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Chapter

Upper Airway Expansion in Disabled Children

David Andrade, Joana Andrade, Maria-João Palha, Cristina Areias, Paula Macedo, Ana Norton, Miguel Palha, Lurdes Morais, Dóris Rocha Ruiz and Sônia Groisman

Abstract

Breathing is essential for life in all of its stages. Cellular, mitochondrial respiration requires an adequate supply of oxygen, provided by the air we breathe, after airway conduction, treatment by the lungs, and transport to tissues. At different stages of life, pediatric dentists and orthodontists can intervene in the upper airway, expanding it, which helps with ventilation. The greater airway space, if used, contributes in different ways to the child’s development and the recovery of respiratory problems and should always be present as a weapon that physicians and the population should know. The value of the techniques becomes even more important when applied to children and young people with disabilities who can significantly improve their development and performance. Rapid Maxillary Expansion and Extraoral Traction Appliances are two important pediatric resources to treat these children. Clinical practice of the authors, is discussed, emphasizing the importance of early intervention and the need for multi and interdisciplinary collaboration in the follow-up of disabled people.

Keywords: pediatric dentistry, effects, health, development, disabled persons, syndrome, obstructive sleep apnea, neuromuscular diseases, rapid maxillary expansion, extraoral traction appliances, airway obstruction, congenital muscular dystrophy, palatal expansion technique, maxillary retrusion

1. Introduction

This chapter analyses the effects of Rapid Maxillary Expansion (RME) and Extraoral Traction Appliances (ETA) on children with a high prevalence of specific otorhinolaryngologic pathology like persistent nasal obstruction and/or repeated upper respiratory infections (three episodes over six months or four episodes in a year nasal obstruction).

This type of obstructive symptomatology is common in Down syndrome (DS) children [1] but may occur in children with other syndromes or diseases, and even in healthy persons.

Other possible causes of breathing difficulty are related to muscle weakness. If we look to the population that uses Noninvasive Ventilation (NIV), we identify the significant groups of risk, where respiratory muscles are weakened, or the airway is...
obstructed: Obstructive sleep apnea (OSA), Neuromuscular disorders (ND), Cystic fibrosis, Children with Obesity and Down syndrome (DS).

Upper airway obstruction may have several causes, and accumulated secretions augment the obstruction. Adenoidectomy and tonsillectomy are common to remove the obstruction, but many times, not enough. Another cause related to obstruction, often forgotten, is a constricted and/or retruded maxilla. In most cases, we find the presence of lateral crossbite and/or evidence of maxillary compression.

A diminished transverse dimension of the maxilla reduces the nasal cavities, thereby reducing the airflow into the lungs [2].

The nasal respiratory space represents a vital role in the craniofacial skeleton growth and development (the most important stimuli for the growth of the midface is ventilation by the nose).

The respiratory pattern can determine an altered mandibular posture, allowing compensatory oral ventilation. When the tongue does not occupy a stable position in the oral cavity, the entire balance that keeps the teeth in their typical situation changes, allowing the occurrence of malocclusion.

The occlusion between the maxilla and mandible is essential to choose the type of therapy to use.

Based on scientific evidence and clinical practice, this chapter supports a better understanding of these treatments that improve oral functions and the child’s general development.

2. Rapid maxillary expansion

RME is a widespread orthodontic practice [3]. It is a dentomaxillofacial orthopedic treatment process commonly adopted in young patients to treat narrowed maxilla (Figure 1) [4]. This procedure is used for handling structural and functional problems in the middle of the face [5]. It involves applying an intraoral screw mechanism anchored on selected teeth (Figure 2) or bone that produces orthopedic forces to the mid palatal suture, with the forces dispersing through the circum-maxillary and cranial sutures [6].

In particular, RME enlarges the nasal cavity base and the maxilla [7, 8]. RME is used to fix the constricted transverse diameter [9], expanding the arch perimeter that will deliver more space for the correct positioning of crowded teeth and permit crossbite correction [10].

Figure 1.
Severely narrowed maxilla and first ERM appliance. Anterior and posterior crossbite before and after the first RME appliance.
When we open the midpalatal suture, we get a diastema between central incisors (Figure 2) that is closed per se without an appliance procedure.

The RME device is a fixed appliance that does not require from parents or children intense cooperation. It is easily cleaned and works in a short period, between two and four weeks [11].

Palatal enlargement in children increases nasal flow and diminishes nasal resistance [12].

