

Oral health status of Chinese teenagers with cerebral palsy

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Objectives To examine caries experience, periodontal status, and oral hygiene practices of Chinese teenagers with cerebral palsy in Hong Kong. **Participants** Chinese students aged 12 years or older studying in the three special schools of the Spastics Association of Hong Kong were invited to participate. **Clinical setting measures** Caries experience and periodontal status were assessed by a clinical oral examination using World Health Organization criteria. Information on oral hygiene and snacking habits were obtained by a questionnaire. Information on medical history and mental status was obtained from school records. **Results** Of 65 students with a mean (\pm SD) age of 15.0 ± 2.0 years, the majority (74%) had spastic cerebral palsy. About half of the participants (49%) had mild mental retardation and 31% had moderate mental retardation. Caries experience as the mean DMFT score (\pm SD) was 1.2 ± 1.9 and 43% of caries remained untreated; however, 62% of participants had no caries experience. None of the participants had healthy gums, 57% had calculus, and 66% snacked between meals. They all practised daily tooth brushing, with or without caregiver assistance. About one third (33%) also used mouthrinse. There were no significant differences in caries experience between the participants who brushed their teeth with and those who brushed without caregiver assistance. **Conclusions** The mean DMFT score of this sample of Chinese teenagers with cerebral palsy was 1.2. Despite daily tooth brushing, the periodontal status of all participants was poor. Providing oral hygiene instructions and scaling are essential to improve their oral health.

Key words: Caries, cerebral palsy, Chinese, periodontal, teenagers.

Introduction

Cerebral palsy (CP) is a major cause of childhood developmental disability (Yam *et al.*, 2006), and its reported prevalence ranges from 1.2 to 2.5 per 1,000 live births worldwide (Stanley *et al.*, 2000). Cerebral palsy actually refers to a group of disorders of movement and posture that are attributed to non-progressive disturbances that occurred in the developing foetal or infant brain (Bax *et al.*, 2005). Such brain damage can develop during a long labour period, disturbed circulation in the umbilical cord, premature birth, head injuries, and viral infections such as rubella (Surabian, 2001). A common cause of brain damage leading to CP is hypoxia that may occur before, during or shortly after birth.

Cerebral palsy is conventionally classified by the type of tone or movement abnormality displayed—namely, spastic, dyskinetic (athetoid), ataxic, hypotonic, and mixed type (Howle, 2002). Spastic CP is characterized by stiffness and rigidity of the extremities, whereas dyskinetic CP involves slow involuntary and uncontrolled movement and difficulty in maintaining stable posture and balance. In ataxic CP, individuals cannot walk steadily and have poor balance when moving and poor eye-hand coordination. In hypotonic CP, individuals have muscle flaccidity and a decreased ability to generate voluntary muscle force and to maintain posture (Hosey and Welbury, 2005). People with mixed-type CP have symptoms of more than one type of involvement. Among these five types of CP, spastic CP is the most common, followed by dyskinetic CP (Hosey and Welbury, 2005). Hypotonic and ataxic types are relatively rare. In addition to having motor dis-

abilities, children with CP often have co-morbidities that persist throughout life; these include epilepsy, learning difficulties, behavioural problems, visual and hearing impairment, and disturbances of sensation, cognition, communication, and perception.

People with CP can also have a number of clinical dental features (Bhowate and Dubey, 2005; Rodrigues dos Santos *et al.*, 2003; Pope and Curzon, 1991). Among them are delayed eruption, malocclusion (increased prevalence of skeletal class II with anterior open bite), enamel hypoplasia, increased risk of periodontitis, drug-induced gingival hyperplasia, and increased drooling and mouth breathing. Bruxism and temporomandibular joint problems have also been reported (Hosey and Welbury, 2005). A study in India found high caries rates in children aged 3 to 14 years with CP (Bhowate and Dubey, 2005), while a second study found that children with CP had a higher prevalence of caries and poorer periodontal status than controls (Bhavsar and Damle, 1995). Similarly, in Brazil, both male and female children with CP were shown to have significantly higher caries experience in their permanent dentition than controls, but were less likely to receive restorative care and more likely to have carious teeth extracted (Rodrigues dos Santos *et al.*, 2003). Although a survey in the United Kingdom found that children with CP had similar caries levels to those of non-handicapped children, they had significantly higher levels of plaque and gingivitis, more teeth extracted, more untreated teeth, fewer restorations, and poorer quality restorations (Pope and Curzon, 1991). By comparison, a study in Denmark showed that among children with CP, those who were

most severely mentally and motor handicapped had the lowest caries experience (Nielsen, 1990). A study in Spain also showed that the caries prevalence in children with CP was not high (Gomis Subira, 2000).

