

# We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index  
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?  
Contact [book.department@intechopen.com](mailto:book.department@intechopen.com)

Numbers displayed above are based on latest data collected.  
For more information visit [www.intechopen.com](http://www.intechopen.com)



---

# Orthodontic Treatment in Children with Cerebral Palsy

---

María Teresa Abeleira, Mercedes Outumuro,  
Marcio Diniz, Lucía García-Caballero, Pedro Diz and  
Jacobo Limeres

Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/64639>

---

## Abstract

Cerebral palsy is a permanent neuromuscular motor disorder that gives rise to many functional problems, including impaired swallowing, chewing and speech. Maxillary transverse deficiency and Angle Class II malocclusion are common. Some of these functional problems can be due to maxillary malocclusion. To our knowledge, no case series has yet been published on orthodontic treatment in children with cerebral palsy. In this chapter, we provide an overview of this topic based on the literature and on our own clinical experience. We consider that some patients with cerebral palsy are susceptible to orthodontic treatment. The keys to success are appropriate patient selection, based on anatomical, physiological and behavioural characteristics, and the degree of involvement of parents and caregivers. Among parents of cerebral palsy children undergoing orthodontic therapy, the perceived level of overall satisfaction was very high and expectations were often exceeded; however, these results are conditioned by factors such as the Peer Assessment Rating (PAR) index. Although some authors reported improvements in aesthetics, speech and oral function, an objective assessment of functional improvement is still lacking. In our experience, correction of resting position and management of neuromuscular alterations are essential if successful orthodontic treatment is to be achieved and relapses avoided.

**Keywords:** cerebral palsy, malocclusion, orthodontic treatment, oral function, special care dentistry

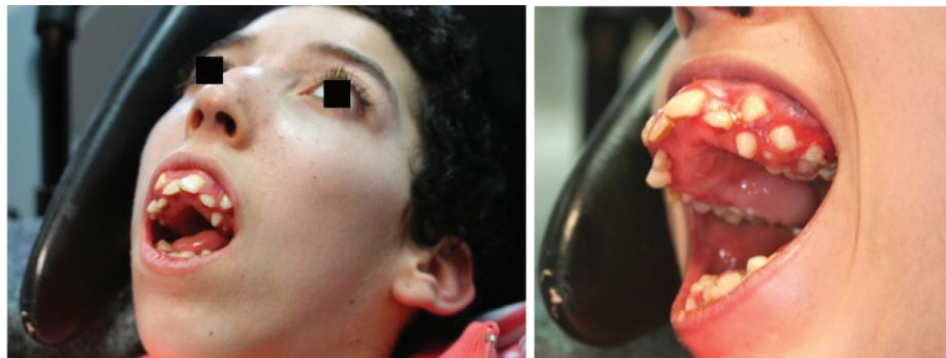
---

## 1. Introduction

Cerebral palsy (CP) carries a significant morbidity and has a limited life expectancy [1]. We should therefore ask ourselves the following question: Are these patients susceptible to

---

orthodontic treatment? The main indication for orthodontic treatment is dental malocclusion. In 1956, Lyons [2] had already suggested that CP had effects on dentofacial development and, in particular, on tooth occlusion (to facilitate comprehension, a glossary of orthodontic terms has been included at the end of the chapter [Box 1]). The most common malocclusions described in CP patients are overjet and overbite, which have significantly higher prevalences in these patients than in healthy controls matched for sex and race [3]. Overjet  $\geq 4$  mm has been reported in around 70% of spastic CP children and anterior open bite  $\geq 2$  mm in up to 90% of cases [4]. Compared with other physical disabilities, there is a particularly high prevalence of open bite in CP; it is estimated that children diagnosed with CP have a threefold greater chance of having open bite than children with other special needs [5]. Paradoxically, when anteroposterior malocclusion is analysed, the prevalence of Angle Class I (normo-occlusion) in patients with CP is higher than in the general population [3]. However, malocclusion in the vertical plane provokes marked functional alterations that, in some cases, could justify performing orthopaedic-orthodontic treatment (**Figure 1**).