The treatment of mouth breathing is multidisciplinary, and the patient should be sent to the otorhinolaryngologist as treatment should be initiated after the triggering condition of oral breathing is resolved. RME is the recommended therapy in the interception phase [13].

After RME, improved resistance and nasal flow were documented in patients in the supine position, who had a posterior and anterior obstruction. Smaller changes were observed in isolated forms of obstruction and in the orthostatic position. In nasal airway obstruction with maxillary constriction, RME has proved effective for improving nasal breathing in children via an enlargement effect on the nasopharynx [14]. Pharyngeal airway pressure during inspiration is decreased with the reduction of nasal resistance [15].

In intermaxillary, internasal, frontonasal, frontomaxillary, and maxillonasal sutures, RME produces significant width increases, whereas the zygomaticotemporal, frontozygomatic, pterygomaxillary, and zygomaticomaxillary sutures showed nonsignificant changes; forces elicited by RME affect mainly the anterior sutures (maxillary frontal nasal and intermaxillary interfaces) compared with the posterior (zygomatic interface) craniofacial structures [16]. Cephalometry showed increased maxillary width after RME [10].

The RME substantially increases interglenoid chamber distance and mandibular condyle displacement at six months in growing patients compared to a control group.
RME is effective during growth, enlarging the interglenoid fossa space and the lateral positions of the condyles and eventually expanding the nasal cavity without producing asymmetry [17].

After RME, substantial improvement in the transverse dimensions of the maxillary basal bone, the nasal cavity, and the midpalatal suture opening happened, with the highest growth in the midpalatal suture followed by nasal cavity and basal bone [18].

Considerable alterations in the space of the pharynx may be obtained in Class II patients through both RME and mandibular advancement devices with the capacity of palatal expansion [19].

RME improved the mucociliary clearance in children with maxillary narrowness, positively affecting nasal physiology and improving nasal cavity volume [20].

3. Extraoral traction appliances

There are different ETA, bone or teeth anchored (Figure 3) that, if used well, cause anterior traction of the upper jaw.

One can have a maxillary retrusion, a mandibular prognathia, or a mixture of the two. Respiratory problems can arise with maxillary retrusion when the maxillary is back positioned and encroaches on the nasopharyngeal airway.

Research conducted over the past decade has shown associated improvements in airway size with maxillary protraction [21].

Existing controlled clinical studies on humans show that ETA for skeletal Class III intervention might be related to broader airway proportions, mostly minor in

Figure 3.
Rapid maxillary expansion, prepared for traction, if necessary.
magnitude [22]. Positive stable changes in the airway dimensions of Class III subjects were obtained by treatment with RME and ETA [23].

Maxillary protraction is a complement of RME. It is used only if necessary; only those with problems in the sagittal plane may need ETA when anteroposterior dimension mismatch between the maxilla and the mandible. Most cases that require RME do not require ETA. The best time to use ETA is immediately after finishing the RME, taking advantage of the lack of union of the sutures and superior displacement of the bones, as they are less trapped.

While RME is responsible for the transverse maxillary increase, ETA becomes important in the anteroposterior dimensions.

4. Obstructive sleep apnea and obstructive sleep apnea syndrome

A small-scale upper jaw and/or mandible can predispose kids to sleep-disordered breathing, which is a continuum of gravity from snoring to OSA. Related health consequences, such as cardiovascular and neurocognitive functions, have not yet been systematically referred [24].

OSA often goes undiagnosed and affects approximately 5% of the population. Obstructive Sleep Apnea Syndrome (OSAS) is a more serious form of OSA where there is evidence of both a disruption of standard breathing patterns during sleep, and symptoms such as excessive sleepiness in the daytime. OSAS occurs in approximately a quarter of those with OSA [25, 26]. Within the upper airway, the pharynx, particularly the oropharynx and hypopharynx, is the region where most obstructive processes leading to OSAS are found [27]. It is characterized by episodes of partial or complete obstruction of the upper airway during sleep, interrupting (apnea) or reducing (hypopnea) the flow of air, followed by brief awakening that leads to the restoration of upper airway permeability. The descriptions may eventually become redundant in the context of rapid technological advances in breathing measurement and other signal acquisition [28].

OSAS prevalence is supposed to rise with the present obesity epidemic. If not treated, it is related to significant morbidities such as growth collapse, endothelial dysfunction, neurocognitive impairment, and pulmonary and systemic hypertension [29].

