

## The dental status of cerebral palsied children

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### Abstract

*The prevalence of dental disease, the types and quality of dental care, and the provision of services were assessed for 150 cerebral palsied children (mean age 10.25 years) attending special schools in Leeds and compared with a matched control group of 191 children (mean age 10.39 years). Similar dental caries experience existed in the two groups, but study children had more extracted and unrestored teeth, and fewer and poorer quality restorations than control children. Oral hygiene and gingival health were worse in the study group, which also exhibited delayed eruption and higher levels of tooth wear. Significantly greater overjet (5.1 mm compared with 2.5 mm) and less crowding occurred in the study group than in the control group. All parents had favorable attitudes toward dentistry and were satisfied with their children's dental care. More study children received treatment from the community dental service, while the general dental services were used more commonly by the control group.*

### Literature Review

Cerebral palsy was first described by Little (1862) and usually is classified according to the type and site of motor deficit (Minear 1956). The prevalence of cerebral palsy in the United Kingdom (UK) was stable from 1966 to 1977, due to improved survival of premature infants (Pharoah et al. 1987). The dental status of cerebral palsied children (CP) in the UK was investigated by Swallow (1968), who found similar decay levels, fewer carious teeth restored, more extractions, and worse oral hygiene and gingival health in CP children compared with controls. Authors in the United States (Shmarak and Bernstein 1961; Album et al. 1964; Fishman et al. 1967) have described similar inferior dental health status and poorer levels of care in CP children. However, a recent study in Denmark (Nielson 1988) described lower caries experience in CP children than in controls, although the level of restorative care was not reported.

There are no dental health studies in the UK of CP children more recent than that of Swallow (1968). Data concerning the dental health of handicapped children

in general in the UK showed a similar prevalence of caries in handicapped children compared with controls in Birmingham and Newcastle, England (Maclaurin et al. 1985a; Nunn and Murray 1987). However, mirroring the findings of Swallow (1968), handicapped children received less restorative care, with more teeth unrestored or extracted than in control children. Handicapped children also had poor oral hygiene and gingival health (Maclaurin et al. 1985b; Nunn and Murray 1987).

Swallow (1987), reflecting on the inferior dental health of handicapped children in the 1980s, considered their relative position in the UK to have remained unchanged and disadvantaged over the previous 25 years, with regard to dental treatment received. The Court Report (1976), which investigated available child health services in the UK in the early 1970s, stated that the handicapped had special and largely unmet dental needs, and recommended that their dental care be brought up to and maintained at the level of that provided for other children. A recommendation was made that suitable training and encouragement should be available to dentists to work in this field. These recommendations apparently have not been implemented.

This study was designed to determine the extent and quality of dental care of CP children in the UK, and to ascertain whether their relative position had improved over the last 20 years with regard to dental care.

### Materials and Methods

Three groups of CP children — under 6 years old, 6 to 11 years old, and 11 years old and over — attending special schools in Leeds, England, were examined for dental caries, quality of restorations, plaque, gingivitis, dentures, tooth wear and orthodontic status. A control group of nonhandicapped children, matched for age, gender, race and social class was similarly examined at mainstream schools in Leeds. The study group was subdivided according to the presence or absence of mental handicap.

Dental caries was diagnosed using the method of

Radike (1972), modified to use a blunt probe. The type and quality of restorations were assessed using the criteria of Webster and Mink (1981), with restorations being given an overall rating per tooth, rather than per surface. Oral hygiene and gingivitis were assessed using the partial scoring modification described by Ramfjord (1967) of the method of L oe (1967).

Tooth wear was assessed for primary teeth for children under 6 years, and permanent teeth for children ages 11 years and over. A simplified form of the Tooth Wear Index of Smith and Knight (1984) was used, examining incisal/occlusal wear only, without attempting to define the etiology. A simple occlusal assessment was also carried out, for children ages 6 years and over, as described in the Children's Dental Health in the United Kingdom Survey (Todd and Dodd 1983). Personal details recorded were gender, date of birth, racial origin, social class, the presence of mental handicap and the type of cerebral palsy as ascertained from school nursing staff. A pilot study was carried out to ensure reproducibility of the diagnosis for caries, gingivitis and tooth wear by inter- and intra-reexamination of 20 children attending the Dental Hospital at Leeds during one day.

