

CASE REPORT

Orthodontic treatment of an adolescent with cerebral palsy – A case report

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Abstract

Cerebral palsy is a common cause of chronic motor neuron impairment. A constant prevalence of 2 to 3/1000 births in industrialized countries has been described.

This case report describes the treatment of a 9 year old boy presenting this form of motor neuron impairment and class II malocclusion with an overjet of 14 mm, hyperdivergent growth pattern and various habits.

Orthodontic treatment consisted mainly of a two-phase treatment. The first phase was treated with removable appliances and followed by a phase with fixed appliances.

Treatment duration with removable appliances was 4 years and 5 months and for the fixed appliance phase, 1 year and 7 months.

A class I occlusion could be achieved in this case by removable and fixed orthodontic appliances combined with adjunctive treatment for the hypotonic orofacial musculature.

KEYWORDS

behavior management, cerebral palsy, hemiparesis, intellectual disability, orthodontic treatment

1 | INTRODUCTION

Infantile cerebral palsy (CP/ICP) is the most common chronic motor neuron disease in childhood and was first described by William Little in the 1840 s.¹ The prevalence of ICP in industrialized countries has been almost constant for decades and is reported to be 2 to 3/1000 live births.^{2,3} It is estimated that in Germany alone, approximately 80,000 children live with the consequences of brain damage due to birth complications.⁴ In the year 2000, the expert group for surveillance of CP in Europe named three decisive characteristics for the definition of ICP. First,

in addition to motor dysfunction, a posture and movement disorder. Second, the permanence of the damage, which is caused by variable factors. Third, damage to the developing (fetal/early child) brain of the affected person should be non-progressive.³ Bax et al. extended these criteria by various other accompanying disorders, for example, in the field of communication, behavior, perception and sensory perception.⁵ Knowledge of the latter disorders is important for dental and orthodontic care, diagnosis and therapy, which often is carried out in the sensitive and intimate orofacial region. Patients affected by CP are often reported to have various increased risks of

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dental problems such as caries, fall-related tooth fractures and malocclusions.⁶⁻⁹ Common symptoms are a class II malocclusion, an increased overjet, open bite, mouth breathing, drooling habit, a long face and an impairment of orofacial musculature.¹⁰⁻¹²

2 | CLINICAL CASE

2.1 | History and diagnosis

In November 2012 a 9 year old Caucasian boy presented at the dental clinic and dental school at the University of Witten/Herdecke, Germany. In the general anamnesis an assured diagnosis of CP with accompanying intellectual and physical disabilities, growth disorders and a hemiparesis on the left side was reported. The patient did not receive any prior dental treatment before attending the university's department of special care dentistry, where he received regular dental examinations and oral hygiene instructions. Elements of ritualized behavior-management techniques, such as the "Tell-Show-Do-Technique" were used by the dentist, aiming at improving the patient's cooperation. The patient was referred to the orthodontic department at the age of 9 years mainly because of his class II malocclusion. During the orthodontic treatment, professional dental hygiene and individual prophylaxis measures (e.g., fluoride varnish application) were carried out in the department for special care dentistry to support oral hygiene, which were promoted by the parents of the patient at home.

Extraoral examination in frontal view confirmed the hemiparesis on the left side accompanied with a slight

Highlights

- Cerebral palsy is commonly associated with class II malocclusion and impairment of orofacial muscle function.
- As patients often suffer from intellectual disabilities third party help is beneficial to provide oral hygiene during orthodontic treatment.
- Behavioral management and logopedic treatment are advised as adjunctive measures.
- Treatment with removable and fixed appliances seem to be feasible for patients with cerebral palsy.

mandibular deviation to the right. In the lateral view the patient presented a convex profile with protruded lips in the upper jaw in combination with lip incompetence, a pronounced submental fold and an increased nasolabial angle in addition to an increased lower facial third. (Figure 1A, B).

The intraoral examination revealed a class II malocclusion with an increased overjet of 14 mm, a deep bite tendency (4 mm overbite), medial and lateral diastema. The upper arch showed asymmetric constriction, rotated front teeth and a slight midline shift to the right. The lower teeth were rotated and crowded, with the crowding being more severe on the right side. Lower incisors showed contact with the palatal gingiva. The molar relationship was a ½ premolar width distal on the left side and ¾ premolar width distal on the right side in concordance with a mandibular deviation to the right. Additionally, all

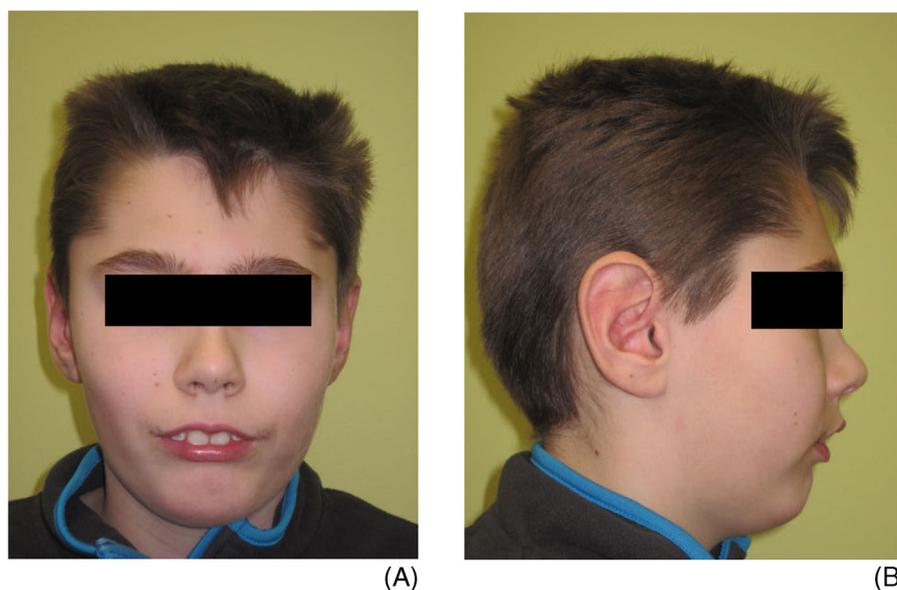


FIGURE 1 Pre-treatment extraoral facial photographs (A) frontal view (B) lateral view