OSAS during infancy results in significant physical and neuropsychomotor disorders. Therefore, it must be recognized and treated as soon as possible to prevent or mitigate the chronic problems associated with OSA, harmful to child development. Adenoidectomy and, in some circumstances, continuous positive airway pressure (CPAP) have been the chosen therapies for OSAS in pediatric patients, but they are unsuccessful in ultimately improving the condition. RME in kids with OSAS seems a successful cure for this condition [5, 30, 31].

The dentist’s role is pivotal in children when identified with OSA; initiating dental therapies in the course of growth can aid patients, protecting them from malocclusion, and intervening in dentofacial structural development can help escape therapies such as CPAP and different surgeries. Proper evaluation and treatment may avoid compromised quality of life, delays in treatment, morbidity, and, in some cases, mortality [32].

RME treatment positively affected kids with chronic snoring and OSA, producing growth of the nasal cavity and nasopharyngeal airway volume, with enlargement of the maxillary and nasal osseous size. Enlarged nasal width at the posterior nasal spine (PNS) plane improved nasopharyngeal volume. The enlargement of the maxillary width is directly correlated with the increase in respiratory tract volume, resulting in
functional enhancement. RME treatment may reestablish and enhance a regular nasal airflow with the disappearance of OSA [33].

A better apnea-hypopnea index and lower O2 saturation were observed in OSA children treated with RME [34]. As indicated by improvement in oximetric parameters, RME would appear effective for treating slight or moderate OSA. It might be efficacious as a coadjuvant treatment to adenotonsillectomy (AT) in severe situations of pediatric patients with maxillary constriction [35].

OSA can lead, if left untreated, to severe medical complications, growth disorders, behavioral changes, and reduced quality of life. Synergy allows pediatric OSA detection, diagnosis, and treatment in an interactive and collaborative approach between ENT, orthodontists, pediatric dentists, pneumo-allergologists, sleep doctors, endocrinologists, speech-language pathologists, and myo-functional orofacial therapists to improve the short, mid, and long-term results [36].

OSAS is associated with neurobehavioral and cardiovascular abnormalities, growth, and inflammation. The treatment results in enhancements in attention, behavior, and likely improvement in cognitive skills [37]. RME can be a helpful methodology in pediatric patients with OSAS and malocclusion, as the effects of such treatment persist 24 months after the end of treatment [38].

Determining apnea-hypopnea index (AHI) per hour of sleep is essential. The greater the index, the more serious the OSA is. The onset of anomaly is 1.5AHI/h for children and 5AHI/h for adults. This syndrome has consequences far from negligible, potentially affecting mood problems, learning disabilities, growth abnormalities, and delayed neurocognitive development; it can even affect metabolism [39].

Adenotonsillar hypertrophy, in children, continues the main anatomical risk factor of OSA. AT and orthodontic treatment were more successful together than separately to cure OSA in children [40]. After undergoing both treatments, there was a more significant reduction in AHI and respiratory disturbance index and a major increase in the lowest O2 saturation and the O2 desaturation index [41].

RME devices reduce AHI in pediatric patients with OSAS making RME therapy a correct alternative treatment decision for these patients [42, 43].

RME has positive effects on nose breathing, natural head position, OSAS, nocturnal enuresis, and conductive hearing loss. RME can be considered the last treatment choice for those with normal occlusion when other possible interventions in nose breathing, nocturnal enuresis, OSAS, and conductive hearing loss have been unsuccessful [44].

Repetitive hypoxia seen in obstructive sleep apnea syndrome (OSAS) may affect bone metabolism, increasing the risk for secondary osteoporosis [45].

5. Down syndrome

In Trisomy 21, the rate of otolaryngologic infection (otitis media, amygdalitis, and adenoiditis) decreased significantly before and after RME when compared to controls, regarding breathing obstruction symptoms (p < 0.01), audiometric and tympanometric progress, and various factors considered by speech pathologists such as articulation of speech sounds and tongue mobility (p < 0.01). RME offers a considerable decrease in upper airway obstruction, hearing loss, and enhanced tongue mobility and articulation in pediatric patients [46]. RME results in decreased hearing loss, the annual rate of ENT infections, parentally considered symptoms of upper airway obstruction, and enhanced articulation, tongue mobility, and intelligibility. Breaking the cycle of mouth breathing and growing the area for nasal ventilation may deliver an answer for some respiratory
issues, a decrease of tongue projection and drooling, as well as the high incidence of repeating respiratory infections and the high rates of crossbites and compression. The parents relate that RME produces an esthetic improvement. By putting the tongue in its natural place, speech is enhanced, thus enabling integration into society, because of the higher esthetics and self-confidence of the child. This appliance should be part of the recommendation to parents’ organizations of children who have Trisomy 21. These outcomes are possibly associated with enlarged oronasal space due to RME [47].