A dental health questionnaire was sent to parents of children examined to determine attitudes to dental health, the types of dental treatment received by their children, and the services utilized. Data were analyzed using the SurveyPlus package, produced by Providence Software Services, Bristol. Nonparametric statistical tests, including Mann-Whitney-U and Fisher's Exact Test were used to analyze dental data, while the Chi-square test was used to compare questionnaire responses between the two groups.

## Results

The study group comprised 150 children, 82 males and 68 females, ages 3.08 years to 18.16 years, the mean age being 10.25 years. The control group consisted of 191 children, 104 males and 87 females, ranging in age from 3.17 years to 16.25 years, with a mean age of 10.39 years. The two groups were well matched for race and social class. Spastic quadriplegia and spastic diplegia together affected more than 60% of the study group, of whom 18.7% were moderately and 46.7% severely mentally handicapped as judged by the medical practitioners attending the special schools of the children. The results of the study are presented in Tables 1 to 5, where the symbols mean for primary teeth: dt (decayed teeth), mt (missing teeth), ft (filled teeth), and for permanent teeth: DT (decayed teeth), MT (missing teeth) and FT (filled teeth).

The results for dental caries experience in the under-6-year age group are summarized in Table 1. Cerebral palsied children had statistically more unrestored teeth than the control group, yet had more unerupted and fewer sound teeth. Of the study group, 40.6% were caries free, compared with 65.7% controls. When mentally handicapped and nonmentally handicapped CP children were compared, those with mental handicap had fewer sound teeth ( $P < 0.05$ ).

The results for the 6-11 year age group are summarized in Table 2 (next page). Significantly more restored and sound permanent teeth and higher DMFT were seen in control children than in the study population, but more sound primary teeth were seen in the study group. Caries-free permanent teeth were seen in 90.7% of study children and 66.1% of controls, whereas for the primary dentition, the percentages were 42.6% and 35.5%, respectively. Comparison of study children with mental handicap with those without mental handicap showed no significant differences.

The results for the 11 years and over group are summarized in Table 3 (next page). Caries-free mouths existed in 27.7% of study and 22.1% of control children. Study children had more decayed and missing and fewer filled teeth, but no significant difference in DMF. Study children had more unerupted teeth, and those with mental handicap had more decayed and missing teeth than those

**Table 1. Comparison of decayed, missing and filled teeth in the primary dentition in study and control group children under 6 years of age**

		<i>N</i>	<i>Mean</i>	<i>Mann-Whitney-U (Z)</i>	<i>Significance</i>
<u>dt</u>	S	32	2.094	-2.083	*
	C	35	0.943		
<u>mt</u>	S	32	0.250	0.473	NS
	C	35	0.114		
<u>ft</u>	S	32	0.250	0.441	NS
	C	35	0.349		
<u>sound</u>	S	32	16.562	2.903	†
	C	35	18.457		
<u>dmft</u>	S	32	2.437	-1.896	NS
	C	35	1.400		
<u>ue</u>	S	32	0.531	-2.138	*
	C	25	0.000		

S Study Group  
ue Unerupted

NS Not significant  
† Significant at .01 level

C Control Group

\* Significant at .05 level

without mental handicap.

For eruption dates, there were statistically more unerupted primary teeth in the youngest group and more unerupted permanent teeth in the two older age bands in the study group. A highly significant difference existed in the eruption date of the lower first permanent molar, with control children in the 6 to 7.5 year age group having 1.64 and study children 0.5 lower first permanent molars present. The quality of restorations for the under 6 year group was the same for both groups. In the 6 to 11 year age group, no significant difference existed in restoration quality between the two groups in either dentition. However, study children 11 years and over had 78 amalgam and two composite restorations, compared with 207 amalgam and 10 composite restorations in the control group. A highly significant difference ( $P < 0.01$ ) existed in the quality of restorations ( $z = 4.299$ ). Restorations in study children were of inferior quality to those in control group subjects.

Examination results for plaque and gingivitis showed significantly more plaque in the study than control group at all ages, the differences being of greater statistical significance among older children. No significant difference existed between study children with and without mental handicap. Significantly worse gingival health was seen at all ages in study children. Gingival health was also worse in study children with mental handicap in the youngest group than in those with no mental handicap.

Higher levels of tooth wear were seen in study children than controls ( $P < 0.001$ ) for primary teeth ( $z = 16.1$ ) and permanent teeth ( $z = 15.9$ ). Percentages of teeth exhibiting each grade of tooth wear are depicted in Figs 1 and 2.

