

The Comparison of Malocclusion Prevalence Between Children with Cerebral Palsy and Healthy Children

Danko Bakarčić¹, Vlatka Lajnert², Barbara Mady Maričić³, Nataša Ivančić Jokić¹, Zlatka Rokсандić Vrančić⁴, Renata Gržić² and Igor Prpić⁵

¹ University of Rijeka, School of Medicine, Department of Pediatric Dentistry, Rijeka, Croatia

² University of Rijeka, School of Medicine, Department of Prosthodontics, Rijeka, Croatia

³ Private practice, Rijeka, Croatia

⁴ Private practice, Karlovac, Croatia

⁵ University of Rijeka, School of Medicine, Department of Pediatrics, Rijeka, Croatia

ABSTRACT

This study sets out to examine the prevalence of malocclusion and habits in a group of children with cerebral palsy and to compare it with a control group of healthy children. The presence of an anterior open bite was statistically significantly higher in the cerebral palsied group. The presence of a posterior crossbite was not significantly different between the examined groups, as was the case for a lingual crossbite. The occurrence of visceral swallowing, incompetent lips and oral respiration was significantly higher in the cerebral palsied group. The current study cannot satisfactorily sustain the issue of a higher prevalence of posterior and lingual crossbite in children with cerebral palsy because of no significant differences between groups, but it certainly can for an anterior openbite. The present study also adds to the evidence that there is an increased prevalence of oral breathing, visceral swallowing and lip incompetence in children with cerebral palsy.

Key words: children, cerebral palsy, malocclusion, habits, prevalence

Introduction

Cerebral palsy (CP), a range of non-progressive syndromes of posture and motor impairment, is a common cause of disability in childhood. The disorder results from various injuries to different areas within the developing nervous system, which partly explains the variability of clinical findings. The prevalence of CP in children is 2–4 per 1,000 children¹. Approximately 5–10% of cases can be ascribed to perinatal hypoxia, but the vast majority of cases are caused by the interplay of several risk factors and antenatal, perinatal, and neonatal events. The strongest risk factors include prematurity and low birth weight².

CP results from an injury to the developing central nervous system. Injury to upper motor neurones decreases cortical input to the reticulospinal and corticospinal tracts, which in turn affects motor control, decreases the number of effective motor units and produces abnormal muscle control and weakness. Classical symptoms are

spasticity, spasm, other involuntary movements (e.g. facial gestures), unsteady gait, problems with balance, and/or soft tissue findings consisting largely of decreased muscle mass^{1–3}.

Regarding the prevalence of malocclusion in children with CP, there are very different and conflicting reports. Some not so recent authors (Gum, Miller, Rosenbaum and Magnusson) have found the prevalence of malocclusion to be within the limits of children without CP^{4–7}. Recently, a higher frequency of malocclusion in a group of children with CP has been reported by different authors^{8–10}.

The assumption is that the function and tone of the muscles in the orofacial region in children with CP can be abnormal, so the facial growth and occlusion may be altered^{8–10}.

This study therefore sets out to examine the prevalence of malocclusion and habits in a group of children with CP and to compare it with a control group of healthy children.

Materials and Methods

Subjects

Fortythree children with CP, 28 boys and 15 girls from 6 to 16 years of age, were included in the study. All of them suffered from quadriplegic CP. All of the children lived with their families. During their parent's working hours, they were residents of day-care centres for disabled children or special schools.

The criterion for inclusion was the presence of CP in our examinees. Children were only included in the study if their first permanent molars, upper permanent central incisors and all permanent lower incisors had erupted, and if they had never knowingly had orthodontic treatment, and if they (or their guardians) claimed they did not suck their thumb.

The same inclusion criteria (except CP) were followed for the control group of healthy children, which was formed from children attending the Department of Paediatric Dentistry at the University Dental Clinic of Rijeka. The children were selected to match the age and gender of children in the examined group – thus the control group also had 43 children. This was done so that when all children in the group of CP children were examined, their data of age and gender were followed as main criteria for inclusion in the study. When these criteria was satisfied other inclusion criteria were checked and when they all corresponded to default criteria the children were included in the study.

