent dentition group.

2. Materials and Methods

2.1. Subjects

More than 30 young patients with hemophilia underwent annual dental checkups at a comprehensive outpatient clinic for children with hemophilia. Of the 170 young patients with hemophilia who visited from 2015 to 2019, 168 patients (aged 1 year, 4 months–28 years, 10 months) were included (two children with incomplete test results were excluded).

Among the 168 patients who visited our clinic between 2015 and 2019, we selected subjects who had visited annually since 2015 (Figure 1). We classified the subjects into primary dentition, mixed dentition, and permanent dentition, however, there was no patient with primary dentition at the 5th visit. Therefore, we selected subjects who were in the mixed and permanent dentition stages. The frequency of hemophilia is low, and we decided not to select subjects randomly but to include all patients with hemophilia within the study period. The number of subjects in the mixed dentition was 8 in the first visit, 6 in the second visit, 8 in the third visit, 9 in the fourth visit, and 11 in the fifth visit. In addition, the numbers of subjects in the permanent dentition were 15, 8, 8, 7, and 8 each year. Clinical information about the subjects in the mixed dentition and permanent dentition groups is presented in Table 1.

Table 1. Clinical information on young patients with hemophilia.

Stage	Clinical Information	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
Mixed dentition	Year	2015	2016	2017	2018	2019
	Number of subjects	8	6	8	9	11
	Type A:B	7:1	5:1	6:2	7:2	8:3
	Male:Female	8:0	6:0	8:0	9:0	11:0
	Minimum age	6Y6M	7Y6M	6Y4M	6Y9M	6Y8M
	Maximum age	12Y1M	10Y5M	11Y5M	12Y4M	11Y3M
	Average age	8Y8M	8Y10M	8Y1M	8Y10M	8Y9M
Permanent dentition	Year	2015	2016	2017	2018	2019
	Number of subjects	15	8	8	7	8
	Type A:B	11:4	7:1	8:0	7:0	8:0
	Male:Female	14:1	8:0	8:0	7:0	8:0
	Minimum age	10Y8M	10Y5M	11Y3M	12Y3M	13Y4M
	Maximum age	28Y10M	23Y5M	24Y4M	20Y6M	21Y6M
	Average age	17Y3M	16Y4M	16Y3M	16Y1M	16Y7M

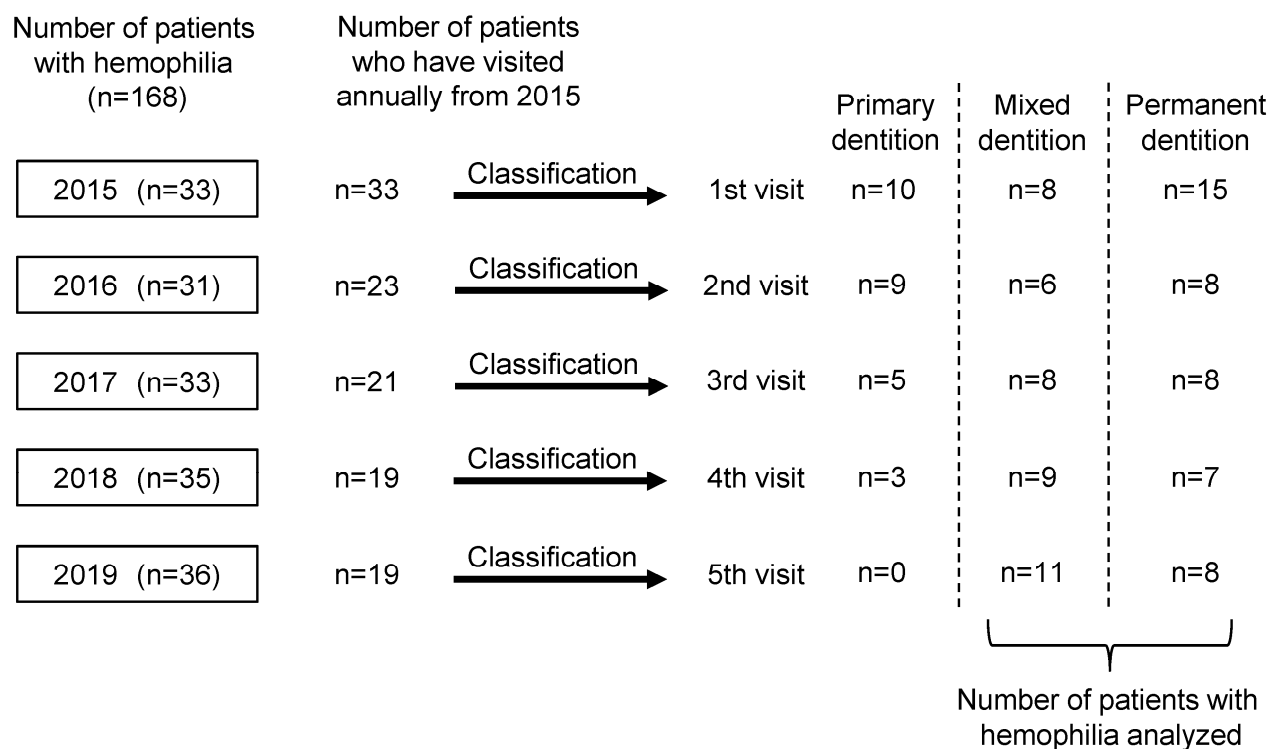


Figure 1. Flowchart of the study.