After the expansion of palatal suture by RME, conductive hearing impairment enhancement was due to the renovated normal function of the openings of the auditory tubes [48].

6. Adverse effects of noninvasive ventilation

In ND, DS, and other diseases, it is frequent to use noninvasive ventilation to help children ventilation. Masks, type bilevel positive airway pressure (BiPAP), continuous positive airway pressure (CPAP), and similar are generally supported on the maxilla. However, if used in the tender bone of young children and for a long time, these appliances (BiPAP, CPAP, or similar) may produce retrusion of the face. The deleterious facial effects of noninvasive ventilation [49] are described in a girl with neuromuscular dystrophy, an example of these rare diseases (Figure 4). And the necessity of an interdisciplinary team is essential for successful treatment.

Figure 4. Extraoral traction appliance (face mask) in a child with neuromuscular dystrophy.
In the same way, RME may be used to restore the compressed maxilla of Carey Fineman Ziter syndrome, a very rare genetic muscular disorder present at birth (congenital myopathy), and ETA may reestablish the correct relationship between maxilla and mandible. In Figure 4, we may find maxillary constriction in conjunction with anterior and bilateral posterior crossbites in a child with Carey Fineman Ziter syndrome that used a BiPAP from the age of four months.

Congenital nemaline myopathy is another rare disease that may benefit from pediatric dental treatment, as oral maxillofacial dystrophy is highly dysfunctional (Figure 5) and needs intervention and special care from birth.

Figure 5. Maxillary constriction in conjunction with anterior and bilateral posterior crossbites in a child with Carey Fineman Ziter syndrome that used a BiPAP from the age of 4 months.

Figure 6. Severe dentomaxillofacial pathology in a boy with congenital nemaline myopathy with one of the known mutations, nebulin. In addition to the compressed jaws, the maxilla has enormous retrusion, affecting several essential functions, from breathing to swallowing, chewing, and speaking.
Anyway, this is just one of the phases of the multidisciplinary treatment that may help oral functions in a moment of life, but that always needs to be complemented by other professionals, including pediatric surgeons, speech therapists, myofunctional physiotherapists, ENT, and others (Figure 6).

7. Other syndromes

RME proved to be a beneficial treatment in a patient with Turner syndrome. Followed by an esthetic rehabilitation of dental morphology proved feasible to achieve facial and smile harmony [50].

Also, in patients affected by imperfect osteogenesis and treated with bisphosphonates, RME could be performed with a standardized protocol without complications after a follow-up of one year [51].

In the case of a child with Schwartz-Jampel syndrome, severe OSA, constricted maxilla, and moderate tonsillar hypertrophy, who could not tolerate the initially prescribed CPAP, following RME therapy, as the pressure setting decreased, the patient showed better compliance with CPAP [52].

Rapid blood cell turnover and bone marrow expansion produced by beta-thalassemia (βT) lead to dentoalveolar and craniofacial abnormalities. The recent literature proposes early interceptive orthodontics to reduce dentoskeletal anomalies, severe malocclusion, and soft tissue imbalance. Therapy includes dental-maxillomandibular orthopedic and functional management with dental-maxillary treatment, preventing orthosurgical procedures later or minimizing their extent. So, an interdisciplinary approach involving a pediatrician, a hematologist, an orthodontist, and a pediatric dentist may enhance the patient’s quality of life [53].

Also, ETA proved beneficial in causing significant improvement in patients having combined cleft lip and palate [54]. These children’s conductive hearing loss and middle ear effusion improved significantly during RME and after six months of follow-up [55]. Also, a study showed that the correction of the palatal anatomy through RME had a positive and statistically significant effect on improving hearing and middle ear function in patients without cleft and with bilateral cleft lip and palate, with normal hearing levels and with mild conductive hearing loss. Likewise, RME significantly influenced voice quality in patients without cleft but had no significant effect in patients with bilateral cleft lip and palate [56].

8. The role of the pediatric dentist and orthodontist and the importance of early intervention

Early treatment of Class III syndrome resulted in better skeletal modifications with less dental compensation [57]. Early intervention with class III protraction facemask was less likely to need orthognathic surgery than untreated controls. Early class III ETA decreases the need for orthognathic surgery [58].

Starting orthodontic treatment as soon as symptoms occur is essential to enhance the effectiveness of therapy. Integrated medicine is necessary [5].