The study's importance was explained to the children's parents/guardians, who were then asked to sign an Informed Consent form agreeing to the child's participation in the study. A clinical examination was performed and the children's teeth impressions were taken.

The research was reviewed and approved by the Ethical Committee of the Faculty of Medicine, University of Rijeka, Croatia.

Motor and topographical classification was used to identify the type of CP of each child. The children were diagnosed as spastic with most of them having spastic hemiplegia and quadriplegia. Neither spastic diplegic, athetoid, hypotonic, nor ataxic types of CP were found among the examinees in this study.

Presence of malocclusions and habits

The presence of malocclusions was established with dental clinical examination and occlusion analysis.

Alginate impressions of the upper and lower arches of all children included in the study were taken. Study models were constructed with the aid of a wax bite. The diagnosis was made according to plaster study models obtained from the impressions. Study models were placed in occlusion and various measurements were made using a metal ruler and a vernier caliper.

The following were recorded in the intercuspitation: anterior open bite, posterior crossbite, lingual crossbite or posterior open bite.

Anterior open bite (presence or absence): an anterior open bite was recorded as being present if the lower incisors were not overlapped in the vertical plane by the upper incisors, and did not occlude with them.

Posterior crossbite: a posterior crossbite was recorded as being present if the buccal cusps of the lower first permanent molars occluded outside the buccal cusps of the upper first permanent molars.

A lingual crossbite was included in this study if the buccal surface of the lower first permanent molars occluded with the palatal surface of the upper first permanent molars¹¹.

A posterior open bite was recorded as being present if the lower lateral teeth were not overlapped in the vertical plane by the upper, and did not occlude with them.

Occlusion was recorded according to Angle classification¹².

Oral breathing was shown by water vapour condensing on the surface of a mirror placed outside the mouth. The cause of oral breathing was not established.

Abnormal swallowing was defined for this study as swallowing without the posterior teeth in occlusion. Clinical observations were used to determine the presence or absence of the visceral swallowing pattern. By holding the fingertips in the area of the temporalis muscle, it could be determined if contraction occurred during swallowing. Another method involved placing the fingertips on the masseter muscle during swallowing. At the same time, the thumbs were used to retract the lower lip to allow a visual check of the occlusion of the posterior teeth.

Lip competence was assessed by direct observation of the lips of the children using the Ballard method. If the mandible was in the physiological resting posture and the lips were in apposition without contraction of the orbicularis oris and mentalis muscles, the lips were competent. If the child had to contract the orbicularis oris and mentalis muscles vigorously in order to close the lips, the lips were recorded as being incompetent¹³.

Statistics

Statistical analysis was made by personal computer using the statistical programme SPSS ver. 10 (SPSS, Inc., Chicago, USA).

The percentage of presence of each malocclusion and habits in the CP group and the control group were calculated. The presence of malocclusion and the habits in the two groups were compared using Fischer's exact test. A statistically significant difference was estimated on the level of $p < 0.05$.

Results

The anterior open bite, posterior crossbite and lingual crossbite are compared in Table 1.

Statistically, the anterior open bite was significantly higher in the CP group ($p = 0.007$). The presence of a pos-

terior crossbite was not significantly different between the examined groups, as with the presence of a lingual crossbite.

The Angle's classification of molar relationship is compared in Table 2.

No significant difference in the Angle's classification of molar and cuspid relationship measurements was detected between the two groups.

The habits are compared in Table 3.

Oral breathing, visceral swallowing and the presence of incompetent lips were significantly higher in the CP group ($p=0.001$).

Discussion and Conclusion

The present study adds to the evidence that there is an increased prevalence of certain malocclusion in children with CP. Children with CP often have an anterior open

bite^{8,11,14}. Many authors show data that children with CP have a larger frequency of sagittal, vertical and transversal malocclusions because of the disbalance between perioral and intraoral muscles^{8,15–18}. This disbalance causes the development of open bite, lingual crossbite and posterior crossbite^{10,19–22}. Browsing the literature, we became aware that our finding of an increased anterior open bite in children with CP corresponds with the work of many recent authors such as Mitsea, Gonzales, Franklin or Carmagnani, but it also contradicts some older studies, such as those of Magnusson and Rosenbaum who found that overbite in children with CP is no different than in healthy children. However, their articles were published 30–40 years ago^{6–8,11,14}. One can conclude that recent literature generally suggests that malocclusion (especially the open bite) is not equally present in healthy children and children with CP.