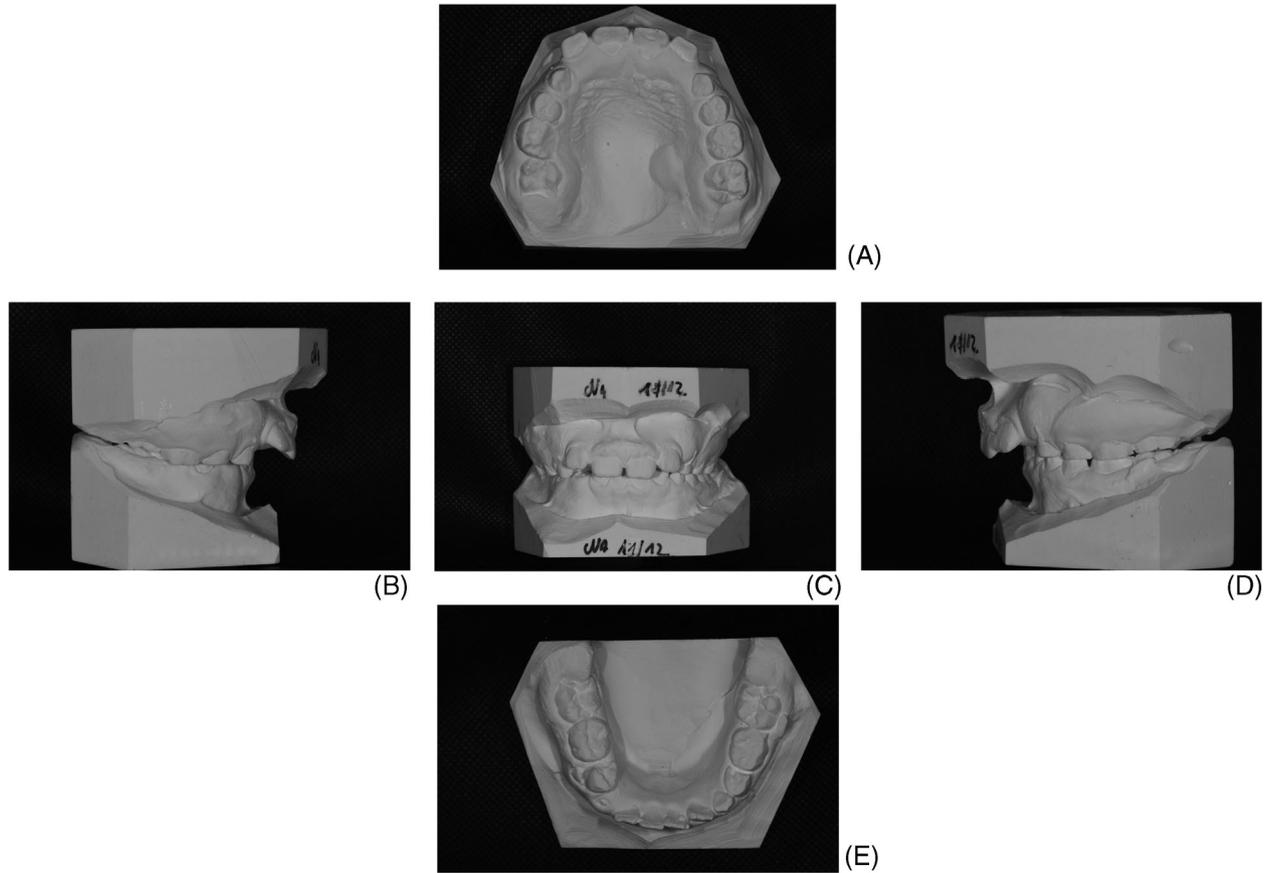


FIGURE 2 Pre-treatment dental casts (A) upper view (B) right lateral view (C) frontal view (D) left lateral view (E) lower view

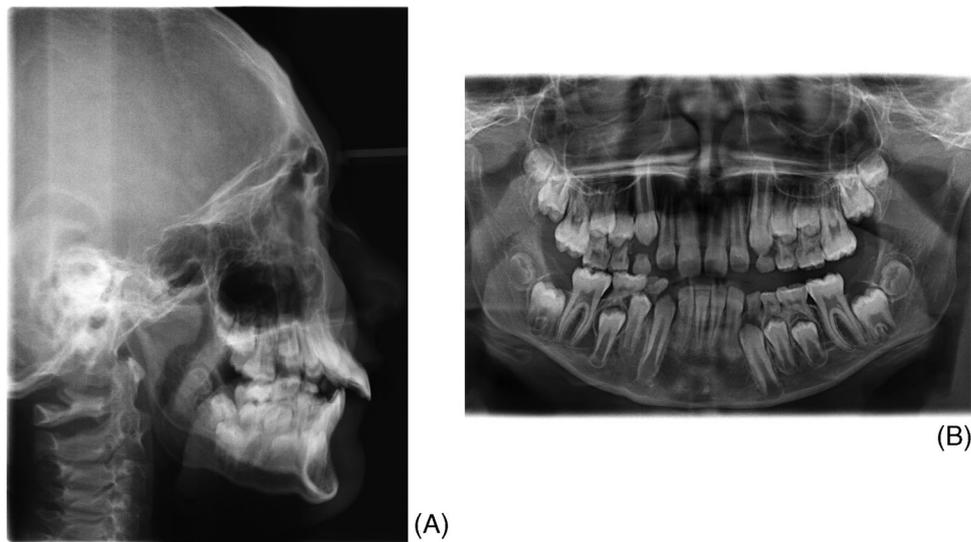


FIGURE 3 Pretreatment cephalometric (A) and panoramic (B) radiographs

posterior teeth on the right side were in a buccal non-occlusion (Figure 2A–E).

