Original article

Oral hygiene and oral status of institutionalized children with motor and intellectual disabilities

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Abstract: The oral hygiene and oral status of children with severe disabilities with both nutritional and respiratory complications who were institutionalized at Karugamonoie (KNI), a facility for children with disabilities, were investigated in this study. Their oral hygiene management was solely dependent on caregivers and nurses at the institution. Thirty children (13 females, 17 males; average age, 7.6 years) who had a tracheotomy and feeding tube (gastrostomy, nasogastric, or jejunostomy feeding tube) were included in the study. As for oral characteristics, poor control of tongue movement, anterior open-bite, abnormal strain of facial muscles, dry mouth, and swallowing dysfunction were found in 63.3%, 63.3%, 13.3%, 20.0%, and 100.0%, of the children, respectively. The mean $\pm$ standard deviation Decayed, Missing, Filled Teeth score was 0.13 ± 0.57 . The Gingival Index (GI) showed that the children had mild (53.3%) to moderate (46.7%) gingivitis. The Simplified Oral Hygiene Index was excellent in 50.0% of the children, good in 23.3%, fair in 20.0%, and poor in 6.7% of the children. These indices were satisfactory in general except for GI management, which may have been hampered by abnormal oral functions and anterior open-bite. In conclusion, oral hygiene management of children with nutritional and respiratory complications at KNI was shown to be of high quality even without on-site intervention by dental specialists.

Keywords; children, dental caries, motor and intellectual disability, oral hygiene, periodontal disease

Introduction

Oral healthcare plays an important role in both preventing dental caries and maintaining general health [1-4]. However, it is not common for a general hospital to employ a dental team that supports oral healthcare for pediatric patients who are institutionalized. Saitama Medical Center (SMC) is a central hospital that plays a supportive role in regional medical care in collaboration with the Advanced Tertiary Medical Center and Center for Maternal Fetal and Neonatal Medicine in Saitama Prefecture, Japan. SMC has a facility called Karugamonoie (KNI) for children with profound intellectual disabilities and those with multiple disabilities, which was established in 2013. KNI operates in accordance with the Child Welfare Law and provides protection, knowledge and skills necessary for independent living, guidance for everyday life, and treatment for children under 18 years old. At present, KNI mainly admits only children with severe disabilities with either nutritional complications or respiratory complications or both. Pediatric doctors and nursing staff at KNI work in shifts 24 h a day.

KNI does not employ regular dental specialists. Since 2014, however, dentists and dental hygienists from the Oral and Maxillofacial Surgery Clinic at SMC have performed oral examinations on the children at KNI once every 6 months and, if necessary, have carried out dental treatment. Oral healthcare for the institutionalized children at KNI is performed by caregivers and nurses twice a day. Oral hygiene management of children

with disabilities with neurological impairment is difficult in general, particularly when it is provided only by caregivers and nurses and not by dental specialists [5]. If the daily oral hygiene management by caregivers and nurses at KNI was found to be insufficient, more active intervention would be necessary. In this study, the oral status and oral hygiene-related factors were evaluated in children with severe respiratory and nutritional complications at KNI to evaluate the present status of oral hygiene management provided by caregivers and nurses.

Materials and Methods

This study was conducted in accordance with the Declaration of Helsinki, and the Ethical Review Board of SMC approved (No. 1877) the study.

Thirty-two children were admitted to KNI as of December 27, 2017. Of these 32 children, 30 with nutritional and respiratory complications were enrolled in the present study. Respiratory complications included breathing with a tracheotomy, with or without a respirator, and nutritional complications included gastrostomy, nasogastric, or jejunostomy tube feeding. All children had profound intellectual disabilities and some had multiple disabilities and were in need of help from the caregivers for all activities of daily living, including oral hygiene activities. The following basic characteristics were examined in the children: age, underlying diseases, oral status, nutritional and respiratory management, and function associated with oral hygiene management. Conditions of dental caries, periodontal disease, and oral hygiene were also recorded. The oral status and function included poor control of tongue movement, anterior open-bite, swallowing dysfunction, abnormal strain of facial muscles, and dry mouth. The status of dental caries was assessed using the Decayed, Missing and Filled (DMF) Index. The DMF Index expresses the caries burden numerically and is obtained by calculating the number of teeth that are decayed (D), missing due to caries (M), and filled (F) [6]. Oral hygiene status and periodontal disease were assessed using the Oral Hygiene Index-simplified (OHI-S) and the Gingival Index (GI) [7,8]. The GI scores indicated the severity of gingivitis as follows: 0.1-1.0, mild inflammation; 1.1-2.0, moderate inflammation; and 2.1-3.0, severe inflammation [9,10]. The OHI-S score (sum of the values of the dental plaque index and dental calculus index) is classified as excellent (score 0), good (scores from 0.1 to 1.2), fair (scores from 1.3 to 3.0), or poor (scores from 3.1 to 6.0) [6,11].