2.2. Evaluation of Periodontal Condition

Intraoral examinations were performed by dentists with at least 5 years of experience in pediatric dental clinics, using dental mirrors and probes [8]. Examiners were calibrated using the WHO guidelines [9] and randomly assigned to see hemophilic patients. In pocket probing, a total of 6 points were measured for the target tooth, 3 points each on the buccal and palatal/lingual sides, and the most severe score was counted.

The status of periodontal disease was assessed using the CPI [9], which consists of five levels ranging from 0 to 4, representing (0) healthy, (1) bleeding on probing, (2) calculus, (3) 4–5 mm pockets, and (4) 6 mm or deeper pockets [10]. CPI values were measured on the maxillary and mandibular molars on both sides, and on the maxillary right and mandibular left central incisors [9]. When both the first and second molars had already erupted, the more severe score was counted as the score in the region, which is based on the periodontal disease screening manual of the Ministry of Health, Labor, and Welfare (<https://www.mhlw.go.jp/content/10801000/001115164.pdf>, accessed on 17 January 2024) [11]. When the target permanent tooth had not erupted, the first and second primary molars or the primary central incisor at the same site were measured. In cases where the primary tooth had fallen out and the permanent tooth had not erupted yet, the site was excluded. In addition to tabulating CPI separately by site, the average value of CPI for all teeth was calculated.

2.3. Survey of Oral Health Habits

A questionnaire on oral health habits was administered to all subjects and parents who participated in this study. It was written in Japanese by members of our department. It consisted of 14 items, including sex, age, type, and current state of hemophilia, visits to family physicians, and oral health habits (Table 2). The questions were closed multiple-choice questions, with free descriptions permitted in special cases. The questionnaire was completed by adult patients or by accompanying parents or guardians of pediatric patients without the presence of an interviewer. Blanks left on the questionnaire were excluded from totaling. There are large differences in brushing techniques depending on age, and

we did not include a questionnaire regarding patients' own teeth brushing. In addition, patients with permanent dentition aged over 16 years were not asked about toothbrushing by their parents. For closed questions, we calculated the selection rate for each option, and for numerical answers, we calculated the average value and standard error of the data obtained from each subject.

Table 2. Questionnaire items.

1. What is your sex and age?
2. What is the type of hemophilia and the age of onset?
3. What is your recent clotting factor activity value?
4. How many times have you visited the comprehensive outpatient clinic for children with hemophilia?
5. Is there any current preliminary and regular replacement therapy?
6. Do you have a family physician, and how many times have you seen the physician per year?
7. Have your family physician explained the importance of regular dental checkup?
8. How often do you brush your teeth? (every day, several times a week, rarely, never)
9. How many times do you brush your teeth per day?
10. Do you use dental floss?
11. How often do parents brush their children's teeth with hemophilia? (every day, several times a week, rarely, never)
12. Have you received a fluoride application?
13. Have you received any experience of tooth brushing instruction?
14. Have you visited your family dentist?

2.4. Statistical Analysis

Statistical analyses were conducted using GraphPad Prism 9 (GraphPad Software Inc., La Jolla, CA, USA). The Mann-Whitney U test, Kruskal-Wallis test, and Dunn test for multiple comparisons were used for comparisons between groups. Differences were considered statistically significant at $p < 0.05$.

3. Results

3.1. Community Periodontal Index (CPI) Values of Young Patients with Hemophilia

The mean CPI values for these patients for each year are shown in Figure 2, and no difference was observed in the number of dental visits. The CPI values were further analyzed separately by site in the mouth (Table 3). In the mixed dentition group, the average CPI value was 1.75 at the upper right molars at the first visit, but the CPI values decreased to less than 1.00 thereafter, with significant decreases in the second and fifth years compared with the first year ($p < 0.05$). The lower left central incisor also showed significant decreases in the CPI values in the third and fifth years compared with the first year, and in the fifth year compared with the fourth year ($p < 0.05$). Subjects in the permanent dentition group showed a significant decrease in the CPI value in the fourth year compared with the first and third years for the upper right molars ($p < 0.05$), but the CPI value of the other molars did not decrease, showing average scores of more than 1.00 in most years. In addition, a significant increase in CPI was recorded in the fifth year compared with the second and fourth years for the lower left central incisor ($p < 0.05$).