It was not possible to take all intraoral photos due to lack of patient compliance at this stage. The appointment for taking impressions was planned accordingly with an extended time frame.

The panoramic radiograph showed no pathologies. Cephalometric analysis presented a hyperdivergent growth pattern with a skeletal class II and mandibular retrognathia. The upper incisors were protruded and proclined (Figure 3A, B). A summary of the cephalometric analysis is shown in Table 1.

TABLE 1 Cephalometric analysis with pre-treatment and in-treatment values

Measurement	Standard deviation of caucasian deviation	Pre-treatment values	In-treatment values
Facial axis	90.0 +- 3.0°	79.8°	81.3°
Facial depth	87.0 +- 3.0°	82.5°	85.3°
Maxillaposition	64.0 +- 2.0°	58.5°	62.0°
MP/FH	26.0 +-4.0°	30.2°	27.5°
PP	1.0 +-4.0°	1.5°	-1.2°
SNA	82.0 +-3.0°	81.9°	83.9°
SNB	80.0 +-3.0°	74.8°	75.8°
ANB	2.0 +-2.0°	7.1°	8.1°
Wits	0.0 +-2.0 mm	1.3 mm	6.6 mm
L1/A-Po	1.0 +-2.0 mm	-0.5 mm	0.3 mm
U1/A-Po	4.0 +-2.0 mm	9.8 mm	10.4 mm
Interincisal angle	130.0 +-5.0°	121.4°	111.2°
U6/PP	0.0 +-2.0 mm	-6.8 mm	2.3 mm

[Correction added on 24 December 2021, after first online publication: Table 1 has been corrected in this version].

The patient presented several habits like chronic mouth breathing, lip sucking and a visceral swallowing pattern.

2.2 | Treatment objectives and alternatives

Treatment objectives consisted of treatment of the skeletal discrepancy, leveling the arches, correcting the dental malocclusion and ensuring retention. Patient compliance is a factor that has to be considered for successful treatment with removable appliances. Logopedic adjunctive treatment was instituted to improve the orofacial dysfunction, correct the habits and prevent relapse of the orthodontic procedures. Treatment alternatives discussed in the team were, extraction therapy or distalization but these would not be favorable for the posterior inclined profile of the patient. Another alternative was to postpone treatment until the end of growth was reached and to use surgical modalities in combination with orthodontics. The latter treatment option was rejected by the parental guardian.

Treatment was finally pursued with removable functional appliances and fixed appliances, a combination described earlier by Iscan et al. for treatment of a patient with ICP.¹³ Retention phase was to be accomplished with fixed and removable retainers.

2.3 | Treatment progress

Active treatment time for this patient was 6 years which included treatment with removable appliances for 4 years and 5 months and with fixed appliances for 1 year and 7 months. The active phase was followed by a reten-



FIGURE 4 An activator appliance according to Karwetzky – UBA Class II appliance

tion phase of 6 months. Treatment was initiated with a Sander type II appliance. After one year this appliance was replaced by an activator appliance according to Karwetzky (UBA) (Figure 4). The UBA holds the mandible in a forward position and supports lip closure and nasal breathing. Recommended wear time for removable appliances was at least 16 h per day as advised by Witt et al.¹⁴

After 1 year and 2 months of phase one treatment with the removable appliance new diagnostic records were taken (Table 1, Figures 5–7). The upper incisors were still in a proclined and protruded position and change of overjet was not noticeable. It was discussed within the