Anterior open bite is a common dentoalveolar component of the craniofacial pattern in patients with an increased

TABLE 1
COMPARISON OF ANTERIOR OPEN BITE, POSTERIOR CROSSBITE AND LINGUAL CROSSBITE

	CP group		control group		p
	N	%	N	%	
Malocclusion					
Anterior open bite	10	23	1	2	0.007
Posterior open bite	2	5	0	0	0.494
Lingual crossbite	1	2	0	0	0.500

$p<0.05$, CP – cerebral palsy, N – number

TABLE 2
COMPARISON OF CLASSES ACCORDING TO ANGLE'S CLASSIFICATION

Classes	CP group		control group		p
	N	%	N	%	
Class I	12	28	18	42	0.258
Class II/1	27	63	16	37	0.030
Class II/2	3	7	7	16	0.313
Class III	1	2	2	5	0.500

$p<0.05$, CP – cerebral palsy, N – number

TABLE 3
COMPARISON OF HABITS AND LIP COMPETENCE

	CP group		control group		p
	N	%	N	%	
Oral respiration	39	91	3	7	<0.001
Abnormal swallowing	16	37	0	0	<0.001
Lip competence	2	5	39	91	<0.001

$p<0.05$, CP – cerebral palsy, N – number

vertical dimension (also known as facial hyperdivergence or high-angle facial pattern)²³⁻²⁵. A series of pathogenetic factors (abnormal tongue posture, tongue thrust, and overall sucking habits) can be associated with the formation or maintenance of anterior open bite in hyperdivergent patients during growth^{26,27}. However, such finding might be expected in association with an increased overjet²⁸.

The current study cannot sustain this issue regarding posterior and lingual crossbite satisfactorily because of no significant differences between the groups, but it certainly can for anterior open bite. The present study also adds to the evidence that there is an increased prevalence of oral breathing, visceral swallowing and lip incompetence

in children with CP, similar to that recorded by Rodrigues dos Santos²⁹ and Winter³⁰.

In this study clinical examination and analysis of occlusion established that an anterior open bite has a higher level in the children with CP than in the healthy children. Oral breathing, visceral swallowing and lips incompetence were present significant more often in patients with CP. Posterior and lingual crossbite are not frequently present in the children with CP.

This study has not compared children with CP and a mental handicap with those with no mental handicap due to the small size of the sub-groups but certainly this is a recommendation for further investigation.