A significant difference existed in mean overjet between the study group (5.1 mm) and the control group (2.5 mm). In the 6–11 year age study group, the value was 5.2 mm, while in the control group 3.0 mm. ANOVA gave a  $t = 7.234$  for the older age group, and  $t = 4.073$  ( $P < 0.001$ ) for the 6 to 11 years group. An increased overjet

**Table 2. Comparison of decayed, missing and filled teeth in primary and permanent dentitions in the 6–11 year band in study and control groups**

		N	Mean	Mann-Whitney-U (Z)	Significance
<u>dt</u>	S	54	0.722	0.115	NS
	C	62	0.806		
<u>DT</u>	S	54	0.148	-0.022	NS
	C	62	0.097		
<u>mt</u>	S	54	0.630	-0.650	NS
	C	62	0.242		
<u>MT</u>	S	54	0.000	0.000	NS
	C	62	0.000		
<u>ft</u>	S	54	0.667	1.944	NS
	C	62	1.113		
<u>FT</u>	S	54	0.019	4.096	†
	C	62	0.500		
<u>sound</u>	S	54	11.037	-3.093	*
	C	62	7.935		
<u>SOUND</u>	S	54	8.685	3.712	†
	C	62	12.226		
<u>dmft</u>	S	54	2.037	0.962	NS
	C	62	2.210		
<u>DMFT</u>	S	54	0.167	3.102	*
	C	62	0.597		

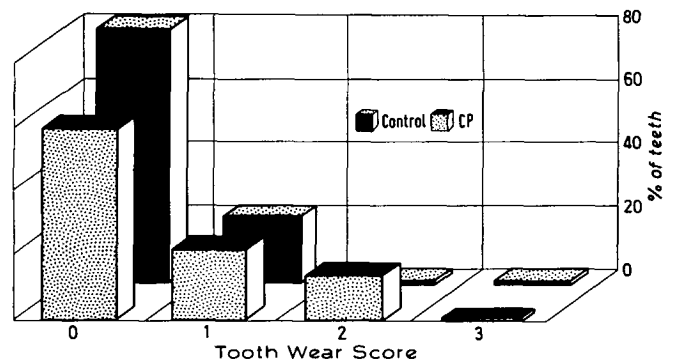
S Study Group

† Significant at .001 level

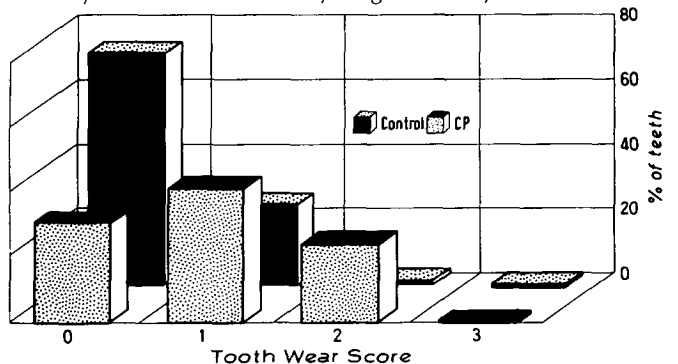
\* Significant at .01 level

NS Not significant

C Control Group



**Fig 1.** Comparison of tooth wear scores in the primary dentition in study and control children younger than 6 years old.



**Fig 2.** Comparison of tooth wear scores in the permanent dentition in study and control children aged 11 years and older.

**Table 3. Comparison of decayed, missing and filled teeth in the permanent dentition in the 11 years and over age group in study and control populations and in mentally handicapped and non mentally handicapped cerebral palsied children**

		N	Mean	(Z)		N	Mean	(Z)
<u>DT</u>	S	65	1.170		MH	50	1.400	
	C	95	0.663	-3.130 <sup>†</sup>	PH	15	0.400	-2.163*
<u>MT</u>	S	65	0.369		MH	50	0.480	
	C	95	0.126	-2.160*	PH	15	0.000	-1.967*
<u>FT</u>	S	65	1.231		MH	50	1.060	
	C	95	2.284	3.442 <sup>†</sup>	PH	15	1.800	1.182 NS
<u>SOUND</u>	S	65	20.846		MH	50	20.220	
	C	95	22.642	1.449 NS	PH	15	22.930	1.336 NS
<u>DMFT</u>	S	65	2.862		MH	50	3.040	
	C	95	3.084	1.111 NS	PH	15	2.267	-0.705 NS
<u>UE</u>	S	65	7.970		MH	50	8.360	
	C	95	5.923	-3.021 NS	PH	15	6.667	-0.529 NS