**Figure 1.** Severe open bite and oral functional impairment in a spastic cerebral palsy patient.

## 2. Severity of malocclusion

A study carried out in Minas Gerais in Brazil, with the participation of 60 spastic CP children and 60 age-matched controls, showed that some orofacial alterations with functional repercussions were more common in CP children than in the controls: severe lip incompetence was 2.8 times more common, mouth breathing 4.8 times more common and long facies 5.4 times more common [4]. Unfortunately, oral functionality is often left as a secondary issue when discussing the need for orthodontic treatment and many dental practitioners focus treatment on cosmetic objectives. The index most widely used for this purpose is the Dental Aesthetic Index (DAI), published 30 years ago by investigators in the University of Iowa. That index gives us the following classification for malocclusion: mild or absent (DAI score  $<25$ ), defined (DAI = 26–30), severe (DAI = 31–35) and very severe or debilitating (DAI  $>35$ ) [6]. ‘Severe’ and ‘very severe’ malocclusions (DAI  $\geq 31$ ) are usually considered susceptible to orthodontic correction from a cosmetic point of view [6]. In a study of 44 CP patients of 12–59 years of age performed in Spain, significant differences were observed in the DAI scores for lip incompe-

tence and mouth breathing compared with healthy controls [7]. In that series, resting head position also affected the DAI score; the highest scores were observed in patients with absent resting heading position control, followed by those who held their head permanently in flexion, those who held their head in hyperextension and, finally, those with a resting head position in a vertical axis [7].

A relevant issue is whether CP patients with associated mental disability have a less favourable facial phenotype than those with an intellectual coefficient in the normal range (**Figure 2**). On this subject, a study performed in Leeds, in the United Kingdom, found significantly greater overjet in CP with mental disability (mean of 8.3 versus 5.5 mm) as well as a higher frequency of Angle Class II division 1 (Class II-1) malocclusion (75% versus 36%) [3].



**Figure 2.** Cerebral palsy is a physical disability and many patients have a normal intelligence.

### 3. Orthodontic management

No large series of CP patients undergoing orthodontic treatment has been published in the literature, with the exception of a group of 62 adult CP individuals living in Bad Oeynhausen in Bielefeld, Germany; 32% of the patients aged between 18 and 36 years had worn orthodontic appliances, whereas none of the 31 patients aged over 36 years had received treatment. A possible interpretation of such a difference is that it could have been due to the individual initiative of a single dental practitioner or group of practitioners, and the results should therefore be extrapolated with a degree of caution [8]. It has been suggested that the aims of orthodontic treatment in patients with disabilities should focus on optimal aesthetic

improvement and enhanced social acceptance, taking into account that an ‘ideal’ treatment may not be possible [9]. In a review of the literature, we found no studies or case reports that explored the benefits and effects of functional or fixed orthodontic appliance therapy in children with CP [10].

The following basic requirements need to be satisfied when considering orthodontic treatment in children with disabilities: the commitment of the patient and of the parents/carers, adequate oral hygiene, the degree of patient collaboration (behaviour management) and manual dexterity [11]. The criteria for patient selection are detailed in **Table 1**.

• Medical condition
• Malocclusion
• Aesthetic assessment
• Parent/carers commitment
• Child’s tolerance to treatment
• Oral hygiene
• Risk/benefit ratio