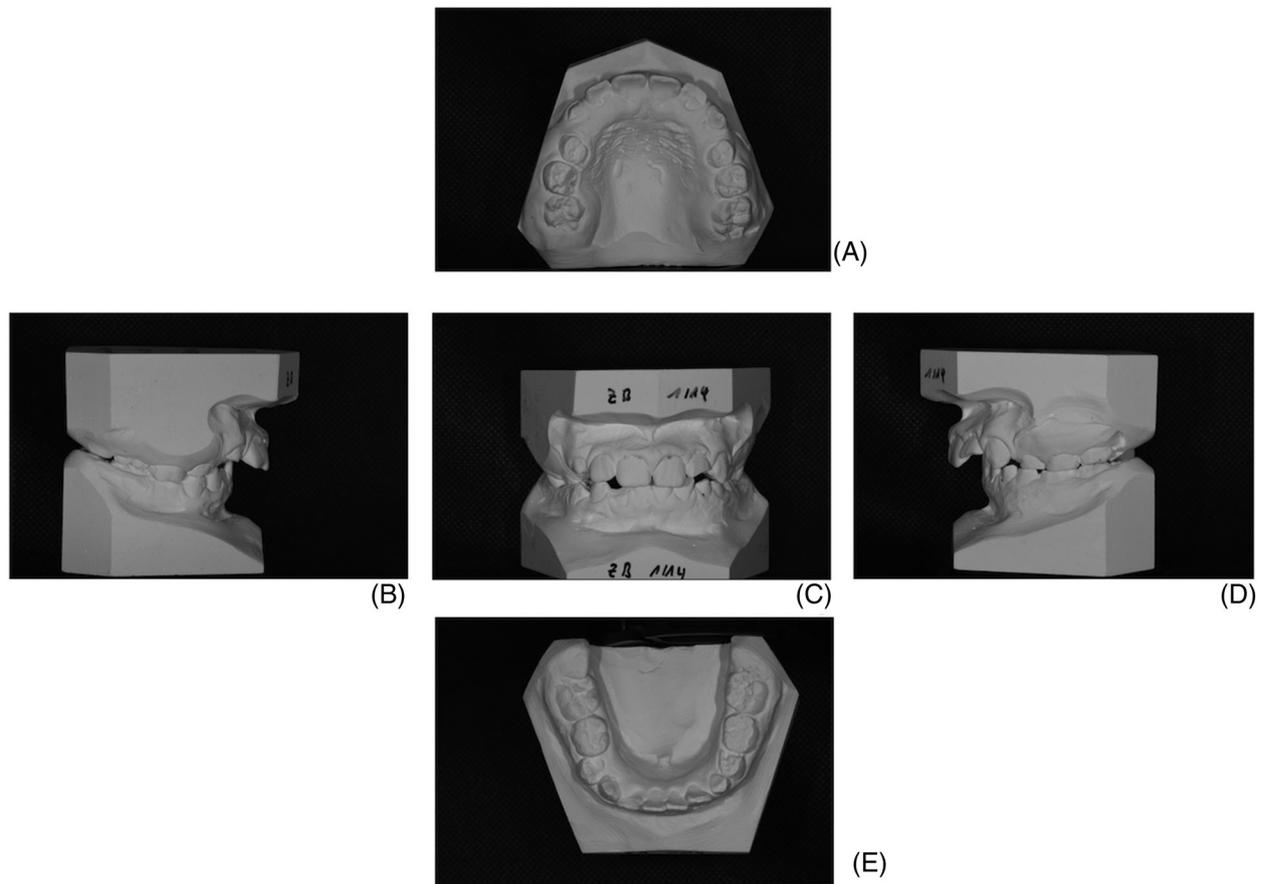


FIGURE 5 In-treatment dental casts (A) upper view (B) right lateral view (C) frontal view (D) left lateral view (E) lower view

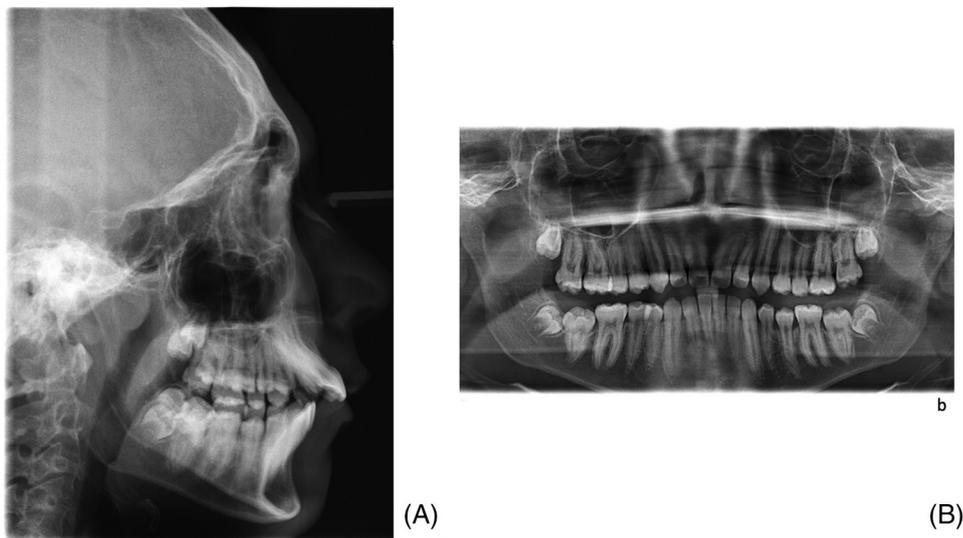


FIGURE 6 In-treatment diagnostic records - cephalometric (A) and panoramic (B) radiographs

team to stop treatment due to missing patient compliance. After re-motivating the patient and using adjunctive treatments like therapeutic horseback riding the patient started to wear the appliance regularly but at the begin-

ning only during the horseback riding sessions. Wear time was increased gradually and an increase in patient motivation was noticed. Removable treatment was continued for another 3 years and 3 months. During this the molar

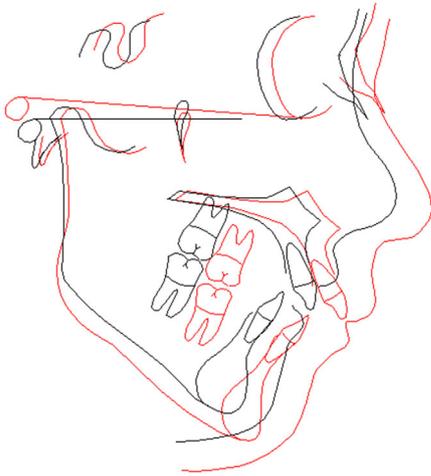


FIGURE 7 Cephalometric superimposition on Basion-Nasion at CC-Point: black (pre-treatment) red (in-treatment)

relationship was improved bilaterally to $\frac{1}{2}$ premolar width distal occlusion. The upper transverse width was reduced and only tooth 15 remained in a buccal non-occlusion. The transverse width of the lower jaw was increased and crowding was mostly resolved. The overbite was reduced to 35 mm. New diagnostic records were not taken at this time as the amount of diagnostic records to be taken is limited by public health insurances in our country but intra- and extraoral dental photographs were taken (Figures 8–9).