S Study Group NS Not significant C Control Group  
 \* Significant at .05 level UE Unerupted † Significant at .01 level  
 MH Mentally handicapped \* Significant at .001 level PH Nonmentally handicapped  
 Z Mann-Whitney-U Z value

requiring treatment was seen in 24.6% of study children ages 11 years and over and in 29.7% in the 6–11 years age group. Of the control group ages over 11 years, 4.2% were considered to have an overjet requiring treatment, together with 11.5% of the 6–11 year group. The difference was significant at the 0.1% level in the older group.

No significant difference existed in numbers of rotations, in standing upper incisors, edge-to-edge incisors or traumatic overbites. One study child and eight control children wore orthodontic appliances. Of the study group ages 11 years and over, 35.4% were considered to require orthodontic treatment, and 40.5% in the 6 to 11 years group, compared with 40% and 36.5% respectively in the control groups. The two principal features recorded as necessitating orthodontic treatment were crowding and increased overjet. Crowding requiring treatment was seen in 18.5% of study children ages 11 and over, and in 13.5% ages 6–11 years. The corresponding figures for the control groups were 36.8 and 30.8%.

A response rate of 70.6% was obtained for the questionnaires from study group parents, and 55.5% from controls. More control children had received a dental check-up ( $P < 0.05$ ), but no significant difference existed in attendance frequency, although 20.2% of study children only attended the dentist with problems, compared with 8.6% of controls. More study children were treated in a mobile dental clinic, or were taken by a teacher; more control children were taken by a parent or visited the dentist alone ( $P < 0.05$ ). The community dental service treated 35.2% of study children and 19.8% of controls. Respective figures for the general dental services

were 41.8 and 65.5%.

No differences existed in the number of parents reporting problems obtaining their child's treatment, in treatment types used under local and general anesthesia, nor in attitudes toward the importance of retaining natural teeth. No difference existed in the perceived benefits of toothbrushing, and 82% of parents believed that brushing prevented decay, and 61.5% that it kept gums healthy. Dental advice from a dentist for their child had been received by 70.7% of study and 87.1% of control parents. Advice included toothbrushing to 57.5% of each group's parents, dietary sugars to 18% of control and

20% of study parents, and fluoride use to 23% of study and 25% of control parents. Of the study group, 71.2% had their teeth brushed by a parent or helper, 27.3% brushed their own teeth and no one brushed the teeth of 1.5%. Among the control group, 19.3% had their teeth brushed by a parent, and 80.7% brushed their own teeth. These differences were significant ( $P < 0.001$ ). No statistical difference existed either in the number of falls damaging teeth or in the number of such teeth repaired.

## Discussion

Mentally handicapped study children had fewer sound teeth than those without mental handicap. Cerebral palsied (CP) children had more unrestored carious primary teeth, more unerupted teeth, fewer filled and more missing teeth. These findings in the primary dentition differ from those of Swallow (1968), who described fewer decayed, missing and filled teeth in CP children under 6 years old. This change may be due to the improved dental health seen over recent decades in the child population as a whole (Todd and Dodd 1985). Shmarak and Bernstein (1961), Magnusson and De Val (1963), and Fishman et al. (1967) described higher (but not significant) dmft values at this age in their study children.

When dmft and DMFT in the 6 to 11 years group were examined, higher DMFT, more filled and sound permanent teeth were seen in the control group, but more sound primary teeth and a higher percentage of caries-free permanent dentitions, and more unerupted permanent teeth in the study group. These results im-

ply later eruption in study children. Magnusson and De Val (1963) found no significant difference in def in the mixed dentition. Shmarak and Bernstein summed def and DMF and found higher decay experience levels in CP children. Swallow (1968) found lower dmf and DMF values in this age group in CP children, but they had a much lower number of filled teeth. Fishman et al. (1967) described very similar DMF values and components of DMF in CP children and siblings, but slightly higher def (not statistically significant) in the CP children.

There were significantly more decayed, missing and unerupted permanent teeth, and fewer filled teeth in the 11+ years study group. Mentally handicapped study children had significantly more decayed and missing teeth than those without mental handicap. Previous authors have described higher DMF in CP children of this age (Shmarak and Bernstein 1961). Swallow (1968) and Magnusson and De Val (1963) described similar DMF, but Swallow found far fewer fillings in the CP children. The findings of the present study echo Swallow's findings in the UK of 20 years ago, with no significant improvement in DMF, but indeed fewer fillings, more decayed and more missing teeth. The situation seems to have deteriorated even further from that described by Swallow.