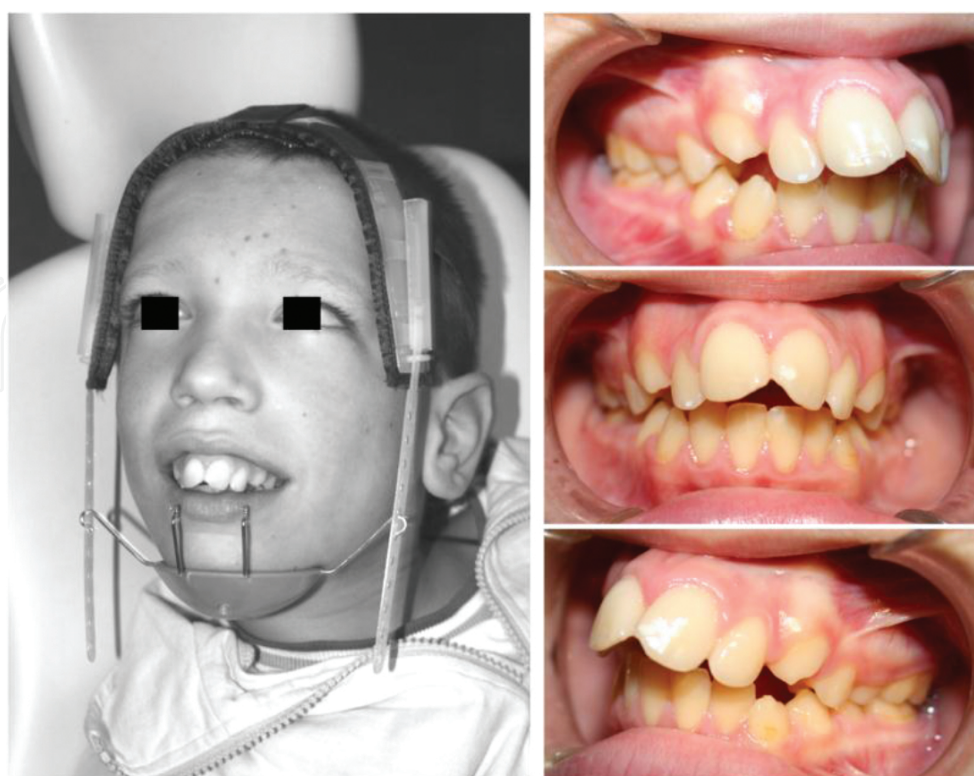
**Table 1.** Selection criteria for patients with severe disabilities who are candidates for orthodontic treatment (modified from [9]).

• Impressions using quick-set materials
• Easy bonding of brackets
• Self-etching primer
• Advanced memory wires
• Self-ligating brackets
• Oral functionality
• Advances in orthognathic surgery
• Reversible mini-implant anchorage

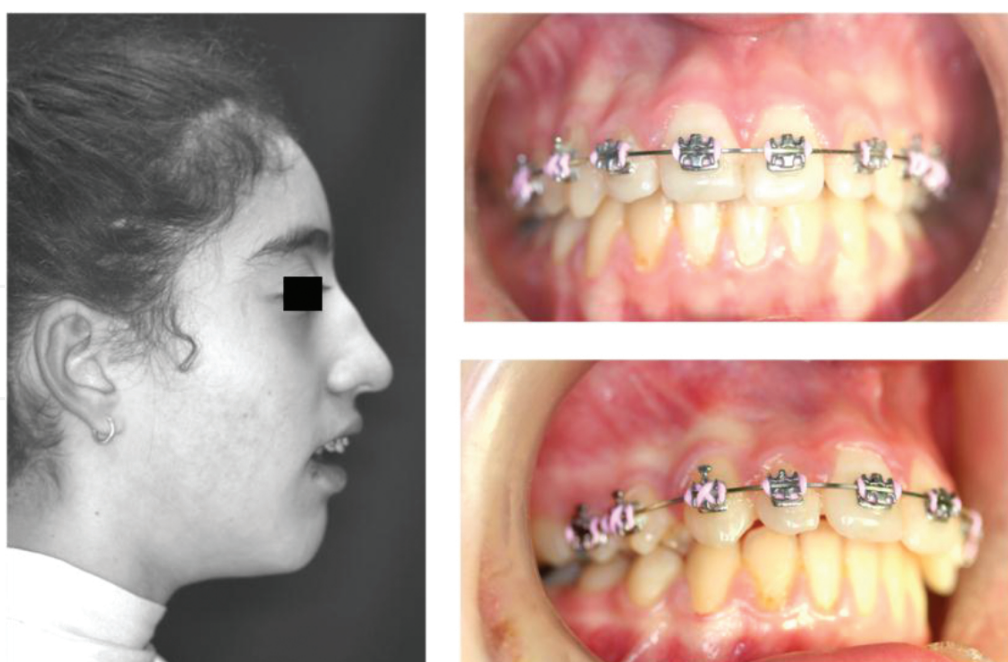
**Table 2.** Technological innovations for dental patients with disabilities (modified with permission from Becker and Shapira [11]).