REFERENCES

1. KOMAN AL, PATERSON SMITH B, SHLIT JS, *The Lancet*, 363 (2004) 1619. DOI: 10.1016/S0140-6736(08)61060-0. — 2. LAWSON RD, BADAWIN, *Hand Clin*, 19 (2003) 547. — 3. SHEVELL MI, MAJNEMER A, MORINI, *Pediatr Neurol*, 28 (2003) 352. — 4. GUM SW, *Am J Orthod*, 48 (1962) 66. — 5. MILLER JB, TAYLOR PP, ASDC, *J Dent Child*, 5437 (1970) 331. — 6. MAGNUSSON B, *Odontol Revy*, 15 (1964) 41. — 7. ROSENBAUM CH, MCDONALD RE, LEVITT EE, *J Dent Res*, 45 (1966) 1696. — 8. MITSEA AG, KARIDIS AG, DONTA-BAKOYIANNI C, SPYROPOULOS ND, *J Clin Pediatr Dent*, 26 (2001) 111. — 9. HARRIS D, *Emerg Med J*, 23 (2006) 4. DOI: 10.1016/j.annemergmed.2008.06.161. — 10. STRODEL BJ, ASDC, *J Dent Child*, 54 (1987) 255. — 11. GONZALEZ RODRIGUEZ E, TRAVESI GOMEZ J, OSTOS GARRIDO MJ, *Av Odontostomatol*, 6 (1990) 270. — 12. ANGLE EH, *Classification of malocclusion*, *Dent Cos*, 41 (1899) 248. — 13. BALLARD CF, *Transactions of the European Orthodontic Society*, (1953) 143. — 14. FRANKLIN DL, LUTHER F, CURZON MEJ, *Eur J Orthod*, 18 (1996) 637. — 15. KOCH G, POULSEN S, *Pediatric dentistry – a clinical approach* (Munksgaard, Copenhagen, 2001). — 16. BAKARCIC D, LEGOVIC A, SKRINJARIC T, MADY B, SASSO A, VANCURA I, *Stomatologija*, (Mosk) 85 (2006) 57. — 17. ORELAND A, HEIJBEL J, JAGELL S, *Swed Dent J*, 11 (1987) 103. — 18. DINESH RB, ARNITHA HM, MUNSHI AK, *Int Dent J*, 53 (2003) 13. — 19. GAVIAO MB, RAYMUNDO VG, SOBRINHO LC, *Pediatr Dent*, 23 (2001) 499. — 20. SOH J, SANDHAM A, *Angle Orthod*, 74 (2004) 769. — 21. TATE GS, THROCKMORTON GS, ELLIS E, SINN DP, *J Oral Maxillofac Surg*, 52 (1994) 476. — 22. HENRIKSON T, EKBERG EC, NILNER M, *J Prosthodont*, 11 (1998) 125. — 23. PROFFIT WR, *The development of vertical dentofacial problems: concepts from recent human studies*. In: MCNAMARA JA (Ed) *The Enigma of the Vertical Dimension* (The University of Michigan, Ann Arbor, 2000). — 24. PROFFIT WR, BAILEY LJ, PHILLIPS C, TURVEY TA, *Angle Orthod*, 70 (2000) 112. — 25. BUSCHANG P, SANKEY W, ENGLISH JD, *Semin Orthod*, 8 (2002) 130. — 26. GRABER TM, RAKOSI T, PETROVIC A, *Dentofacial Orthopedics with Functional Appliances* (St Louis, Mosby, 1997). — 27. MCNAMARA JA JR, BRUDON WL, *Orthodontics and Dentofacial Orthopedics* (Needham Press, Ann Arbor, 2001). — 28. HOUSTON WJB, STEPHENS CD, TULLEY WJ, *A textbook of orthodontics*, 2nd ed (Butterworth-Heinemann Ltd, Oxford, 1992). — 29. RODRIGUES DOS SANTOS MT, MASIERO D, NOVO NF, SIMIONATO MR, *J Dent Child*, (Chic) 70 (2003) 40. — 30. WINTER K, BACCAGLINI L, TOMAR S, *Spec Care Dentist*, 28 (2008) 19.

Z. Roksandić Vrančić

Private Practice, Lušičić 6A/1, 47 000 Karlovac, Croatia

e-mail: zlatka@optinet.hr

USPOREDBA PREVALENCIJE MALOKLUZIJA I NEPOŽELJNIH NAVIKA IZMEĐU DJECE S CEREBRALNOM PARALIZOM I ZDRAVE DJECE

SAŽETAK

Ovom studijom pokušalo se istražiti prevalenciju malokluzija i nepoželjnih navika u skupini djece s cerebralnom paralizom te ju usporediti s onom kod zdrave djece. Prevalencija prednjeg otvorenog zagrizava bila je statistički značajnija u skupini djece s cerebralnom paralizom. Prevalencija stražnjeg križnog zagrizava nije statistički značajno odudarala od kontrolne skupine kao ni kod škarastog zagrizava. Pojava visceralnog gutanja, inkompetentnih usana i oralnog disanja bila je značajno veća kod djece s cerebralnom paralizom. Ova studija ne može zadovoljavajuće poduprijeti saznanja o višoj prevalenciji stražnjeg križnog i škarastog zagrizava u djece s cerebralnom paralizom zbog nepostojanja statistički značajne razlike, ali otvorenog zagrizava svakako da. Također potvrđuje i nalaze veće prevalencije visceralnog gutanja, inkompetentnih usana i oralnog disanja u djece s cerebralnom paralizom.