In the present study, more decayed and extracted teeth were seen in mentally handicapped CP children than in those without mental handicap. However, recent evidence from Denmark (Nielsen 1988) for 14- and 15-year-old CP children showed lower mean DMFS scores and more caries-free mouths in CP children than controls. Nielson found that motor handicap was the best caries predictor. The evidence of the present study shows that the reverse situation exists in the U.K. for this age group. These findings of similar decay experience, but less restorative care mirror recent findings in handicapped children in other areas of the UK (Maclaurin et al. 1985a; Nunn and Murray 1987). It is clear that there has been no improvement in the dental care received by CP children in the last 20 years, and the quality of care actually may have worsened.

The data collected for dmf and DMF revealed significantly more unerupted primary teeth in CP children under 6 years old and permanent teeth in those ages 11 years and over. This disagrees with the findings of Swallow (1968), who found no significant difference. However the combined def-DMF score used by Shmarak and

**Table 4. Comparison of results of the examination for plaque in study and control groups**

Age	Group	N	Mean	Mann-W-U	Significance
Under 6	S	32	1.422		
	C	35	0.638	-2.513	*
6-11	S	54	1.160		
	C	62	0.392	-4.787	†
11 and over	S	65	2.722		
	C	95	0.610	-7.794	†

S Study Group

\* Significant at .05 level

C Control Group

† Significant at .001 level

Mann-W-U Mann-Whitney-U (Z)

Bernstein (1961) reached a minimum at age 10 for control children, but at age 13 for CP children. This implies that highly caries-prone primary teeth are present in CP children for longer. At age 11, the def-DMF was more than twice the value in CP children as controls. Data analyzed in the present study for the lower first permanent molar showed a significant delay of 1.5 years in its eruption in the study group. This possible late eruption of teeth in CP children merits further research, as prolonged life for the primary dentition necessitates vigorous preventive advice and high quality restorative care.

No significant difference existed in restoration quality in primary teeth, but few restorations were present. In the 11 years and over group, the control group had received considerably more restorations, and a significant difference existed in the quality of restorations present, with those in study children being of inferior quality to those in controls. A higher quality of work might have been achieved under general anesthesia or by a specially trained clinician. Bourke and Jago (1983) suggested that restorative work might be difficult to accomplish for CP children. Gurling et al. (1979) found that 52% of CP children received restorative work un-

**Table 5. Comparison of results of the examination for gingivitis in study and control groups and in mentally handicapped and non mentally handicapped study children**

Age	Group	N	Mean	Mann-W-U	Group	N	Mean	Mann-W-U
Under 6	S	32	1.104		MH	20	1.517	
	C	35	0.538	-1.881*	PH	12	0.416	-2.149*
6-11	S	54	1.046		MH	28	1.102	
	C	62	0.315	-4.941†	PH	26	0.987	-0.861 NS
11 and over	S	65	2.471		MH	50	2.625	
	C	95	0.538	-8.056†	PH	15	1.056	-0.717 NS

S Study Group

\* Significant at .05 level

C Control Group

† Significant at .01 level

MH Mentally handicapped

† Significant at .001 level

PH Non mentally handicapped

Mann-W-U Mann-Whitney-U (Z)

der general anesthesia, and Watson (1979) advised its use whenever uncontrolled movements occurred. It is apparent that a higher quality of dental care is required by the CP children of the UK.

Increasing discrepancy in oral hygiene with age between handicapped and nonhandicapped children was seen in the present study and has also been described by Maclaurin et al. (1986b), Murray and McLeod (1973), Noah (1982), and Brown and Schodel (1976). Fishman et al. (1967) described worse oral hygiene in CP children than in nonaffected siblings. Eisenfeld and Friedman (1953) recognized that dyskinetic movements might render good oral hygiene impossible, and Eisenberg (1976) and Kavanagh (1982) stressed the importance of assisted brushing for the CP child. Nevertheless, despite all previous work and recommendations to improve oral hygiene, it apparently still is difficult to maintain good oral hygiene in CP children.