3.2. Changes in Oral Health Habits of Young Patients with Hemophilia

Of the 14 items in the questionnaire, only three items—"whether or not floss is used", "frequency of brushing by parents (every day, several times a week, rarely, never)", and "presence of a family dentist"—showed evident changes resulting from continual dental support and were associated with periodontal disease status. Therefore, we decided to focus on these three items for further analysis. Details of the questionnaire results are shown in Tables 4 and 5.

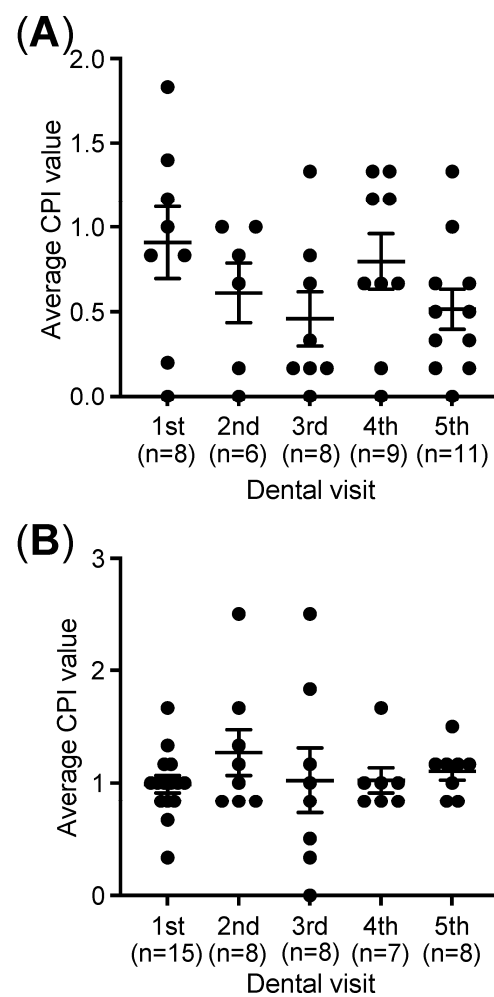


Figure 2. CPI values in young patients with hemophilia. (A) Mixed dentition. (B) Permanent dentition. Each black circle indicates the CPI value for each subject. Bars indicate mean and SE.

Table 3. Community Periodontal Index (CPI) values for different sites of the dentition in young patients with hemophilia.

Stage	Sites of the Dentition	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
Mixed dentition	Upper right molar	1.75 ± 0.49	0.50 ± 0.22 **	0.75 ± 0.49	0.89 ± 0.31	0.45 ± 0.16 *
	Upper central incisor	0.67 ± 0.21	0.67 ± 0.21	0.38 ± 0.18	0.67 ± 0.33	0.27 ± 0.14
	Upper left molar	0.50 ± 0.19	0.50 ± 0.22	0.50 ± 0.19	0.78 ± 0.15	0.82 ± 0.12
	Lower right molar	0.50 ± 0.19	0.50 ± 0.22	0.50 ± 0.19	1.00 ± 0.29 †	0.73 ± 0.27
	Lower central incisor	1.13 ± 0.30	0.83 ± 0.40	0.25 ± 0.16 *	0.89 ± 0.31	0.18 ± 0.12 **,§
	Lower left molar	0.88 ± 0.35	0.67 ± 0.21	0.38 ± 0.18	0.56 ± 0.18	0.64 ± 0.15
Permanent dentition	Upper right molar	1.27 ± 0.18	1.50 ± 0.33	1.34 ± 0.38	0.86 ± 0.14 **,‡	1.00 ± 0.00
	Upper central incisor	0.67 ± 0.13	0.88 ± 0.13	0.50 ± 0.19	1.00 ± 0.00	0.63 ± 0.18
	Upper left molar	1.07 ± 0.15	1.63 ± 0.53	1.25 ± 0.41	1.00 ± 0.38	1.25 ± 0.25
	Lower right molar	1.00 ± 0.17	1.38 ± 0.38	1.00 ± 0.33	1.29 ± 0.29	1.25 ± 0.25
	Lower central incisor	0.73 ± 0.18	0.88 ± 0.23	1.13 ± 0.35	0.71 ± 0.18	1.50 ± 0.19 †,§
	Lower left molar	1.20 ± 0.20	1.38 ± 0.38	0.88 ± 0.35	1.29 ± 0.29	1.00 ± 0.00

The data are shown as the mean ± SE. Statistical comparisons were performed on the same teeth in each dentition. * $p < 0.05$ and ** $p < 0.01$ versus 1st visit; † $p < 0.05$ versus 2nd visit; ‡ $p < 0.05$ versus 3rd visit; § $p < 0.05$ versus 4th visit.

Table 4. Responses to the questionnaire of young patients with hemophilia in the mixed dentition.