Besides, early intervention stimulates and improves several functions in children, young people, and adolescents.

The dentist must instruct these techniques to medical colleagues for the benefits they can bring to the general population and, specifically, to children with disabilities [1].
The dentist must check certain aspects of the child's ventilation, articulating with the pediatrician and the ventilatory difficulties team. Pediatric dentists and orthodontists play a progressively more important role in handling breathing problems and snoring with oral appliances, including RME [59]. Overall, parent satisfaction with their children’s RME therapy is significantly higher when supplied by pediatric dentists than orthodontists. Factors related to the doctor-patient relationship and situational aspects (i.e., office place and project, appointment waiting, and treatment length) substantially affected parent satisfaction [60].

9. Discussion

RME can be used to treat problems associated with the growth of the middle face and can produce positive side effects on the patient’s overall health. The RME and ETA procedures allow an increase of the whole nasal pyramid, causing benefits for the oral and general health of disabled children, seen in clinical evaluation and related by caregivers. Overall, esthetics and function improve significantly (Table 1).

The upper airway problem may be congenital, hereditary, or acquired, interfering in the size and position of the maxilla and in the greater or lesser tonus and synchrony.

| Effects | Respiratory (with better breath), better ventilation [11, 31, 33, 50, 64, 65]. Decreases the number of upper airway infections [11]. Improvement in chewing (more firmly and quickly) **[50, 66]. Improvement on swallowing [66] Drinking (faster)” [50]. Improves several parameters analyzed by speech therapists (sound modification—alteration of voice quality, word articulation, intelligibility, speech/diction) [10, 11, 50, 65, 67]. Improvement of AHI [4, 8, 31, 33, 35, 38, 40–42, 64, 68–70]. Improvement on snoring, reduced and quieter [10, 38, 70, 71]. Improvement of sleep, without nightmares and sudden waking with startle [4, 10, 38, 41]. Nocturnal sweating ceased [41, 70] Improvement on dribbling [10, 72]. Less sleepiness/fatigue during the day, irritability, tiredness, headaches, an increase of attention and activity [4, 11, 38, 41, 70]. Performance in school improved [38, 41, 70]. A smaller number of hours lost by family in medical consultations [11, 50]. Better general health and development [11, 50, 70]. The self-confidence of the individual enables his integration into society [10, 11, 66]. |

| Orofacial skeletal modifications: expansion of the maxilla, the opening of the midpalatal suture, and the skeletal structures like the nasal cavity [34]. Improvement on nasal symptomatology, rhinorrhea, and allergy and increase the area for nasal ventilation (nasal width) [9–11, 21, 33, 35, 38, 61, 62]. Better airway—increase in total upper [11, 31, 33, 50, 63] airways volume [64, 65]. Improves nasal permeability, mucus drainage, better drainage of secretions [10, 11, 50]. Otologic symptomatology: resolution from the serous otitis, hearing, decreased nasal edema, reduced mucosal inflammation, and improvement of an audiogram and tympanogram [10, 11]. Progress on mouth breathing, return of nasal breathing [4, 10, 11, 30, 31, 38]. Tongue mobility and positioning, more space in the oral cavity for the tongue, reduction of tongue protrusion and drooling [10, 11, 33, 35, 50, 62, 66]. Improvement on bruxism [4] Improvement on halitosis [4] Better skin Esthetics*** |

Table 1.
Reported effects of rapid maxillary expansion.
of the ligaments and muscles, including the vascular and nervous components of the organs in which it is integrated.

Some severe cases of respiratory disease may include the obligatory use of non-invasive ventilation during a high period of time and sometimes beginning in the first months of life. This required helpful device may have different consequences, depending on the time of use, the direction of the forces, type of appliance, place where the force takes effect, and hardness of the structure.

As we have seen, the absence of treatment for this situation can have serious consequences, and there are multiple treatment approaches. Among the different possibilities, the doctor must not forget the devices we are talking about, among many others with beneficial effects.

When we opt for any orthodontic techniques, we have to consider that the child may not be able to collaborate in the placement or use of the device, which is a limitation.

Furthermore, when expansion is achieved in children who are used to mouth ventilation, the collaboration of a myofunctional therapist may be imperative to teach and encourage nasal ventilation, meaning space is not enough. We have to train muscles to the desired function. Usually, in children, we use tonsillectomy and adenoidectomy to free up some space so that the child breathes better. RME is an alternative treatment to AT because it reduces nasal resistance and makes air passage through the nose easier. Besides enhancing the quality of nasal breathing, RME benefits the growth of the maxillary dental arch and thus enhances the tongue position, allowing proper sealing of the lips [13, 37, 73–76].