Statistical analyses were performed using Origin pro 2016 software (Lightstone Corp., Tokyo, Japan). Descriptive statistics were calculated. Comparisons between the groups were assessed with a binomial test or a χ^2 test ($P < 0.05$).

Results

The age distribution of the 30 children (13 females, 17 males) was as follows: 12 children were aged 0-5 years, 8 were aged 6-10 years, and 10 were aged 11-16 years (average age, 7.6 years; Table 1). The underlying diseases in the 30 children included congenital diseases in 12 children (40%), perinatal factors (cerebral palsy; CP) in 15 children (50%), and acquired diseases in 3 children (10%; Table 2). For nutritional management, 18 children (60.0%) were receiving gastric tube feeding, and there was one case of jejunostomy tube feeding (Table 3). Twelve children (40.0%) were receiving nasogastric tube feeding (Table 3). For respiratory

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Table 1 Age and sex distributions of the study patients

Age (years)	Male (n)	Female (n)	Total (n)
0-5	8	4	12
6-10	4	4	8
11-16	5	5	10
Total	17	13	30

There were no significant differences in the age and sex distributions.

Table 2 Underlying diseases

	n (%)
Congenital disease	
Trisomy 13	2
Noonan syndrome	1
Achondroplasia	1
Hypochondroplasia	1
Chondrodysplasia punctata	1
Anomalad	1
Hemophilia B	1
Spinal muscular atrophy	1
Spinocerebellar degeneration	1
Congenital muscular dystrophy	2
Total	12 (40.0%) *
Perinatal factors (cerebral palsy)	
Neonatal encephalopathy	10
Hypoxic encephalopathy	2
Hydrocephalus	2
Severe asphyxia	1
Total	15 (50.0%) *
Acquired diseases	
Post-resuscitation encephalopathy	3
Total	3 (10.0%) *
Total	30 (100%)

* $P < 0.05$

management, all had a tracheotomy, including 23 children with a respirator (76.7%) and 7 children without a respirator (23.3%; Table 3). Twelve children (40.0%) required continuous suctioning (Table 3). As for oral characteristics, an anterior open-bite was found in 19 children (63.3%), poor control of tongue movement in 19 children (63.3%), abnormal strain of facial muscles in 4 children (13.3%), swallowing dysfunction in 30 children (100.0%), and dry mouth in 6 children (20.0%; Table 4). The average (mean $\pm$ standard deviation) D, M, F, and DMF scores were 0.03 ± 0.18 , 0.00 ± 0.00 , 0.10 ± 0.40 , and 0.13 ± 0.57 , respectively (Table 5). Regarding periodontal disease and oral hygiene status, 16 children (53.3%) had mild gingivitis and 14 (46.7%) had moderate gingivitis according to the GI (Table 6), while the OHI-S scores were excellent in 15 children (50.0%), good in 7 children (23.3%), fair in 6 children, and poor in 2 children (6.7%; Table 6).

Discussion

This study investigated the oral hygiene and oral status of institutionalized children who had profound intellectual disabilities and multiple disabilities, particularly those with nutritional and respiratory complications who needed the help of caregivers for all daily living activities. It is generally, difficult to perform oral hygiene on patients with severe intellectual and motor disabilities because of complications, such as nutritional and respiratory management complications, abnormal muscle strain, swallowing dysfunction, disability of tongue movement, head instability, malocclusion, and drooling [12,13]. There have been many studies assessing the oral hygiene status of children with intellectual and motor disabilities, but there are few studies that focused on the oral hygiene of the institutionalized children with severe nutritional and respiratory complications. Most often, the daily oral hygiene care of institutionalized children is performed by caregivers and nurses without the support of dental hygienists. Therefore, it is worthwhile determining the true oral hygiene status of the institutionalized children who receive daily oral healthcare by caregivers and nurses.