Stage	Clinical Information	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
Mixed dentition	Number of subjects	8	6	8	9	11
	Sex (male:female)	8:0	6:0	8:0	9:0	11:0
	Average age	8Y8M	8Y10M	8Y1M	8Y10M	8Y9M
	Hemophilia type (A:B)	7:1	5:1	6:2	7:2	8:3
	Onset age	8.3M	6.8M	6.6M	6.7M	3.1M
		(n = 8)	(n = 5)	(n = 7)	(n = 7)	(n = 7)
	Recent clotting factor activity	3.4%	2.3%	5.0%	4.3%	9.0%
		(n = 8)	(n = 3)	(n = 2)	(n = 6)	(n = 6)
	Number of participations in comprehensive outpatient clinic for children with hemophilia	5.5	8.0	5.5	5.3	7.3
		(n = 8)	(n = 6)	(n = 6)	(n = 7)	(n = 8)
	Subjects with current preliminary and regular replacement therapy (presence:absence)	8:0	6:0	6:2	9:0	9:1
		(n = 8)	(n = 6)	(n = 8)	(n = 9)	(n = 10)
	Number of visits to family physicians per year	5.3 ± 4.3	2.8 ± 1.9	4.2 ± 3.2	4.1 ± 4.0	8.5 ± 4.8
		(n = 8)	(n = 6)	(n = 6)	(n = 8)	(n = 11)
	Explanation about importance of regular dental checkup from family physicians (presence:absence)	1:7	2:4	6:2	5:3	7:0
		(n = 8)	(n = 6)	(n = 8)	(n = 8)	(n = 7)
	Frequency of brushing (every day:several times a week:rarely:never)	8:0:0:0	6:0:0:0	8:0:0:0	9:0:0:0	11:0:0:0
		(n = 8)	(n = 6)	(n = 8)	(n = 9)	(n = 11)
	Number of times to brush teeth per day	2.1 ± 0.6	2.3 ± 0.5	2.3 ± 0.7	2.1 ± 0.8	1.7 ± 0.8
		(n = 8)	(n = 6)	(n = 8)	(n = 9)	(n = 11)
	Dental floss use (presence:absence)	2:6	2:4	4:4	5:4	4:7
		(n = 8)	(n = 6)	(n = 8)	(n = 9)	(n = 11)
	Frequency of brushing by parents (every day:several times a week:rarely:never)	4:1:1:2	3:2:0:1	6:1:1:0	8:0:1:0	8:2:1:0
		(n = 8)	(n = 6)	(n = 8)	(n = 9)	(n = 11)
	Fluoride application (dental clinic and home:dental clinic:home:absence)	2:4:1:1	5:1:0:0	4:2:2:0	4:4:1:0	6:3:2:0
		(n = 8)	(n = 6)	(n = 8)	(n = 9)	(n = 11)
	Experience of tooth brushing instruction (presence:absence)	6:2	5:1	8:0	9:0	10:1
		(n = 8)	(n = 6)	(n = 8)	(n = 9)	(n = 11)
	Presence of attending a family dentist (presence:absence)	7:1	6:0	8:0	9:0	11:0
		(n = 8)	(n = 6)	(n = 8)	(n = 9)	(n = 11)

Table 5. Responses to the questionnaire of young patients with hemophilia in the permanent dentition.

Stage	Clinical Information	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
Permanent dentition	Number of subjects	15	8	8	7	8
	Sex (male: female)	14:1	8:0	8:0	7:0	8:0
	Average age	17Y3M	16Y4M	16Y3M	16Y1M	16Y7M
	Hemophilia type (A:B)	11:4	7:1	8:0	7:0	8:0
	Onset age	1.0M	6.8M	1.0M	4.8M	1.8M
		(n = 11)	(n = 6)	(n = 6)	(n = 5)	(n = 5)
	Recent clotting factor activity	8.1%	1.3%	-	3.0%	2.0%
		(n = 14)	(n = 3)	(n = 0)	(n = 1)	(n = 2)
	Number of participations in comprehensive outpatient clinic for children with hemophilia	7.2	11.2	9.3	12.0	11.4
		(n = 15)	(n = 6)	(n = 4)	(n = 1)	(n = 5)
	Subjects with current preliminary and regular replacement therapy (presence:absence)	13:0	7:1	7:0	6:0	8:0
		(n = 13)	(n = 8)	(n = 7)	(n = 6)	(n = 8)
	Number of visits to family physicians per year	5.2 ± 5.0	5.0 ± 5.0	6.8 ± 5.7	6.4 ± 5.2	3.6 ± 3.6
		(n = 13)	(n = 7)	(n = 6)	(n = 5)	(n = 8)
	Explanation about importance of regular dental checkup from family physicians (presence:absence)	5:9	6:2	4:1	2:3	4:3
		(n = 14)	(n = 8)	(n = 5)	(n = 5)	(n = 7)
	Frequency of brushing (every day:several times a week:rarely:never)	14:0:0:0	8:0:0:0	7:0:0:0	7:0:0:0	6:1:0:0
		(n = 14)	(n = 8)	(n = 7)	(n = 7)	(n = 7)
	Number of times to brush teeth per day	1.8 ± 0.7	1.8 ± 0.7	1.6 ± 0.5	2.2 ± 0.8	1.4 ± 0.5
		(n = 14)	(n = 8)	(n = 7)	(n = 6)	(n = 7)
	Dental floss use (presence:absence)	2:13	2:6	1:6	1:5	1:7
		(n = 15)	(n = 8)	(n = 7)	(n = 6)	(n = 8)
	Frequency of brushing by parents (every day:several times a week:rarely:never)	1:0:0:8	0:0:1:3	0:0:0:3	0:0:0:4	0:0:1:5
		(n = 9)	(n = 4)	(n = 3)	(n = 4)	(n = 6)
	Fluoride application (dental clinic and home: dental clinic: home:absence)	0:1:4:10	1:1:4:2	0:1:2:4	0:1:3:3	0:2:4:2
		(n = 15)	(n = 8)	(n = 7)	(n = 7)	(n = 8)
	Experience of tooth brushing instruction (presence:absence)	10:5	7:1	6:1	5:1	6:2
		(n = 15)	(n = 8)	(n = 7)	(n = 6)	(n = 8)
	Presence of attending a family dentist (presence:absence)	6:9	7:1	6:1	4:2	3:5
		(n = 15)	(n = 8)	(n = 7)	(n = 6)	(n = 8)

