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Review Article

Orthodontic Management of Syndromic Patients- A Review

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Abstract

Syndrome is a group of symptoms which consistently occur together, or a condition characterized by a set of associated symptoms. A relatively small number of orthodontic patients are affected by known genetic syndromes that affect oral structures. The greatest value in knowing that a patient has a particular syndrome is that it allows a much better prediction of future development in the individual who will not grow in the normal pattern. Therefore this review provides features of these syndrome and a review of the previous cases reported, so that the possibility of occurrence of anomalies in a particular individual can be identified and any particular precaution during the treatment can be followed.

Keywords: Syndromes; Orthodontic Patients; Craniofacial

Introduction

Progress in medicine, higher expectations of quality of life, increased life expectancy have resulted in a greater demand for elective dental and medical treatment [1]. Orthodontists need to be aware of the possible clinical implications of many of these diseases. In addition orthodontists see their patients every 6 to 8 weeks and rapidly developing medical problems can manifest themselves at any age. Orthodontists must remain vigilant as they may be the only health care professional seen by otherwise fit, young patients on a regular basis [2].

Syndrome is a group of symptoms which consistently occur together, or a condition characterized by a set of associated symptoms. A relatively small number of orthodontic patients are affected by known genetic syndromes that affect oral structures. The greatest value in knowing that a patient has a particular syndrome is that it allows a much better prediction of future development in the individual who will not grow in the normal pattern. Sometimes recognizing a syndrome is made more difficult by incomplete expression of the genes. If a genetic syndrome is suspected, then the orthodontist should have the patient evaluated. Specific groups, such as those with Down's syndrome or cerebral palsy, have been associated with increased frequencies of malocclusion and particular dental features.

Over the past years there is an increase in number of such patients due to improved medically techniques leading to diagnosis both prenatal and postnatal and also increasing their life expectancy. These children are now more readily accepted in society and are involved in some or other work depending on their mental and physical skill level.

But still somewhere children with syndromes pose a burden to their families and environment in all aspects of their day to day care and needs. Orthodontic treatment cannot resolve their physical and mental handicap but can place new and extra burdens on children and their parents.

This article examines aspects of some of the conditions that are of relevance to orthodontic practice. A comprehensive medical history should be taken and regularly updated. Case notes should alert the clinician to the patient's medical status. All medical conditions should be accurately understood before any treatment is planned and this may involve seeking guidance from the patient's physician. Patients should be well informed of all the options and made aware that any orthodontic treatment has been planned with their best interests at heart. It should be highlighted they are not being penalized for their medical condition. The importance of excellent oral hygiene should be emphasized to all patients considering a course of orthodontics.

Inheritance pattern of various syndromes

Syndrome	Inheritance Pattern
Noonan Syndrome	Autosomal dominant
Oculofacial cardio dental Syndrome	X-linked dominant
Treacher Collins Syndrome	Autosomal dominant
Oro-facial-digital Syndrome	X-linked dominant
Ehlers-Danlos Syndrome	Both Autosomal dominant and Recessive
Pfeiffer's Syndrome	Autosomal dominant
Apert Syndrome	Autosomal dominant
Lowe Syndrome	X-linked Recessive
Turner Syndrome	Non- Inherited
Marfan Syndrome	Autosomal dominant
Stickler Syndrome	Autosomal dominant
Witkop tooth and Nail Syndrome	Autosomal dominant
Klippel-Feil Syndrome	Autosomal dominant
Beckwith-Wiedemann Syndrome	Mixture of different inheritance patterns
Auriculo-condylar Syndrome	Autosomal dominant
Klippel-Trenaunay-Weber Syndrome	Autosomal Recessive
SMMCI Syndrome	Autosomal dominant
Silver Russell Syndrome	Autosomal dominant
Eagle's Syndrome	Autosomal dominant
Cleidocranial Syndrome	Autosomal dominant
Van der Waude's Syndrome	Autosomal dominant
William's Syndrome	Autosomal dominant
Binder Syndrome	Both Autosomal dominant and Recessive
Ellis-van Crevold Syndrome	Autosomal Recessive
Down Syndrome	Trisomy21 (Not Inherited)
Pierre-Robin syndrome	Autosomal Dominant

Noonan syndrome

A developmental disorder characterized by a dysmorphic facial structure, short stature, and mild mental retardation with associated cardiac defects and skeletal malformations The facial construct includes a broad forehead, prominent eyes, hypertelorism, hooded eyelids, down slanting palpebral fissures, low-set posteriorly rotated ears with a thick helix, and a bulbous tip of the nose with a wide base and thick lips. Orthodontically, a there is severe maxillomandibular discrepancy, long face (hyperdivergence), micrognathia, excessive gingival display at smile, high arched palate, an open bite or an increased overjet, Bolton discrepancies, oligodontia, and dental deformities. Sergio and Cardiel [3] prescribed tongue exercises to improve swallowing in his patient.