The literature on dental status of people with CP has thus focused on children and yielded mixed findings. Nevertheless, a Medline search did not reveal any studies reported in English on the dental status of people with CP among any Chinese populations. Therefore, this study aimed to investigate the dental status of Chinese teenagers with CP in Hong Kong.

Method

This study was conducted between February 27 and March 8, 2008, and was approved by the ethics committee of the Spastics Association of Hong Kong and involved a service it provided to students with CP. The study comprised an oral examination and a questionnaire survey and enrolled a convenience sample of students with CP attending three special schools in Hong Kong managed by the Spastics Association of Hong Kong, which is a non-government voluntary organization that serves people with CP. We aimed to restrict the examination to children with secondary dentition. Thus, all students with CP aged 12 years or older were invited to participate in the study through their parents, who received the study protocol and invitation letter. Parental consent was sought before students were recruited. Children who had congenital heart diseases, and hence would have required antibiotic prophylaxis for dental care, were excluded from the study.

A close-ended oral questionnaire used previously by Chu *et al.* (1999) was modified to acquire information on participants' oral hygiene practices and snacking habits. The questions were asked in Chinese (Cantonese) by a trained interviewer, with the assistance of a school teacher or school nurse who knew the participants well. Participating CP students, or their parents if there were communication or comprehension problems, were invited to answer the questions. The questionnaire was divided into three sections: the first asked for demographic data such as age and gender; the second asked about oral hygiene practices—namely, frequency of tooth brushing, parental assistance during tooth brushing, and use of oral cleaning aids such as mouthrinse, interdental brushes, toothpicks, and dental floss; and the third assessed snacking habits via the proxy variable of whether the person had snacked between meals on the previous day.

The relevant medical history of each student, including type of CP diagnosed and degree of mental retardation (classified by Intelligence Quotient [IQ]), were retrieved from school records and checked by school nurses before the clinical oral examination, which was performed in the school after the questionnaire survey. Two trained examiners measured the caries prevalence and periodontal status of the participants using a community periodontal index (CPI) probe and dental mirror with fibre-optic light while the participant was seated in a portable dental chair. If needed, cotton wool and gauze were used to absorb saliva or remove debris from tooth surfaces. Duplicate examinations were conducted for about 10% of the participants to assess the inter-examiner agreement. School teachers or nurses helped any participants

who had communication difficulties or mild or moderate mental retardation.

Criteria suggested by the World Health Organization (1997) were used to measure caries experience as the decayed, missing, or filled teeth (DMFT), and periodontal status as the CPI. For the latter, codes 0, 1 and 2 were used to indicate healthy periodontal status, gingival bleeding, and calculus, respectively; CPI codes 3 and 4 were not used because false pockets were detected in the teenager participants examined.

After the clinical examination, a 5% sodium fluoride varnish was applied with cotton buds on all molar and anterior carious teeth. Individual examination reports were given to the school nurses, who sent them to the participants' parents.

The data from the questionnaires, school records, and clinical examination were entered into a personal computer using Microsoft Excel. The Statistical Package for the Social Sciences version 17.0 (SPSS Inc., Chicago, Illinois, USA) was used for all statistical analyses; a critical value of $P < .05$ was considered statistically significant. Student's *t*-test and analysis of variance (ANOVA) were used to study the association between caries experience and participant's gender, degree of mental retardation, tooth brushing frequency, parental assistance during tooth brushing, use of oral cleaning aids, and snacking habits. The chi-square test was used to study the association between periodontal status and gender, degree of mental retardation, tooth brushing frequency, parental assistance during tooth brushing, and use of oral cleaning aids. Inter-examiner reliability was computed in terms of Cohen's kappa statistics.

Results

Of the 89 students invited, 65 (36 boys and 29 girls; response rate, 73%) completed the study; the mean (\pm SD) age of the participants was 15 ± 2 years. The kappa scores for caries and periodontal assessments were 0.98 and 0.76, respectively.

The majority of the participants ($n=48$, 74%) had spastic CP. Six (9%) teenagers had athetoid CP, 4 (6%) had ataxic CP, 2 (3%) had hypotonic CP, and 5 (8%) had mixed-type CP. Among the 51 participants with spastic CP or mixed-type CP with spasticity, 25 (49%) had triplegic or quadriplegic spasticity, 16 (31%) had diplegic spasticity, 9 (18%) had hemiplegic spasticity, and 1 (2%) had paraplegic spasticity. Thirty-two (49%) participants showed mild mental retardation (IQ, 70-89), whereas 20 (31%) showed moderate mental retardation or moderate educational subnormality (IQ, 50-69). The remaining 13 (20%) participants showed a normal level of intelligence (IQ, ≥ 90).