According to the questionnaires collected from the subjects, 25% of the mixed dentition group used dental floss at the initial visit (Figure 3A). In all subsequent years, the rate of dental floss use increased from the initial visit, especially in the third and fourth years, when more than half used dental floss. Regarding toothbrushing by parents of subjects in the mixed dentition group, 50% (4 of 8 parents) reported brushing their child's teeth daily at the first visit, while 37.5% (3 of 8) reported that they rarely or never brushed their child's teeth. In the second year, the percentage of parents who brushed their child's teeth daily

remained the same as at the first visit, but the rate of those who rarely or never brushed their child's teeth decreased to 16.7% (1 of 6). After the third year, the percentage of parents who brushed their child's teeth daily increased to more than 70%, and no parents reported never brushing their child's teeth. At the first visit, some subjects in the mixed dentition group reported that they did not attend a family dentist, but all were attending a family dentist by the second year.

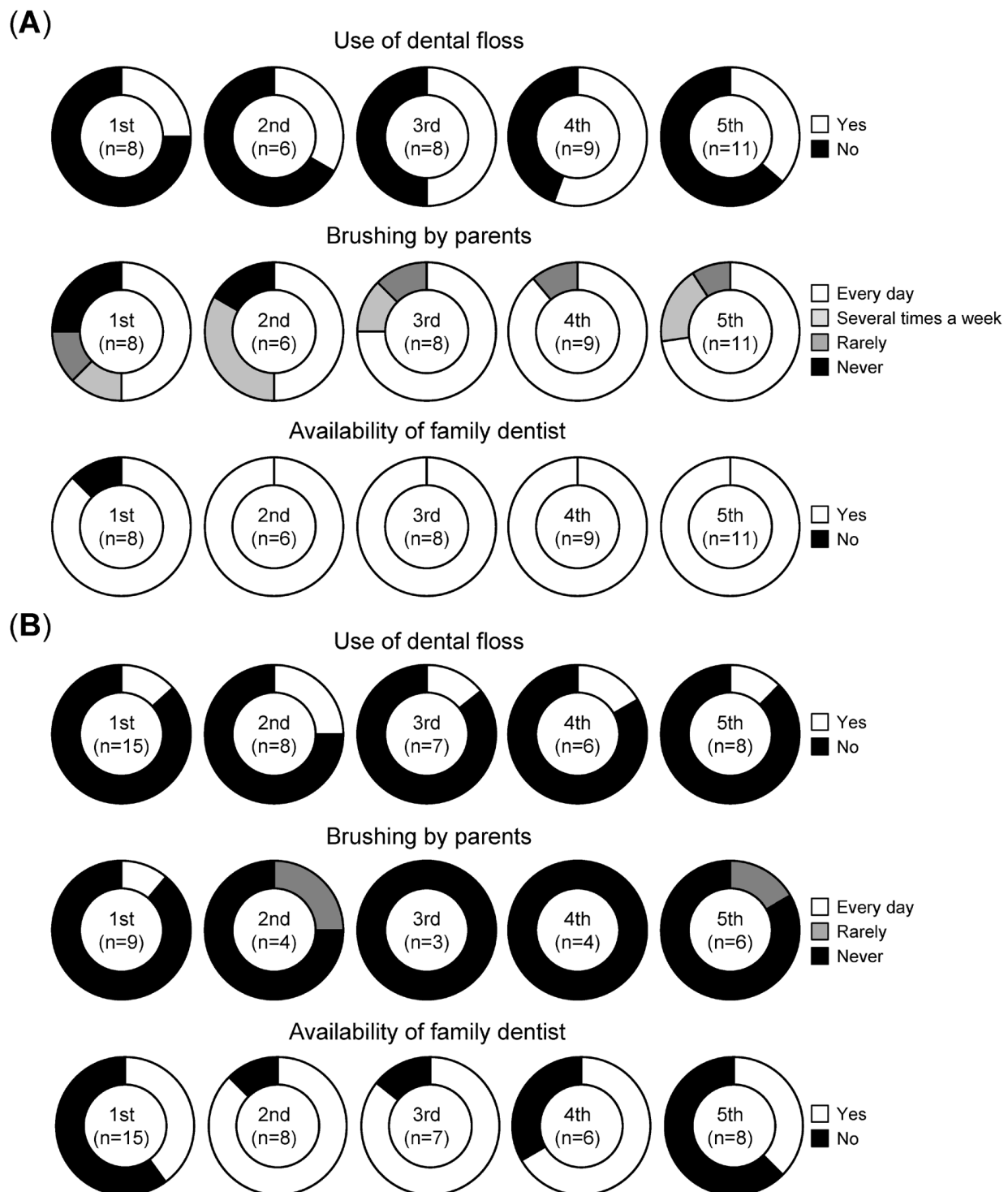


Figure 3. Oral health habits of young patients with hemophilia. (A) Mixed dentition group. (B) Permanent dentition group.

In the permanent dentition group, only 13% used dental floss at the first visit, and the rate of dental floss use did not increase after the second year (Figure 3B). From the first visit through the fifth year, few parents were brushing the teeth of the patients in the permanent dentition group. More than 50% of subjects in the permanent dentition group reported that they did not attend a family dentist at the first visit; this percentage increased in the second and third years but decreased in the fourth and fifth years.