Oculofaciocardiodental syndrome

A rare syndrome characterized by ocular, facial, cardiac, and dental disorders. The most prominent feature is canineradiculomegaly. Other include a long and narrow face, a high nasal bridge, a broad and pointed nose, a bifid nose, ear deformity, cleft palate or submucous cleft palate, maxillary growth retardation, a large gonial angle, open apices, delayed eruption, persistent deciduous teeth, extreme overbite, and constricted maxilla. In orthodontic treatment light forces are applied to minimize the risk of root resorption and ankylosis [5]. In another case reported surgical treatment plan was chosen involving expansion of the maxilla and use a bilateral sagittal split osteotomy [4].

Treacher Collins syndrome (mandibulofacialdysostosis and Franceschetti- Zwahlen-Klein syndrome)

It is a disorder of craniofacial development. Airway obstruction and feeding difficulties result from severe mandibular hypoplasia and the resulting glossoptosis. The oral manifestations include high palatal vault, clefting of the palate, enamel hypoplasia and anterior open bite. Dental malocclusion involving malpositioned and reduced number of teeth is frequently observed. Tooth agenesis, mainly mandibular second premolars, and ectopic eruption -of the maxillary first molars. In 11-year-old boy expansion of the maxillary arch to correct the transverse discrepancy, and extraction of permanent teeth to correct the arch length tooth-size discrepancy were necessary. Surgical treatment was needed to correct the open bite and improve the soft-tissue profile. Mandibular distraction osteogenesis was considered to address the micrognathia [6].

Oral-facial-digital syndrome

It is a syndrome of which the chief symptoms are oral, facial, and digital malformation. Kunishige Nagahara., *et al.* [7] and Ozturk and Doruk [8] presented case in which occlusal stability after correction of this malocclusion was achieved with the up-righting of the posterior teeth, surgical reduction of the enlarged tonsils and highly attached tongue frenum, and oral functional training.

Ehlers-Danlos syndrome

The Ehlers-Danlos syndrome(s) are a group of heterogeneous inheritable connective tissue diseases. They share cardinal features of joint hypermobility and hyperextensibility, plus fragility and tendency toward bruising of the connective tissues, grossly characterized as excessive elasticity of the skin and laxity of the joints. Norton and Assael, has reported two cases [9]. They concluded that although optimal results of orthodontic and TMJ therapy can be affected by the presence of EDS, traditional acceptable treatment methods can still be successfully used, but with a caution that comes from an understanding of the pathophysiology of the syndrome. Tulin Arun., *et al.* [10] reported a 17-year-old male patient presenting EDS type VI. Because of the risks of bleeding and poor healing, it was elected to treat the patient without surgery. Because the patient had abnormalities of the connective tissue, which lead to poor healing, special care was given to his oral hygiene and periodontal status. Catharina Hagberg., *et al.* [11] found that persons with EDS are naturally predisposed to TMJ problems.

Pfeiffer's syndrome

This syndrome is associated with midfacial retrusion, craniosynostosis, broad thumbs and large toes, and partial syndactyly. Hydrocephaly is also found occasionally, along with severe ocular proptosis, ankylosed elbows, abnormal viscera, slow development, significant upper airway compromise, and obstructive sleep apnea. Dental characteristics of the syndrome are similar to those of Apert's syndrome, Crouzon's syndrome, and other craniofacial synostoses. General dental characteristics are maxillary hypoplasia, Class III malocclusion, anterior and posterior crossbites, anterior open bite, and severe crowding of the maxillary arch due to hypoplasia.

YongJong Park., *et al.* [12] presented a report on a patient with Pfeiffer's syndrome treated by midfacial distraction and comprehensive orthodontics.