The poorer gingival health in CP children mirrors recent findings in handicapped children in general (Maclaurin et al. 1985b; Nunn and Murray 1987). In the under-6-year age group, mentally handicapped CP children had more gingivitis than those without mental handicap, while the youngest CP children without mental handicap had less gingivitis than controls. These findings suggest that CP children are unable to brush their own teeth adequately, and require either modified or electric toothbrushes, or more assistance with brushing. More emphasis is needed on research to improve oral hygiene in handicapped people. For the age groups studied, significantly greater degrees of tooth wear (probably caused by bruxism) existed in CP children, despite their apparent delayed eruption. Tooth grinding was reported by many school staff. Bruxism existed in 38% of CP children and in 21% of their siblings (Fishman et al. 1967), as reported by others.

The simple orthodontic assessment carried out indicated that CP children, the majority of whom were affected by spasticity, had a higher prevalence of increased overjet and lower prevalence of crowding than controls. These findings are not in general agreement with previous studies and merit further detailed investigation. The finding of increased overjet may predispose the upper incisor teeth of the CP child to trauma. Shmarak and Bernstein (1961) found malocclusions in 58% of patients examined. Fishman et al. (1967) found a higher prevalence of handicapping malocclusions in older children than siblings. Isshiki (1968) stated that the prevalence of malocclusion did not differ markedly from the norm except in children with severe cerebral palsy.

Eisenfeld and Friedman (1953) suggested that athetoid CP children tended to develop increased overjet, due to tongue thrusting related to poor swallowing reflex. However, Isshiki (1968) found Class II Division I

malocclusion to be as common in spastic CP as in athetosis. The present study included only 11 patients with athetosis, but poor swallowing and other abnormal muscle activity may contribute to increased overjet.

Wessels (1960) considered that the prevalence and severity of malocclusion in CP children increased with age and the fact that the overjet was significantly higher in the older population of this study but not in the 6 to 11 year group, concurs with this. It has been suggested that CP children had significantly different skull and jaw dimensions compared with controls, which combined with abnormal muscular activity would result in severe malocclusion (Brown and Schodel 1976). Foster et al. (1974) demonstrated variable differences in skull dimensions in CP children compared with controls, with the most severely palsied children having the most abnormal and diminished skull dimensions.

The lack of difference in the number of falls damaging anterior teeth is surprising, when the increased overjet and prevalence of epilepsy in the study group are considered. However, restraints may be used in the child's wheelchair, rendering him less accident-prone.

The finding that fewer study than control children had visited a dentist for a check-up, and more study children only visited the dentist on an emergency basis, indicated that dental visits were easier to arrange and accomplish for the nonhandicapped child. Reliance on the public dental service rather than on private dentists was apparent in study children. The finding of no difference in difficulty in obtaining dental treatment disagrees with Bourke et al. (1983), but the parents in Bourke's study were eager for their children to receive treatment at school, a facility not available to them at that time.

Parental attitudes toward the importance of retaining natural teeth were similar between the two groups, despite less restorative care and more extractions in CP children. Fewer study parents had received dietary and fluoride advice. This may be related to use of the community (public) dental service by the study group, with dental visits being organized by schools, and the parent not receiving advice from dental staff. Most study children had their teeth brushed by school staff, but this was frequently less adequate than control children's self-brushing. The parents of CP children were satisfied with the dental treatment given to their child and were unaware that their children received any different type or quality of treatment from control children. There were no comments, such as those quoted by Kenny and McKim (1971) that dentists were not interested in treating CP children. On the contrary, most parents praised the quality of their child's care.

The results of this study indicate that a need still exists for better specialist care for CP children, so that their dental health may be "brought up to and main-

tained at the level of that provided for other children," as was recommended 13 years ago by the Court Report to the British Government in 1976. Virtually no progress seems to have been made in the past 20 years to improve the dental care of CP children.

## Conclusions

1. Dental caries levels did not differ significantly between CP children and controls, but the fate of carious teeth was significantly different. CP children were less likely to receive restorative care, and more likely to have carious teeth extracted. Restorative care received by the study group was inferior to that received by the control group.
2. Unerupted primary and permanent teeth were more common in CP children, and the first permanent molar erupted significantly later. More tooth wear existed in primary and permanent dentitions in the study group. The study group had significantly higher overjet and less crowding than the control group.
3. Significantly higher levels of plaque and gingivitis existed in the study group at all ages.
4. Fewer study children visited the dentist for check-ups. The community dental service was used by more study children than controls.

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