3.3. Relationship between Oral Health Habits and CPI Values

We investigated the association between oral health habits and CPI values in all subjects. In the mixed dentition group, mean CPI values were significantly lower in subjects who used dental floss compared with those who did not ($p < 0.01$) (Figure 4A). The mean CPI value was also significantly lower in subjects in the mixed dentition group whose parents brushed their teeth compared with those whose teeth were not brushed ($p < 0.05$) (Figure 4B). In contrast, in the permanent dentition group, the presence or absence of dental floss use and the presence or absence of a family dentist did not affect the mean CPI values (Figure 4C,D).

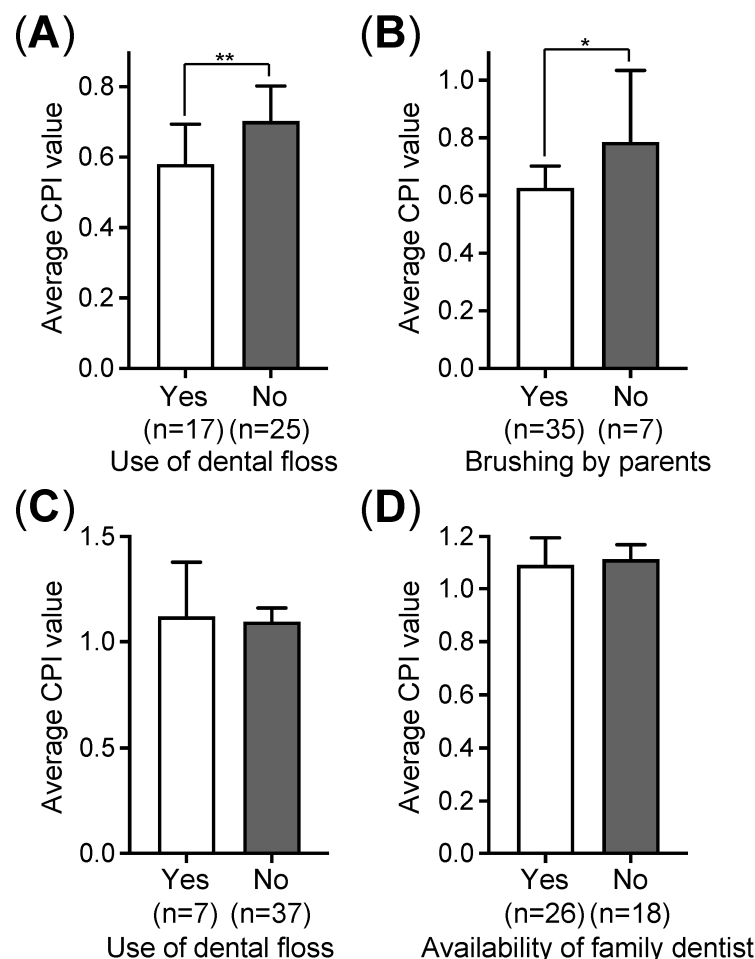


Figure 4. Association between oral health habits and Community Periodontal Index (CPI) values in young patients with hemophilia. (A) Dental floss use and CPI values of the mixed dentition group. (B) Toothbrushing by parents and CPI values of the mixed dentition group. “Yes” includes “every day” and “several times a week”, while “no” includes “rarely” and “never” in the questionnaire. (C) Dental floss use and CPI values of the permanent dentition group. (D) Attendance at a family dentist and CPI values in the permanent dentition group. Bars indicate standard error. Significant differences were determined by using analysis of variance with Bonferroni correction. * $p < 0.05$, and ** $p < 0.01$.