At this stage fixed appliance therapy for tooth alignment was initiated. Leveling began with a 0.013-inch nickel-titanium wire in a 0.018-inch bracket slot system. After nine months of treatment and reaching a rectangular 0.016 × 0.016-inch nickel-titanium wire, class II elastics with 5/16 inch diameter and 6oz force were applied. Class II elastic wear had to be supported by the parental guardian. For further correction of the overbite frontal palatal bite ramps on teeth 11 and 21 were used. A fixed functional appliance like the Bio Bite Corrector (BBC Orthotec, Bad Reichenhall, Germany), to correct the class II occlusion without the need of patient compliance, was suggested. This device is a herbst derivative and the mandible can likewise be positioned anteriorly, but instead of being cemented on the teeth this device is attached to the stainless steelwire bilaterally and in both arches. The use of the appliance was rejected by the patients guardian and the class II elastics were changed to 4/16 inch diameter with 6 oz force and the patient was instructed to wear them full time. Alignment was finished with a 0.016 × 0.022 inch stainless steel arch wire. In the last 5 months of fixed appliance treatment vertical triangular 3/16 inch elastics with a force of 35 oz were used to ensure settling of the teeth.

At the end of the active treatment phase the class II occlusion was corrected and both molar and canine class I relationship was achieved. After 1 year and 7 months

the fixed appliance was removed, and a fixed retainer was chosen for the lower arch. Additionally, vacuum formed retainers were given to the patient for long term retention in both arches. The removable retainers were to be worn at least 15 h daily.

2.4 | Treatment results

By means of orthodontic treatment supported by intensive teamwork with the special care dentistry department and adjunctive logopedic treatment a class I relationship with physiological overbite and overjet could be achieved (Figure 10A–E). The overjet was reduced from 14 to 3 mm. The buccal non-occlusion could be corrected. A physiological swallowing pattern and better orofacial muscle tonus could be achieved. However, the lip sucking habit sometimes still occurs. Nasal breathing was enhanced but could not be established. As shown in the post-treatment panoramic radiograph no root resorption could be detected and root parallelism was obtained (Figure 11). Radiographic cephalometry was not pursued as radiation exposure is to be limited as per governmental regulations and would not affect further therapy. After 4 months of retention no changes had occurred and the treatment results were stable (Figures 12–13).

3 | DISCUSSION

Several studies recorded that patients with CP have a high prevalence of dental problems and malocclusions such as class II and therefore require orthodontic treatment.^{8,10,15–18} Partly this may be a consequence of the primary physical impairment of patients with CP due to hyper- or hypofunction of muscle tone (sleep, spasticity) depending on the severity.^{19,20} The patient showed the afore mentioned typical dental problems associated with CP like class II malocclusion, severely proclined incisors with increased overjet and hypotonic orofacial musculature.^{10–12} Often CP is also accompanied by intellectual disability, which was also evident in the patient in this case report.²¹ As a result, the ability and understanding to perform certain movement patterns or cultural techniques such as brushing teeth is limited or even impossible to perform independently. This insufficient self-efficacy for daily body and oral hygiene requires support from third parties such as people in the social environment (parents, family members or special care). In addition, persistent oral reflexes, such as the biting reflex, can make oral hygiene difficult.¹⁹ In the presented case a caries-free dentition was found without the need for conservative therapy. The dental status corresponds with information from