Certain technological improvements in dentistry in recent years could benefit disabled dental patients in general, including CP patients receiving orthodontic treatment [12] (**Table 2**). These technical innovations and the creation of multidisciplinary teams have made it possible to undertake orthodontic treatment in CP patients with extra-oral appliances (**Figure 3**), fixed multi-bracket appliances (**Figure 4**) and even complex orthodontic treatments and orthognathic surgery (**Figure 5**).

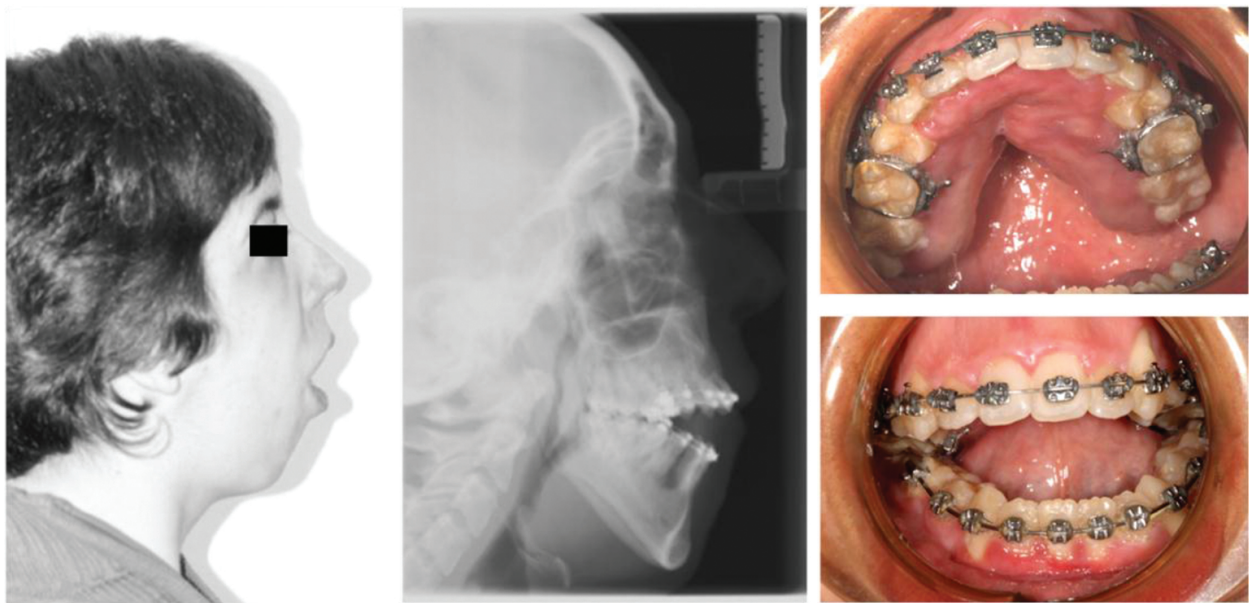




**Figure 3.** Cerebral palsy patient with severe Class II-1 malocclusion. Initial phase of orthodontic treatment with a face mask.



**Figure 4.** Cerebral palsy patient with Class II-1 malocclusion treated with fixed multi-bracket appliances.



**Figure 5.** Cerebral palsy patient with open bite treated using fixed multi-bracket appliances before undergoing orthognathic surgery.

#### 4. Identifying success criteria

Evaluation of the results of orthodontic treatment as successful or unsuccessful requires more than simply quantifying the aesthetic improvement. Parameters such as oral functionality, quality of life and, very importantly, relapse rates must also be taken into account.

In 2014, Işcan et al. [10] published a case report of a 12-year-old girl with ataxic CP who had Class II malocclusion, maxillary transverse deficiency and severe crowding. Treatment consisted of maxillary expansion with simultaneous functional therapy, fixed multi-bracket appliances and a vertical chin cup. The authors reported that acceptable occlusion, improvements in swallowing, speech and drooling, better masticatory muscle activity and a reduction in problems of impaired chewing were achieved [10]. That study demonstrated the need to develop tools able to quantify oral functional deficits—similar to the tools used to quantify cosmetic appearance, such as the Dental Aesthetic Index—to provide an objective assessment of the functional improvements accomplished by orthodontic treatment.