When we compared the association between each oral health habit, in the mixed dentition group, significantly more subjects who used dental floss had their teeth brushed by parents compared with the subjects who did not use dental floss (Figure 5A). On the other hand, the presence or absence of dental floss was not related to the presence of a family dentist in the permanent dentition group (Figure 5B).

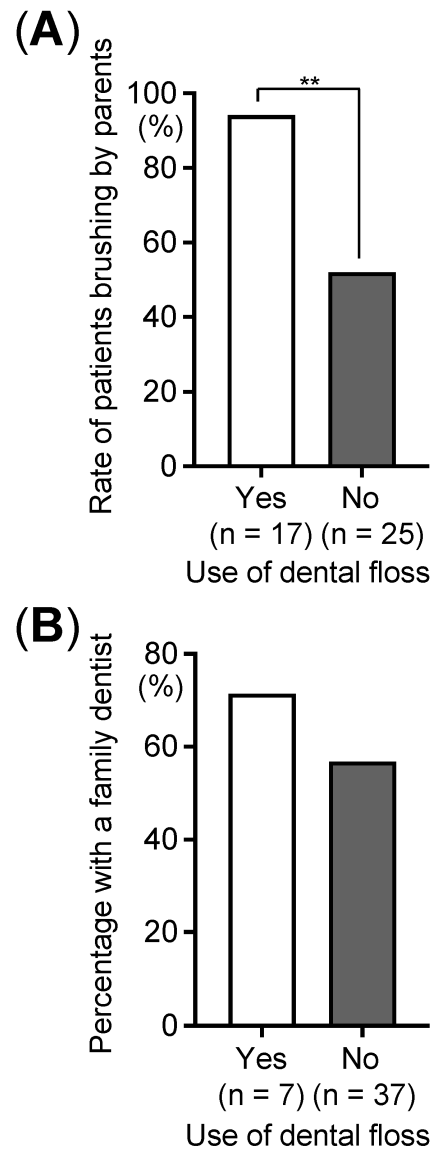


Figure 5. Associations between oral health habits in young patients with hemophilia. **(A)** Association between dental floss use and daily toothbrushing by parents in patients with hemophilia in mixed dentition. There were significant differences, as determined by the analysis of variance with Bonferroni correction. $** p < 0.01$. **(B)** Association between dental floss use and the presence of a family dentist in patients with hemophilia in permanent dentition.

4. Discussion

In the present study, we analyzed the effects of continual dental support over a period of 5 years on the periodontal status and oral health habits of the patients each year and also investigated the association between them. Periodontal status is affected by aging [12], and we compared subjects at two dentition stages (mixed dentition and permanent dentition) in each year. The results showed that continual dental support improved the periodontal status and oral health habits of children with hemophilia in the mixed dentition stage. However, no change was observed in the permanent dentition stage. Our results suggest

that continual dental support may contribute to improved periodontal status and oral health habits in hemophilic patients, especially in the mixed dentition stage.

Patients with hemophilia require measures to be taken to reduce the risk of oral bleeding. According to the World Federation of Hemophilia (WFH) guidelines, prevention of dental disease is crucial for patients with hemophilia to avoid invasive dental procedures [13]. They also recommend access to regular preventive oral care as part of comprehensive hemophilia care [13]. Othman et al. reported that a multidisciplinary approach by multiple medical disciplines, including dentistry, resulted in a lower gingival index and better oral health in children with hemophilia [14]. Those who are involved in dental support should not only educate patients with hemophilia about the importance of good oral health habits but also provide instruction on how to maintain good oral health. Brown et al. (2022) investigated the oral hygiene of children with bleeding disorders and found an association between the oral hygiene of the primary caregiver and the child [15]. This finding suggests that all health providers, family members, and caregivers surrounding the child have an impact on oral disease; this impact may be more significant during the deciduous and mixed dentition periods when children require help with toothbrushing. It is essential to educate the adults in contact with the child so that they have a high level of awareness about the child's oral hygiene.