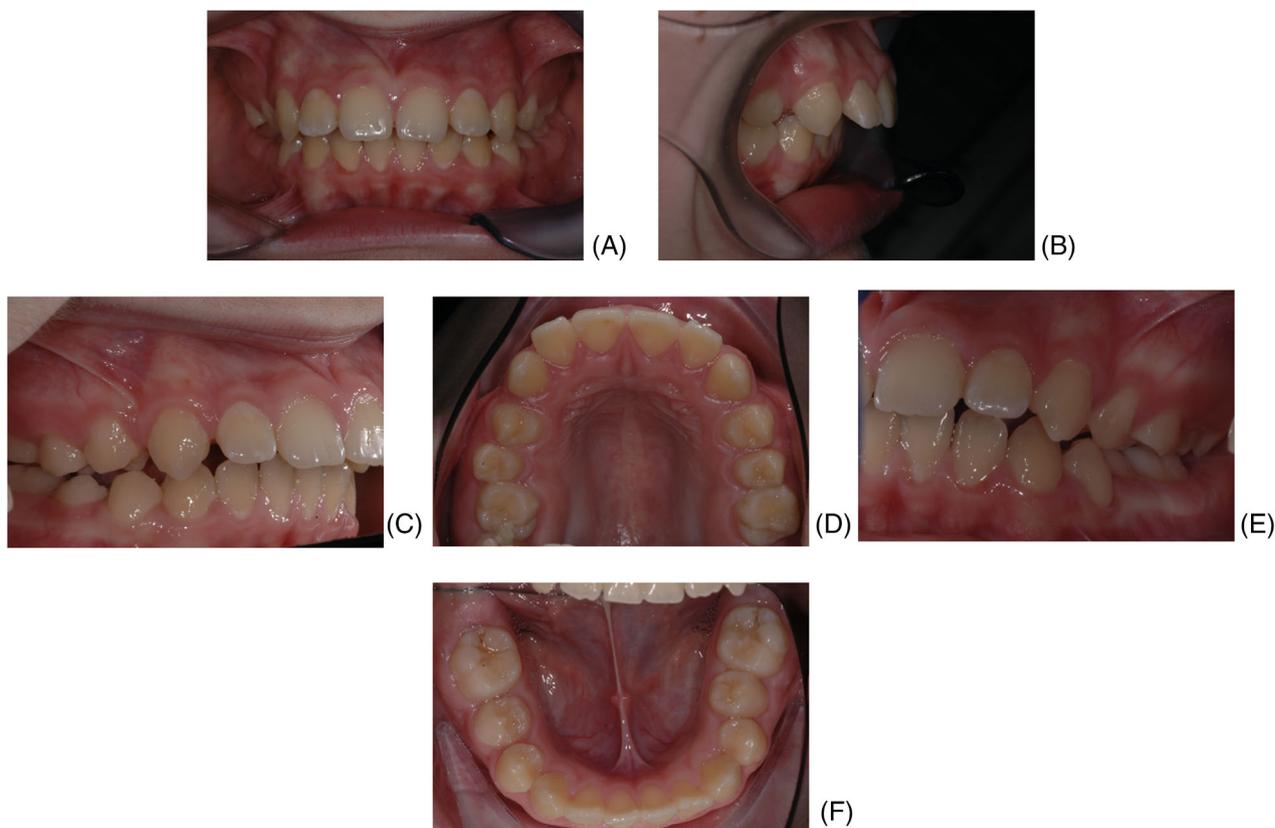


FIGURE 8 In-treatment intraoral photography after removable appliance phase – intraoral photos (A) frontal view (B) lateral view for overjet (C) right lateral view (D) upper occlusal view (E) left lateral view (F) lower occlusal view

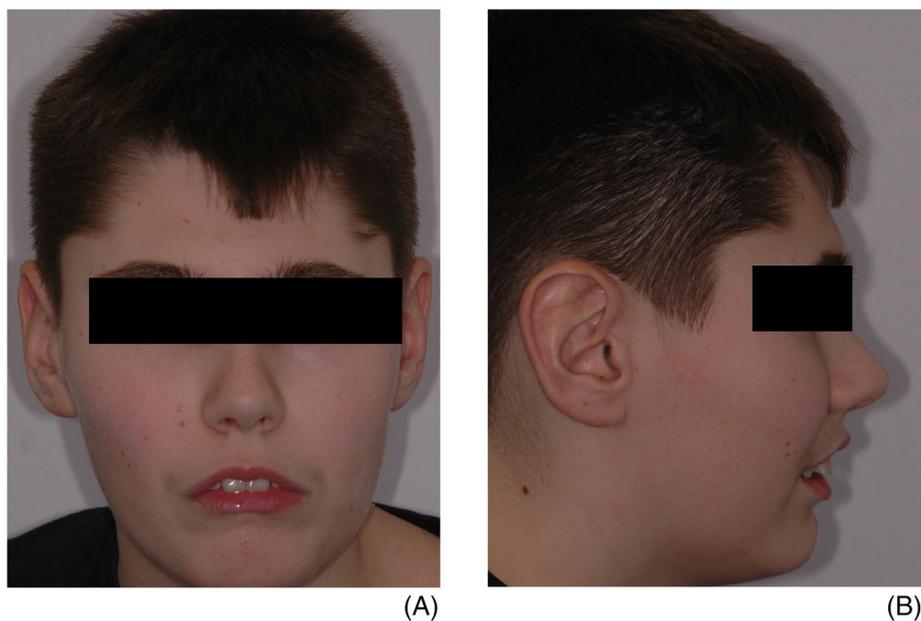


FIGURE 9 In-treatment extraoral photography after removable appliance phase (A) frontal view (B) lateral view

other case reports and study data, which also described mostly a caries-free dentition or lower DMFT-values in CP patients compared to other types of disabilities or to the normal population.^{18,22,23} An orthodontic treatment was

primarily necessary which had to be supported by a structured dental prophylaxis and behavioral concept. In comparison with reports from the literature, it is noteworthy that the treatment phase with removable appliances of