A survey of satisfaction and the appreciation of improvements answered by the parents of disabled children—including CP children—who underwent orthodontic treatment made the following findings: results exceeded expectations in 42% of cases, the reaction of friends and relatives was defined as ‘they got excited’ in 54% of cases, there was a very marked improvement in patient daily activities in 81% of cases, and the child’s social life improved significantly according to 45% of respondents [13]. An analysis of the benefits of orthodontic treatment as perceived by the parents of disabled children reported that improvement in quality of life was a response given by 83% of surveyed parents, improvement in social acceptance in 78% of

cases and improvement in social integration in 71% of cases. Interestingly, when asked about their desire to enhance dental and facial appearance, only 68% of participants answered 'a lot' and 20% 'a little' [13].

We have found no published studies designed specifically to address the issue of improvement in the quality of life of CP children following orthodontic treatment. In a study performed in Sao Paulo, Brazil, in which the parents of 60 CP children aged 6–14 years were interviewed, it was found that the Child Oral Health-Related Quality of Life Questionnaire (COHRQoL) score was not affected by the presence of malocclusion, dental injuries or dental fluorosis, but, in contrast, there was a significant correlation with a history of dental caries, bruxism and family income [14].

## 5. Follow-up and relapse prevention

Regular dental check-ups are mandatory in patients with CP because they are more prone to oral health problems related to enamel hypoplasia, pasty food intake, difficulty in maintaining good oral hygiene, drug-induced gingival hyperplasia and periodontal disease [4]. Consequently, parents and caregivers have to receive oral hygiene and diet instructions to avoid carious lesions, and patient will receive professional scaling at regular intervals before, during and after orthodontic treatment, to avoid periodontal disease [15].



**Figure 6.** Cerebral palsy patient with severe scoliosis that altered the resting position and affected the occlusal pattern (unilateral open bite).



In an article published in 1927 by Stillwell [16], it was suggested that malocclusion and scoliosis affected posture and that this was a two-way relationship, in that alterations of posture also had repercussions on the teeth and the spine. This factor is probably often underestimated by health professionals, and it needs to be taken into account to be able to assess the risk of relapse. The relationship between malocclusion and vertebral alignment was demonstrated in an experimental model in animals (rats), in which the application of resin to induce unilateral premature tooth contact provoked iatrogenic scoliosis within a few weeks; this alteration was reversible when natural occlusal contact was restored [17]. This relationship is so strong that it has been suggested that the detection of hereditary malocclusions in young children 'allows the identification of a group of children who have a high risk of developing scoliosis in later years' [18]. In a systematic review published in 2011, it was concluded that there is plausible evidence for an increased prevalence of unilateral Angle Class II malocclusions associated with scoliosis and an increased risk of lateral crossbite and midline deviation in children affected by scoliosis [19] (**Figure 6**).



**Figure 7.** Cerebral palsy patient with open bite relapse after treatment with fixed multi-bracket appliances and orthognathic surgery.

Although the routine use of specific braces to stabilise the spine in CP children was initiated in the second half of the nineteenth century, certain improvements have been made to the modern versions of these braces. Probably the most popular model is the Milwaukee brace, whose effect on dentofacial growth has been described in detail, particularly with regard to

abnormal proclination of the upper and lower incisor teeth [20]. Descriptions of cases of orthodontic treatment for malocclusion associated with scoliosis (mainly overjet) have also been published [21].

All these contributions indirectly confirm not only the close two-way relationship between resting position and malocclusion but also introduce a new conditioning factor, neuromuscular alterations, particularly relevant when muscle hypertonicity or spasticity is present. In our experience, these three factors are the principal determinants of relapse, and orthodontic treatment in patients with CP should not be initiated without first evaluating muscle tone and resting position. To illustrate this proposal, we only have to look at the case described by İşcan et al. [10] that we commented above. Their patient presented a certain degree of unilateral posterior open bite in the follow-up photographs. Relapse, even if less severe than the initial occlusal situation, can overshadow the success of a complex treatment, such as in the patient shown in **Figure 5**. After prolonged orthodontic treatment with fixed multi-bracket appliances and bimaxillary orthognathic surgery, that patient developed a relapse with unilateral open bite and marked gingival retraction secondary to muscle hypertonicity (**Figure 7**).