Previous studies reported that children with hemophilia have poorer periodontal health than healthy children [5,16–18]. On the other hand, few studies have reported the effect of continuous dental support. In the present study, several children in the mixed dentition group had a CPI value of 3 (4–5 mm periodontal pockets) at the first visit, and the upper right molars had the highest mean CPI value. With continual dental support, the CPI values of the upper right molars improved, and the CPI values of 3 or higher decreased in each site. In the permanent dentition group, there were CPI values of 3 or higher in each molar region, but no improvement was observed except in the upper right molars. These results suggest that periodontal status is more likely to improve in the mixed dentition group than in the permanent dentition group, with continual dental support for hemophilic patients. Periodontal status is associated with oral health habits [7], and continual dental support for the mixed dentition group, whose periodontal status is more likely to improve, may be necessary for them to maintain good periodontal status.

We conducted an annual survey of oral health habits. The questionnaires revealed that continual dental support increased the rate of dental floss use, the frequency of toothbrushing by parents, and the percentage of subjects attending family dentists in the mixed dentition group. In contrast, the number of patients in the permanent dentition group using dental floss didn't exceed 25% at all visits. Additionally, brushing by parents was rarely performed in the permanent dentition group, which is consistent with the general perception that patients begin to brush their teeth on their own when they reach the permanent dentition stage. Most patients in the mixed dentition group attended a family dentist, whereas more than half of the subjects in the permanent dentition group did not, even after 5 years of continual dental support. This is consistent with reports of lower awareness of dental visits among adolescents and young adults [19,20]. Our results suggest that it is more difficult to improve the oral health habits of patients with hemophilia with permanent dentitions than those in the mixed dentition stage.

In the mixed dentition group, the use of dental floss and toothbrushing by their parents was associated with lower CPI values. These findings suggest that teaching the patients and their parents about the importance of oral health habits may improve their periodontal condition. However, the use of dental floss and the presence of a family dentist did not affect CPI values in the permanent dentition group, suggesting that oral health instruction from schools may help patients with hemophilia establish good periodontal health. Future long-term evaluation is needed to determine whether hemophilic patients who acquire correct oral health habits during the mixed dentition stage will be able to maintain good periodontal health when they acquire permanent teeth. Additionally, better

dental interventions should be considered to help the patients maintain good periodontal health in their permanent dentition.

In the present study, the patients with hemophilia who had used dental floss were generally instructed by their family dentists. We also instructed patients with hemophilia on the use of dental floss at the time of their visit, regardless of whether they had used it. Our results suggest that the use of dental floss may have contributed to the improved periodontal condition of patients in the mixed dentition period. The WFH guidelines also encourage the use of dental floss or interdental brushes to ensure complete plaque removal [13]. However, improper use can also increase the risk of gum bleeding, and it is also difficult for young children to use dental floss themselves. Therefore, it is important not only to check whether dental floss is being used but also to instruct patients and their parents on the correct usage.

Saccucci et al. (2022) reported that the saliva of children treated with chemo/radiotherapy had a lower pH, making the teeth more susceptible to dental caries [21]. However, it was concluded that oral hygiene and preventive protocols implemented in children with onco-hematological diseases can improve their level of comfort and help prevent complications that may affect the child's quality of life [21]. Our results revealed that continual dental support contributed to improved periodontal status through oral health habits, especially in the mixed dentition group. Good oral health, resulting from continual dental support, can have an impact on improving the quality of life of patients with hemophilia because oral health is related not only to periodontal disease but also to other oral diseases.

One limitation of this study was the small number of subjects. Hemophilia is a rare disease, and it was difficult to select only subjects with uniform psychological conditions and brushing skills. Additionally, the sample size could not be calculated due to the lack of previous studies focusing on continuous dental support for young patients with hemophilia. When we searched for previous papers that focused on the oral health status of young patients with hemophilia, we found that many reports focused on dozens of subjects [16–18]. Using these papers as references, we recruited more than 30 subjects each year over a five-year research period for 168 subjects. In an important review article on periodontal disease and systemic diseases [22], most studies containing new findings have small sample sizes of 10 to several dozen. However, the papers' systematic review and meta-analysis show a promising association. Due to the limited sample size, this study included patients ranging from infants to adults. Because there are large differences in brushing techniques depending on the age range, we did not include a questionnaire about the patients' own tooth brushing. In the future, more extensive studies should be planned that include hemophilia patients from multiple centers and focus on each age group. Additionally, because young people in some low- and middle-income countries have poorer oral health status than those in Japan [23,24], analyses focusing on patients in different environments are needed.

5. Conclusions

In summary, our results suggest that continual dental support improved the periodontal status and oral health habits of young patients with hemophilia in the mixed dentition stage, contributing to the prevention of periodontal pathology. On the other hand, there was no obvious effect on the patients in the permanent dentition stage. The permanent dentition stage in childhood is crucial when children learn to become independent from their parents about oral health habits. In the future, we would like to develop dental support suitable for all ages so that hemophilic children can maintain good oral health.

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Informed Consent Statement: Patient consent was waived due to a retrospective observational study using only existing medical records. Informed consent was obtained via opt out on our hospital website. Patients who opted out were excluded from the study.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

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Abbreviations

CPI	Community Periodontal Index
WFH	World Federation of Hemophilia

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