Apert syndrome

Apert syndrome is characterized by irregular craniosynostosis, midface hypoplasia, and syndactyly of the fingers and toes. Oberoi, Hoffman, and Vargervik [13] reported 8 cases and concluded that management of individuals with Apert syndrome requires a team of experienced specialists and extends over the entire growth period from infancy to adulthood. R David Rynearson [14] did a multisegmental LeFort I maxillary osteotomy to address the transverse, sagittal and coronal skeletal discrepancies.

Turner syndrome

This syndrome is the combination of short stature, sexual infantilism, webbed neck, and cubitus valgus in females. Russel [15] treated a case with turner syndrome with Orthognathic surgery involving a 3- piece segmental and differential maxillary LeFort 1 osteotomy with concomitant anterior bone grafting and an asymmetric bilateral sagittal split ramus osteotomy with a midline mandibular advancement and genioplasty advancement. Hass., *et al.* [16] concluded that short and retrognathic face characteristic of the syndrome was due largely to the increased cranial base angle, decreased posterior face height, and decreased mandibular length. Although increases in statural height occurred in the TS children who were treated with human growth hormone (GH), there was little or no effect on growth of the jaws, particularly in the older subjects, and the characteristic facies of the syndrome persisted. Dental development was advanced in all TS subjects, and GH administration had no effect on the rate of dental development. According to Marit Midtbo [17] compared with normal girls overjet did not differ significantly while overbite was significantly reduced in 45X patients. The prevalence of distal molar occlusion, anterior and lateral open bite and lateral crossbite was significantly increased. Marja Perkiomaki [18] suggested that maternal influences contribute to the growth of a distinct cranial base and to the magnitude of mandibular retrognathism of subjects with TS.

Marfan syndrome

Marfan syndrome is a disorder of connective tissue that can affect the heart, blood vessels, lungs, eyes, bones, and ligaments. It is characterized by tall stature, elongated extremities, scoliosis, and a protruded or caved-in breastbone. Patients typically have a long, narrow face, a high-arched palate produced by a narrow maxilla and skeletal Class II malocclusion due to mandibular retrognathia. For a patient with no family history of the disorder, at least three body systems must be affected before a diagnosis can be made. In a case report, the authors present the records of three patients with Marfan syndrome. Two patients had severe periodontal disease in the absence of significant contributing local factors. The syndrome thus went unnoticed in one patient for many years [19].

Stickler syndrome

Stickler syndrome is characterized by midfacial flattening and variable disorders of vision, hearing and articulation. The Japanese female patient presented [20] with Stickler syndrome was characterized by a flat midface and had high myopia, sensorineural hearing loss, enlarged joints, and cleft of the soft palate. She had fairly

small SNA and SNB angles and a steep mandibular plane with an enlarged gonial angle. The incisors of both arches were retroclined, and a large overjet and overbite were noted. Orthodontic treatment was initiated at 11 years of age using a lingual arch appliance followed by an edgewise multibracket appliance.

Witkop Tooth and Nail Syndrome

A case report [21] presents the orthodontic treatment of a patient with Witkop syndrome, characterized by the absence of several teeth and abnormalities of the nails. The patient, showed peg-shaped maxillary lateral incisors and the congenital absence of three mandibular incisors as well as spoon-shaped fingernails. Treatment of open-bite and overjet was initiated with functional appliances, and fixed orthodontic appliances were inserted at age 10 years 3 months. The edentulous spaces were maintained for implants that were supposed to be provided once the patient's growth is complete.

Klippel-Feil syndrome

Klippel-Feil syndrome is mainly characterized by congenital fusion of at least two of seven cervical vertebrae in the cervical spine, with limitations to movement of the head or neck, a short neck, and a low posterior hairline. Fusion or anomaly of the vertebrae may be apparent in the thoracic or lumbar spine. KFS is occasionally associated with cleft lip and palate (CLP) and frontonasal malformation. Toshihiro [22] reported a case of 8 year old who had unilateral cleft palate along with KFS. Examination of the lateral cephalogram from this patient incidentally revealed anomalous cervical vertebrae in the cervical spine.