Spasticity of masseter and temporalis muscles causes hypertonia—spastic hypertonia—that aggravates the mandibular malposition (mandible is usually located in a retrograde and posteriorly rotated position) and may promote relapses after orthodontic treatment. It has been shown that intramuscularly injected botulinum toxin type A significantly decreases muscle spasticity [22], which hypothetically may help to prevent relapse in selected cases.

## 6. Conclusions

Orthodontic treatment is feasible in CP children after careful patient selection, taking into account that success depends not only on obvious factors, such as the type and severity of malocclusion and the degree of patient collaboration, but also on resting position and neuromuscular disturbances. The objective assessment of treatment success requires the application of tools that quantitatively evaluate improvements in the domains of aesthetic appearance, oral functionality and quality of life. Unconventional treatment plans have to be chosen at times, and parents must be thoroughly informed to avoid inappropriate expectations.

---

### Box 1. Glossary of orthodontic terms

**Angle's classification system:** A method used to classify different types of malocclusion, based on the mesiodistal relationship of the permanent molars on their eruption and locking.

**Bracket:** A metal, plastic or ceramic element that is glued onto a tooth and that holds a metal wire called an arch wire; this system produces or guides orthodontic tooth movement.

**Class I:** A malocclusion where the upper teeth line up with your bottom teeth (but the teeth are crooked, crowded or turned).

Class II: A malocclusion where the upper teeth protrude beyond the lower teeth. This is also called 'overbite' or 'buck teeth'.

Class III: A malocclusion in which the lower teeth protrude beyond the upper teeth.

Crossbite: A malocclusion in which some of the upper teeth are inside of the lower teeth when the jaws are closed.

Crowding: An orthodontic problem caused by insufficient space for the teeth.

Fixed appliance: An orthodontic component that is cemented or bonded to the teeth.

Malocclusion: A poor alignment of the upper and lower teeth in the anteroposterior or transverse planes when the jaws are closed.

Overjet: An extension of the incisal or buccal cusp ridges of the upper teeth horizontally (labially or buccally) beyond the ridges of the lower teeth when the jaws are closed normally.

Overbite: An extension of the incisal ridges of the upper anterior teeth below the incisal ridges of the corresponding lower teeth when the jaws are closed normally.

Open bite: A malocclusion that occurs in the vertical plane, characterized by lack of vertical overlap between the maxillary and mandibular dentition.

Self-ligating brackets: Ligatureless bracket systems that have a mechanical device built into the bracket to close off the edgewise slot.

## Author details

María Teresa Abeleira, Mercedes Outumuro, Marcio Diniz, Lucía García-Caballero, Pedro Diz\* and Jacobo Limeres

\*Address all correspondence to: [pedro.diz@usc.es](mailto:pedro.diz@usc.es)

Special Needs Unit and OMEQUI Research Group, School of Medicine and Dentistry, Santiago de Compostela University, Santiago de Compostela, Galicia, Spain

## References

- [1] Himmelmann, K., Sundh, V. (2015). Survival with cerebral palsy over five decades in western Sweden. *Developmental Medicine & Child Neurology*, 57(8), 762–767.