In studies of children with intellectual and motor disabilities, children with CP have been frequently studied because CP is a common cause of

Table 3 Management of nutrition and respiration

	n (%)	P value
Management of nutrition		0.362
Gastric tube feeding	18 (60.0%) *	
Nasogastric tube feeding	12 (40.0%)	
Management of respiration		0.000
Tracheotomy with respirator	23 (76.7%)	
Tracheotomy without respirator	7 (23.3%)	
Continuous suctioning		0.362
Yes	12 (40.0%)	
No	18 (60.0%)	

*Gastrostomy tube feeding value includes one case of jejunostomy tube feeding.

Table 4 Oral characteristics

	n (%)	P value
Anterior open-bite		0.201
Yes	19 (63.3%)	
No	11 (36.7%)	
Poor control of tongue movement		0.201
Yes	19 (63.3%)	
No	11 (36.7%)	
Abnormal strain of facial muscles		0.000
Yes	4 (13.3%)	
No	26 (86.7%)	
Swallowing dysfunction		0.000
Yes	30 (100.0%)	
No	0 (0.0%)	
Dry mouth		0.001
Yes	6 (20.0%)	
No	24 (80.0%)	

intellectual and motor disabilities [14]. This was also true in the present study.

In children with swallowing dysfunction, such as that seen with intellectual disability, congenital nervous and muscular diseases, and CP, gastrostomy tube feeding is the preferred method for long-term enteral feeding since it is less obtrusive than a nasogastric tube [15,16]. Neurologically impaired children frequently experience gastro-esophageal reflux disease (GERD), which may cause recurrent chest infections and recurrent vomiting, and GERD can occur whether children are tube-fed or not [17]. Although children who are tube-fed, especially those with gastrostomy and jejunostomy tube feeding, may appear as if they do not need plaque control, they often develop GERD and are at greater risk for aspiration pneumonia due to accumulated debris and oral microorganisms [15,17,18].

In this study, all children had received a tracheostomy. Because the severity of airway obstruction with aspiration in children with CP tends to increase with age, children with CP are likely to require a tracheostomy as they get older [19]. In general, transitioning from mechanical ventilation using an endotracheal tube to tracheostomy is helpful to improve oral hygiene [20]. However, in cases without laryngotracheal separation, the possibility of aspiration of saliva into the airway, which may result in aspiration pneumonia, remains. Swallowing dysfunction is a cause of drooling [16,21]. Some children in this study received continuous suctioning to prevent aspiration pneumonia.

Children with neurological impairment have various complications and characteristics in the orofacial region [22,23]. The most common malocclusion is an anterior open-bite, which has been reported to become worse with age [24]. An anterior open-bite can cause hypotonia of the orofacial muscles with a poor swallow reflex, a resultant forward tongue posture, and frequent mouth breathing [14,25]. Abnormal strain of facial muscles and poor control of tongue movement can disturb oral hygiene treatment [12]. Swallowing dysfunction can cause aspiration if not properly managed. Dry mouth due to mouth breathing or hyposalivation often aggravates oral diseases, such as dental caries and gingivitis [26]. Anterior open-bite, swallowing dysfunction, and poor control of tongue movement were prominent and commonly seen in the children enrolled in the present study.

Table 5 Evaluation of dental caries

DMF Index	Average (mean $\pm$ SD)
D	0.03 $\pm$ 0.18
M	0.00 $\pm$ 0.00
F	0.10 $\pm$ 0.40
DMF	0.13 $\pm$ 0.57

DMF: decayed (D), extracted due to caries (missing: M), filled (F). SD, standard deviation

Other oral characteristics seen in children with neurological impairments include dental erosion, bruxism (tooth wear of molars), and enamel defects [27]. Dental erosion is a type of tooth wear caused mainly by acidic food or gastric fluid [27,28]. It also occurs in cases of poor oral hygiene. In this study, dental erosion was not evident, suggesting that none of the children examined in this study had severe GERD. Bruxism, the habitual grinding of teeth, leads to tooth abrasion and flattening of biting surfaces, which can potentially be destructive to periodontal tissues. Bruxism may be associated with periodontal disease in children with neurological impairments [27]. In the present study, bruxism was not common, probably due to differences in the children's neurological disease status. Congenital enamel defects are often seen in children with CP, and they usually present in a symmetrical manner in both primary incisors and first molars [29]. Poor oral hygiene tends to accelerate expansion of the area of enamel defects. However, obvious enamel defects were seen in only one child in the present study.