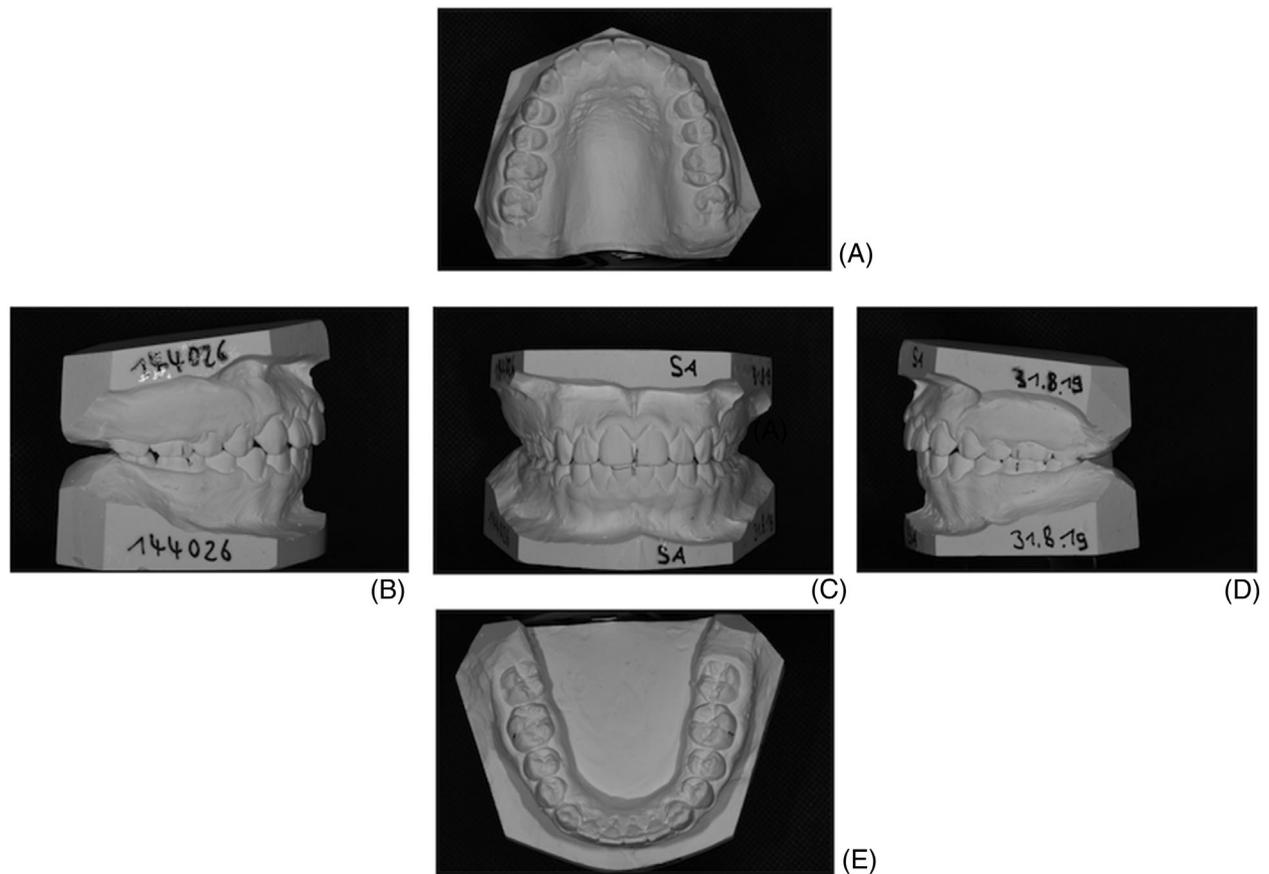


FIGURE 10 Pre-retention dental casts (A) upper view (B) right lateral view (C) frontal view (D) left lateral view (E) lower view



FIGURE 11 Retention phase – panoramic radiograph

4 years and 5 months can be considered as very long. Other authors treating patients with Cerebral Palsy show only a treatment time of nearly 7 months for the removable appliance phase but time for fixed appliance wear was similar to our treatment time with fixed appliances.¹³ It has been reported that removable appliances tend to an increase of the mandibular plane angle.²⁴ As the angle was still in

standard deviation values and the severe SNB of 748° also lead to a more hyperdivergent angle interpretation of the facial axis it was decided in the team to start treatment with removable appliance as a behavioral tool to get the patient accustomed to treatment despite the afore mentioned side effects. Also the use of removable appliances to treat orofacial dysfunctions and swallowing patterns

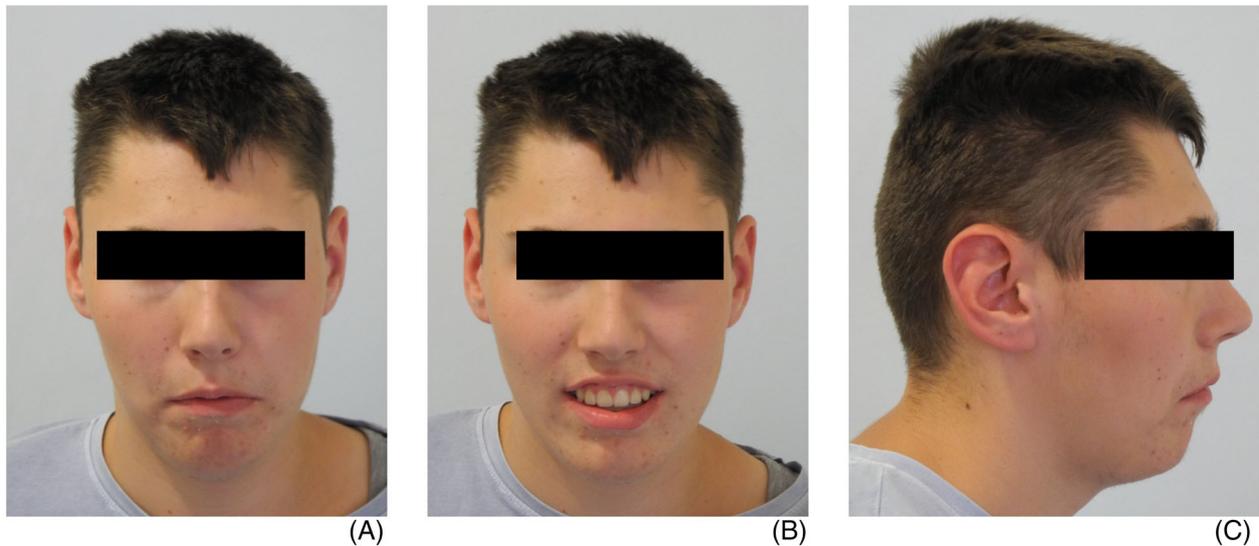


FIGURE 12 Retention phase – extraoral photos (A) frontal view – lips closed (B) frontal view – smile (C) lateral view