Children submitted to RME revealed an augment in the total nasal volume from the initial symptoms to after treatment that persisted over time. Besides, RME substantially increases nasal volume, $P < 0.05$, compared to the control group; these outcomes are constant through the retention period [3].

OSA children with maxillary constriction had no clinical complaint after treatment with RME. Also, clinical evaluations (orthodontic and otolaryngological) remain normal at the 12-year follow-up period. There was a substantial reduction of the AHI and its duration and a significant increase of SpO2 [31, 59]. Children with OSA, with dental malocclusion and treated with RME, improved AHI significantly, respiratory symptoms and nasal resistance diminished, and nasal breathing returned in almost 80% of the children [59].

It remains crucial to understand if RME alone is sufficient for treating mild OSA if significant adenotonsillar hypertrophy is present or if surgery is necessary. When combined with the two techniques, it will not be relevant which treatment is started first as both will be necessary. Still, in some circumstances, there will be the possibility that one treatment performed first solves the problem [74].

The long-term evolution of RME treatment suggests that a reappearance of elderly symptoms is possible, so follow-up is recommended to avoid recurrence [75].

Remember that relapse is always possible and a retention period, sometimes forever (fixed contention), is necessary.

Beckwith-Wiedemann, Marfan’s, Crouzon, or Down Syndrome are characterized by a specific phenotype and OSA prevalence [9–11, 40, 76–80].

Applying these techniques always requires a prior individualized study, holistically considering the patient, evaluating their ability to collaborate and the child’s different family, social, cognitive, and developmental aspects. And some pathologies do not get better with ERM, like Solitary Median Maxillary Central Incisor Syndrome [81] that does not benefit from RME despite the typical nasal and maxilla anomalies.
The different conditions may present with their specifications or integrate with other pathologies, making it difficult to differentiate the treated problem. So, we need to get better definitions of each condition, which may appear as technology gets better.

If we want an increase in the oronasal and pharyngeal space, we depend on the children’s occlusion before and after treatment.

The generality of studies are about mechanical effects of fixed appliances and do not aim at general health, not approaching themes such as cardiovascular risk, neurocognitive impairment or quality of life and the consequences to child’s development.

The importance of the intervention of the pediatric dentist and the techniques used are poorly known among physicians and pediatricians, so its dissemination to family doctors and other specialties is essential, and hospital teams that include the different professionals should be rapidly implemented.

10. Conclusions

Despite being very well documented, this technique is often unremembered. It is vital to maintain the studies involving RME and ETA in disabled children, analyzing the differences before and after the treatment regarding clinical outcomes and personal development.

More studies need to address these positive effects on disabled children.

Regardless of the importance of this treatment for the child’s development, the intervention should have an interdisciplinary team (oral, dentomaxillary, pediatric, ENT, total myofunctional rehabilitation) to improve these children’s quality of life and should be mainly focused on functions.

Conflict of interest

The authors declare no conflict of interest.

David Casimiro de Andrade, Joana Andrade and Maria João Palha are responsible for the conception and design, data collection and manuscript redaction.

Cristina Areias, Paula Macedo, Ana Norton, Miguel Palha, Lurdes Morais, Dóris Rocha Ruiz and Sônia Groisman were responsible for the critical revision of its intellectual contents.

David Casimiro de Andrade was responsible for graphics and photos, the critical revision of its intellectual contents, and the final approval of the version to be published.

All authors declare that written informed consent was obtained from the patient (or other approved parties) to publish this research paper.
Author details

David Andrade*, Joana Andrade, Maria-João Palha, Cristina Areias, Paula Macedo, Ana Norton, Miguel Palha, Lurdes Morais, Dóris Rocha Ruiz and Sônia Groisman

1 Faculty of Dental Medicine, University of Porto, Porto, Portugal
2 Clínica Dentária de Espinho, Espinho, Portugal
3 Santa Maria Hospital, Lisbon North University Hospital Center, EPE, Avenida Professor Egas Moniz, Lisbon, Portugal
4 Child Development Centre Diferenças, Lisbon, Portugal
5 North Maternal and Child Centre from Centro Hospitalar do Porto, Porto, Portugal
6 Faculty of Medicine, University of São Paulo, São Paulo, Brazil
7 Faculty of Dentistry, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

*Address all correspondence to: casimirodandrade@gmail.com

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