The mean (\pm SD) DMFT of the participants was 1.2 ± 1.9 . Not many teeth had been lost owing to caries ($M=0.1 \pm 0.3$). Filled ($F=0.6 \pm 1.2$) and decayed ($D=0.5 \pm 1.5$) teeth contributed to most of the caries experience, representing 52% and 43%, respectively, of the total DMFT score. Forty (62%) participants had no experience of caries (DMFT=0), but two students had the highest DMFT score of 8. The remaining 25 participants with previous or current caries had a mean DMFT score of 3.0 ± 2.0 . The mean DMFT of boys and girls was 1.3 ± 2.0 and

0.9±1.9, respectively ($p>0.05$). Caries experience was also not significantly different among participants in the various categories of mental status (Table 1).

All participants practised daily tooth brushing, and 29 (45%) received parental assistance in tooth brushing. Additional oral cleaning aids, such as toothpicks, mouthrinse, interdental brushes, and dental floss, were used by 35 (54%) of the teenagers. The most commonly used cleaning aid was mouthrinse (32% of all participants), followed by toothpicks (25%). Only 17% of the teenagers used dental floss and less than 5% used interdental brushes. About two thirds (66%) of the participants did not snack the day before, whereas the remainder had snacked at least once. There were no significant differences in caries experience according to participants' mental status, daily brushing frequency, parental assistance during tooth brushing, use of other cleaning aids, or snacking habits.

None of the participants was found to be periodontally healthy—that is, none had a CPI of 0 for all six sextants examined. Thirty-seven (57%) participants had calculus deposits (CPI=2), whereas the remainder showed bleeding after probing (CPI=1). The periodontal status as measured by the mean number of sextants with CPI=2 was not significantly different according to gender, mental status, daily brushing frequency, parental assistance during tooth brushing, or use of other cleaning aids (Table 2).

Discussion

Studies in Asia based on birth registries have revealed that the prevalence of CP is 1.34 per 1,000 among 6-year-old children in Japan (Suzuki and Ito, 2002) and 1.6 per 1,000 among children younger than seven years in China (Liu *et al.*, 1999). Unlike many countries, Hong Kong does not have a CP registry based on birth cohorts. Hong Kong's Education Bureau and Social Welfare Department both provide local statistics on groups of people classified by broad functional disability such as blindness, deafness, and mental handicap, but local information on people with specific neurodevelopmental disorders such as CP is not available (Yam *et al.*, 2006). However, school education is mandatory in Hong Kong, and a survey published in 2006 found that approximately 38% of children with CP studied in various mainstream schools, while 62% studied in special schools; the estimated prevalence of CP was 1.3 per 1,000 school children (Yam *et al.*, 2006).

This study used a cross-sectional design that involved the three special schools run by the Spastics Association of Hong Kong for children with CP. Although 65 of the 89 invited teenagers participated, giving a satisfactory response rate of 73%, the study was limited by its analysis of permanent dentition, the number of CP students, and type of school. Students with CP in a mainstream school would be likely to be better integrated into the community and might be able to take better care of their oral health. The results drawn in this study may not be representative of children with CP in Hong Kong, but it at least provides insight into the oral health status of teenagers with CP.

Spastic CP was the most common type of CP in this study, followed by athetoid CP. Triplegia and quadriplegia were most common types of spasticity among the children with spastic and mixed-type CP. These findings

Table 1. Caries experience according to gender, mental status, daily brushing frequency, parental assistance in tooth brushing, use of other cleaning aids, and snacking frequency

Independent variables	Mean DMFT (SD)	No. (%)	p-value
All	1.2±1.9	65 (100)	
Gender			.24
Male	1.3±2.0	36 (55)	
Female	0.9±1.9	29 (45)	
Mental status			.80
Normal	0.8±1.1	13 (20)	
Mild retardation	1.2±2.0	32 (49)	
Moderate retardation	1.3±2.2	20 (31)	
Daily brushing			.31
Once	1.0±1.6	15 (23)	
More than once	1.7±2.7	50 (77)	
Parental assisted brushing			.36
Yes	1.4±2.4	29 (45)	
No	0.9±1.5	36 (55)	
Use of other cleaning aids			.35
Yes	1.0±1.6	35 (54)	
No	1.3±2.3	30 (46)	
Snacking frequency			.72
Once or more	1.3±2.1	43 (66)	
None	1.1±1.9	22 (34)	

DMFT = decayed, missing, or filled teeth

Table 2. Periodontal status (mean no. sextants with CPI=2) according to gender, mental status, daily brushing frequency, parental assistance in tooth brushing, and use of other cleaning aids