- [2] Lyons, D.C. (1956). An evaluation of the effects of cerebral palsy on dentofacial development, especially occlusion of the teeth. *Journal of Pediatrics*, 49(4), 432–436.
- [3] Franklin, D.L., Luther, F., Curzon, M.E. (1996). The prevalence of malocclusion in children with cerebral palsy. *European Journal of Orthodontics*, 18(6), 637–643.
- [4] Miamoto, C.B., Ramos-Jorge, M.L., Pereira, L.J., Paiva, S.M., Pordeus, I.A., Marques, L.S. (2010). Severity of malocclusion in patients with cerebral palsy: determinant factors. *The American Journal of Orthodontics and Dentofacial Orthopedics*, 138(394), e1–e5.
- [5] Oliveira, A.C., Paiva, S.M., Martins, M.T., Torres, C.S., Pordeus, I.A. (2011). Prevalence and determinant factors of malocclusion in children with special needs. *European Journal of Orthodontics*, 33(4), 413–418.
- [6] Cons, N.C., Jenny, J., Kohout, F.J. (1986). DAI: The Dental Aesthetic Index. Iowa City, Iowa: College of Dentistry, University of Iowa.
- [7] Martinez-Mihi, V., Silvestre, F.J., Orellana, L.M., Silvestre-Rangil, J. (2014). Resting position of the head and malocclusion in a group of patients with cerebral palsy. *Journal of Clinical and Experimental Dentistry*, 6(1), e1–e6.
- [8] Asdaghi Mamaghani, S.M., Bode, H., Ehmer, U. (2008). Orofacial findings in conjunction with infantile cerebral paralysis in adults of two different age groups a cross-sectional study. *Journal of Orofacial Orthopedics*, 69(4), 240–256.
- [9] Chadwick, S.M., Asher-McDade, C. (1997). The orthodontic management of patients with profound learning disability. *British Journal of Orthodontics*, 24(2), 117–125.
- [10] İşcan, H.N., Metin-Gürsoy, G., Kale-Varlik, S. (2014). Functional and fixed orthodontic treatment in a child with cerebral palsy. *The American Journal of Orthodontics and Dentofacial Orthopedics*, 145(4), 523–533.
- [11] Becker, A., Shapira, J. (1996). Orthodontics for the handicapped child. *European Journal of Orthodontics*, 18(1), 55–67.
- [12] Musich, D.R. (2006). Orthodontic intervention and patients with Down syndrome. *The Angle Orthodontist*, 76(4), 734–735.
- [13] Abeleira, M.T., Pazos, E., Ramos, I., Outumuro, M., Limeres, J., Seoane-Romero, J., Diniz, M., Diz, P. (2014). Orthodontic treatment for disabled children: a survey of parents' attitudes and overall satisfaction. *BMC Oral Health*, 14, 98.
- [14] Abanto, J., Ortega, A.O.L., Raggio D.P., Bönecker M., Mendes F.M., Ciamponi A.L. (2014). Impact of oral diseases and disorders on oral-health-related quality of life of children with cerebral palsy. *Special Care in Dentistry*, 34(2), 56–63.
- [15] Sabuncuoglu, F.A., Özcan, E. (2014). Orthodontic management of a patient with cerebral palsy: six years follow-up. *Journal of Contemporary Dental Practice*, 15(4), 491–495.



- [16] Stillwell, F.S. (1927). The correlation of malocclusion and scoliosis to posture and its effect upon the teeth and spine. *Dental Cosmos*, 69, 154–163.
- [17] D'Attilio, M., Filippi, M.R., Femminella, B., Festa, F., Tecco, S. (2005). The influence of an experimentally-induced malocclusion on vertebral alignment in rats: a controlled pilot study. *Cranio*, 23(2), 119–129.
- [18] Pećina, M., Lulić-Dukić, O., Pećina-Hrnčević, A. (1991). Hereditary orthodontic anomalies and idiopathic scoliosis. *International Orthopedics*, 15(1), 57–59.
- [19] Saccucci, M., Tettamanti, L., Mummolo, S., Polimeni, A., Festa, F., Tecco, S. (2011). Scoliosis and dental occlusion: a review of the literature. *Scoliosis*, 6, 15.
- [20] Rock, W.P., Baker, R. (1972). The effect of the Milwaukee brace upon dentofacial growth. *The Angle Orthodontist*, 42(2), 96–102.
- [21] Hitchcock, H.P. (1969). Treatment of a malocclusion associated with scoliosis. *The Angle Orthodontist*, 39(1), 64–68.
- [22] Manzano, F.S., Granero, L.M., Masiero, D., dos, Maria, TB. (2004). Treatment of muscle spasticity in patients with cerebral palsy using BTX-A: a pilot study. *Special Care in Dentistry*, 24(4), 235–239.