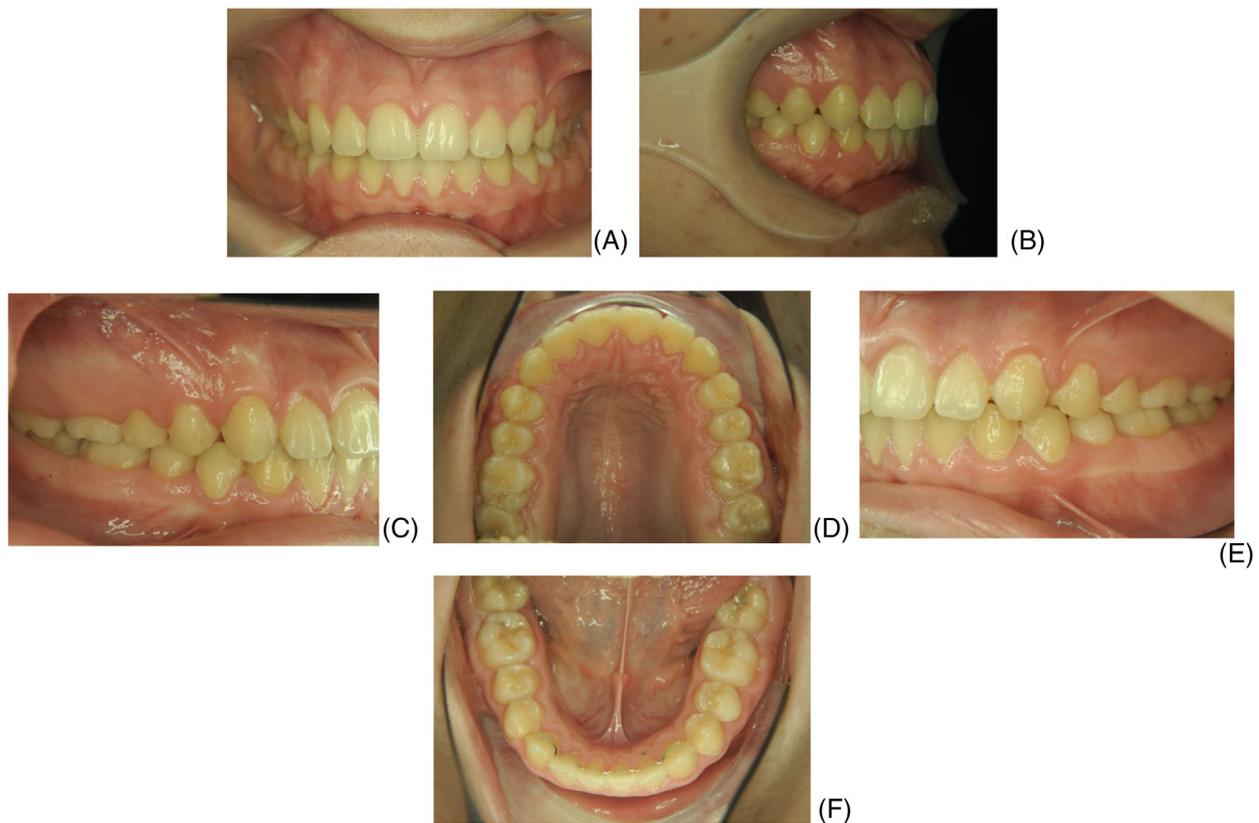


FIGURE 13 Retention phase – intraoral photos (A) frontal view (B) lateral view for overjet (C) right lateral view (D) upper occlusal view (E) left lateral view (F) lower occlusal view

especially in combination with myofunctional therapy seems effective.²⁵

The activator as described by Karwetzky consists of two parts connected with wires in U-form, which can be activated.²⁶ This design provides the ability of stepwise

class II correction which is to be more effective than single step advancement^{27,28} (Figure 4).

Within the first year the patient had problems to adapt to the removable appliance and showed lack of compliance. Through intensive logopedic work and wearing the

appliance during therapeutic horseback riding the compliance increased over the time. Therapeutic horseback riding has been related to enhancing the posture and motor function in patients with CP.^{29,30} It could be beneficial to integrate wearing orthodontic appliances during this procedure.

Due to unrest and poor patient cooperation during the bonding procedure of the fixed appliance it was inserted in two steps at different appointments. Maintaining sufficient good oral hygiene is especially important during fixed orthodontic therapy as its absence could lead to white spot lesions or to absolute contraindication of fixed appliance treatment.³¹ Consultation time during the appointments was not measured but was subjectively more time consuming as the parental guardian had to be instructed intensively for hygiene and elastic wear.

Retention was to be accomplished with a fixed retainer in the lower jaw and a vacuum formed retainer for night time wear in the upper jaw. In literature there is not enough evidence about retention protocols and this topic remains subjective³² though a higher failure rate has been reported for upper fixed retainers due to occlusal factors.³³ After 2 years of adjunctive therapy, with intensive training of the orofacial muscles, lip closure and nasal breathing could be seen in the patient. Unfortunately these orofacial functions could not be maintained as they would be favorable for retention.

4 | CONCLUSION

This case report describes the successful orthodontic treatment of an adolescent with cerebral palsy with its benefits and limitations. An early and adaptable treatment, an interdisciplinary team and a regular follow-up even after treatment is recommended. A class I occlusion could be achieved but oral hygiene is still dependent on third party support and orofacial function of soft tissues could not be established permanently. In concordance with the UN convention on the rights of people with disabilities, further case reports or clinical studies in this field should be conducted and published.³⁴

ACKNOWLEDGMENTS

We would like to thank the patient and his family for their consent to publish this case report, to contribute to continuing education in the field of special care dentistry combined with orthodontics.

PATIENT CONSENT

Patients legal guardian gave consent and consent form has been provided.

AUTHORS CONTRIBUTION

Peter Schmidt and Sachin Chhatwani conceived the idea for the case report. Eva Johannsen, Sachin Chhatwani, and Gholamreza Danesh carried out the dental treatment, Peter Schmidt, Sachin Chhatwani, and Eva Johannsen collected the data and figures. Sachin Chhatwani, Peter Schmidt, and Eva Johannsen led the writing of the manuscript and Sachin Chhatwani, Peter Schmidt, Stephan Mohlhenrich, Andreas Schulte, and Gholamreza Danesh reviewed and edited the draft independently until consensus was reached about the final version.

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