Independent variables	Mean DMFT (SD)	No. (%)	p-value
All	1.7±2.0	65 (100)	
Gender			.09
Male	2.1±2.1	36 (55)	
Female	1.2±1.8	29 (45)	
Mental status			.09
Normal	1.0±1.1	13 (20)	
Mild retardation	1.5±1.9	32 (49)	
Moderate retardation	2.5±2.4	20 (31)	
Daily brushing			.15
Once	2.3±1.8	15 (23)	
More than once	1.5±2.0	50 (77)	
Parental assisted brushing			.60
Yes	1.8±2.3	29 (45)	
No	1.6±1.7	36 (55)	
Use of other cleaning aids			.93
Yes	1.7±1.9	35 (54)	
No	1.7±2.2	30 (46)	

DMFT = decayed, missing, or filled teeth

agree with the frequency distribution of CP described by Hosey and Welbury (2005). The caries experience in terms of DMFT score in this study was 1.2, which is similar to the scores of 0.8 and 1.4 previously reported for Hong Kong school students aged 12 years and 13 to 15 years, respectively (Hong Kong Department of Health, 2002). Pope and Curzon (1991) also found similar caries rates for both children with or without CP aged 11 years and older in Leeds, United Kingdom. In addition, those authors noted a high proportion of decayed teeth that had been left untreated, and this finding was also demonstrated by the high proportion (43%) of the DMFT score attributable to decayed teeth in the present study. Nielsen (1988) reported that 14- to 15-year-old teenagers in Denmark had low caries rates and that motor handicap was the best predictor of caries; however, our study did not investigate the association between caries incidence and motor disability.

The percentage of caries left untreated (DT) (43%) was higher than that of the general population (13%) (Hong Kong Department of Health, 2002), which might be related to difficulties faced by children with CP in accessing dental care and in cooperating with the dental team during visits. Dentists may encounter difficulties in treating people with CP, resulting in lower quality restorations and poorer oral hygiene (dos Santos and Nogueira, 2005; Guare Rde and Ciamponi, 2003; Pope and Curzon, 1991). The importance of regular dental care should be reinforced through education to promote oral health and quality of life among people with CP. Furthermore, dental professionals, perhaps with the cooperation of caregivers, need to be aware of these patients' special requirements.

All participants brushed at least once daily with the use of toothpaste. Because fluoridated toothpastes comprise the overwhelming majority of products available in Hong Kong and the water supply in Hong Kong is fluoridated, such fluoride exposure likely contributed to the low caries rate observed. Just under half of the teenagers received assistance when brushing their teeth, but their caries experience was higher than that of teenagers who brushed without help. People with CP who require brushing assistance may have more severe mental and physical disability, which itself may be associated with poorer oral health status or reduced access to professional care. In addition, caregivers' brushing technique and its effectiveness may be poor. Individual discussions after the study revealed that some parents and caregivers had not been informed on how to brush the teeth of their children properly. A formal evaluation of brushing methods used by parents and caregivers is warranted to confirm the extent of this problem.

A study in Denmark showed that the plaque index and gingivitis index of young people aged 14 to 15 years with CP were higher than those of people without CP (Nielsen, 1990). Similarly, researchers in England showed that the oral hygiene and gingival health of young people with CP (mean age, 10 years) were worse than those of people without CP (Pope and Curzon, 1991). Consistent with these findings, none of the participants in our sample had healthy gums, whereas about 5% of 12-year-old children in Hong Kong reportedly do (Hong Kong Department of Health, 2002). However, more than

half of the children with CP in our study (57%) had calculus deposits, which is similar to the proportion of 12-year-olds with calculus in Hong Kong (60%) (Hong Kong Department of Health, 2002), suggesting that scaling needs to be promoted among children and caregivers in general in Hong Kong.

Our findings show that despite regular tooth brushing, the periodontal health of teenagers with CP is unsatisfactory, as is the effectiveness of parental assistance with brushing. Specific interventions are thus needed in Hong Kong to improve the oral health among children with CP attending special schools. There is room for improvement in promoting the importance and technique of proper tooth brushing among both teenagers with CP and caregivers, and in promoting professional scaling. Talks targeting parents and teachers of students with CP could be held in the school to raise awareness of good dental and oral health. Scaling and appropriate prophylaxis could be provided by dentists or by dental hygienists to improve periodontal health.

Conclusions

The caries experience of this sample of Hong Kong Chinese teenagers with CP is not high (mean DMFT score, 1.2) and 62% of them have no caries experience. However, the proportion of untreated decay is high. Almost half of the teenagers receive parental assistance in tooth brushing, but this is mostly ineffective. Despite daily tooth brushing, all the teenagers had gingivitis and more than half had calculus. Oral hygiene instructions and scaling are essential to improve the oral health of teenagers with CP. Monitoring the effectiveness of these interventions is recommended.

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