The dental disease status of children with CP has been frequently described [5,30], but there have been few studies focused on children with tracheostomy and tube feeding. Dental caries is considered a common problem in children with neurological impairments [31], and some studies reported that the prevalence of dental caries in children with CP was similar to or lower than that in children in the general population [22,32]. The low caries rate in children with CP can be partly attributed to effective oral hygiene strategies for children with disabilities, including those with neurological impairments [33,34], although prevention of dental caries in patients with neurological impairments is still a major problem in some developing countries [35]. Patients with feeding tubes have been described as being at low risk for dental caries even with limited oral hygiene practice because they do not take food orally [36]. In the present study, all children were fed via a tube, and the DMF Index was quite low. It is evident that the methods of nutrition are strongly associated with the prevalence of dental caries in children with nutritional complications.

Another common dental disease is periodontal disease. It has been reported that patients with CP are at greater risk of periodontal disease [37]. Various indices have been used to evaluate the periodontal status of children with motor and intellectual disabilities. It has been reported that the prevalence of gingivitis is relatively high in institutionalized children who receive adequate oral healthcare [22,34,37], and this is true for the children examined in the present study. Several factors contribute to the development of periodontal disease: hydantoin (which causes gingival hyperplasia), dry mouth, open bite, high viscosity of saliva, hypofunction of tongue movement, and difficulty in oral hygiene management [27,37]. Aging is also a common factor that needs to be considered in taking preventive action against periodontal disease because the prevalence of periodontal disease tends to be higher in older children [34]. Because tube feeding is a cause of unusual accumulation of calculi [18], children institutionalized at KNI for years have to be managed as a group at high risk for periodontal disease.

The benefit of keeping good oral hygiene is not just protection from oral disease, but also avoiding systemic disease [2-4]. The effectiveness of oral hygiene for preventing respiratory diseases such as aspiration pneumonia has been described in a report involving senior citizens [1]. Oral hygiene strategies including education and technical training for those engaging in nursing care, which would include medical and dental staff and caregivers, are important [30,38,39]. In healthcare facilities without the participation of dental specialists, caregivers mainly perform oral hygiene for children

Table 6 Evaluation of gingivitis and oral hygiene

	n (%)
GI	
No inflammation (0)	0 (0.0%)
Mild (0.1-1.0)	16 (53.3%)
Moderate (1.1-2.0)	14 (46.7%)
Severe (2.1-3.0)	0 (0.0%)
OHI-S (Debris index + Calculi index)	
Excellent (0)	15 (50.0%)
Good (0.1-1.2)	7 (23.3%)
Fair (1.3-3)	6 (20.0%)
Poor (3.1-6)	2 (6.7%)

GI, Gingival Index; OHI-S, Oral Hygiene Index-simplified

in the institution. In a past clinical trial, motivation of caregivers to carry out oral hygiene for patients with motor deficiency was shown to be very important, and high motivation resulted in the reduction of the plaque index and microorganism counts [30].

Oral hygiene of institutionalized children with neurological impairments seems to be performed relatively well in recent years [34]. In the present study, 50% of children had excellent scores on the OHI-S, and only two children had poor scores. This means that oral hygiene of the children at KNI was relatively well maintained through daily oral care by nurses and caregivers without on-site intervention by dental specialists, despite the fact that most of the children had a tracheostomy and tube feeding. This could be attributed to the high motivation for oral hygiene and the untiring efforts for management of health by the nurses and caregivers at KNI.

There were some limitations in the statistical analysis of the present study. First, the number of children examined was relatively small, which made classifying the motor and intellectual disabilities of each child uninformative. Second, the time of their admission to KNI and the onset and duration of extraoral nutrition and tracheotomy were unclear. To determine what was behind the relatively high GI score in KNI, further studies to clarify factors that are closely associated with gingival conditions in children with intellectual and multiple disabilities are needed.

In conclusion, the actual oral status and oral hygiene of institutionalized children with severe respiratory and nutritional complications were investigated. The quality of daily oral hygiene of children at KNI by nurses and caregivers were revealed to be high even without on-site intervention by dental specialists.

Conflict of interest

The authors declare no conflict of interest.

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