Beckwith-Wiedemann Syndrome

Macroglossia, is the most common symptom of the Beckwith-Wiedemann Syndrome along with protruded lower lip, mandibular protrusion and anterior open bite. In the case report the jaw base relationship improved to skeletal Class I and the molar relationship to Angle Class I at the early preadolescent period following tongue reduction and phase I orthodontic treatment using a chin cap and tongue crib. Optimum intercuspation of teeth was achieved after edgewise treatment without orthognathic surgery, and a skeletal Class I apical base relationship and good facial profile were maintained. Shouichi Miyawaki., *et al.* [23] suggests that early orthodontic treatment with tongue reduction can be effective to improve an abnormal dentoskeletal pattern. A woman with BWS was treated and followed for 30 years. Treatment consisted of tongue reduction, orthopedic and orthodontic treatment, orthognathic surgery, and retention [24].

The auriculo-condylar syndrome

Clinical signs of the syndrome include auricular malformation, hypoplasia of the mandibular condyles, anomalies of the temporomandibular joints, malocclusion, and, in more severe cases, cleft palate, glossoptosis, facial asymmetry, and respiratory problems. Distraction osteogenesis was chosen as the surgical procedure of choice to increase the vertical height of the mandibular rami and to establish a more acceptable condyle-to-fossa articulation. An alternative surgical option to ramus distraction osteogenesis would consist of reconstruction of the ramus-condyle complexes with bilateral costochondral grafts. This option would be chosen if the ramus-condyle deformity was even greater, as would be the case in a Kaban type III deformity. Furthermore, TMJ reconstruction with costochondral grafts carries with it far greater postoperative morbidity than intraoral distraction osteogenesis and does not stretch the soft tissue envelope (distraction histogenesis). For this reason, costochondral grafting is regarded as a potentially less stable procedure than distraction osteogenesis. A similar treatment is usually selected for patients presenting with hemifacial microsomia [25].

Klippel-Trenaunay-Weber syndrome

It is a congenital, non-inherited abnormality, characterized by the triad of vascular nevi, venous varicosities, and ipsilateral hyperplasia of soft tissue and bone. When combined with arteriovenous fistulas, the syndrome is known as Klippel-Trenaunay-Weber syndrome. Michele Bolan [26] treated a girl (aged 8.5 years) with Rapid palatal expansion with Haas palatal expander was activated for 15 days and remained in the oral cavity for splinting purposes for 6 months; it was then replaced by a removable acrylic plate with a Hawley arch.

Solitary median maxillary central incisor (SMMCI) syndrome

This anomaly is characterized by a symmetric central incisor of normal size located exactly in the midline of the maxilla. It is characterized by high labial position, malformation in the palatal suture, V-shaped palate with prominent mid-palatal ridge, and absence of labial frenulum and incisive papilla. Michele Bolan [27] treated a case with syndrome with rapid maxillary expansion. A Haas expander was used and activated twice per day (quarter turn per activation) for 15 days. Although the crossbite was clinically corrected after the expansion, radiographs and tomographs showed no opening of the mid-palatal suture.

Silver Russell syndrome

Generally the calvarium is normal or slightly smaller, with the appearance of pseudohydrocephaly, frontal bossing, triangular facies, a small and pointed chin with a hypoplastic mandible, and a high, arched palate. Microdontia, crowding, congenital absence of lateral incisors, second premolars and dental abnormalities have also been reported. The upper lip vermilion is thin, and the corners of the mouth are often turned downward. The ears are set low, with protruding pinnae. Delayed closure of the anterior fontanelle is an occasional finding. Reha S Kisnisci [28] reported a patient who was treated by means of distraction osteogenesis of the mid-symphysis to widen the mandible in concert with sagittal-ramus osteotomies to lengthen the mandible. This treatment created significantly increased arch length in the mandible.

Eagle's syndrome

Eagle's syndrome, or styloid-stylohyoid syndrome, is characterized by styloid process elongation or stylohyoid ligament ossification. This syndrome can be associated with various symptoms, none of them pathognomonic: dysphagia, sore throat, otalgia, and vague facial pain. The symptoms are based on the length of the styloid process, which originates from the temporal bone and proceeds between the internal and external carotid arteries. Pithon reported a case [29] on orthodontic treatment of patient described a surgical intervention to remove the calcified process.

Cleidocranial dysplasia

Clavicle hypoplasia results in placement of the shoulders close to the front of the body, and these patients often seem to have a long neck. The face is brachycephalic with an increased transverse diameter of the skull. The eyes are widely spaced, and the base of the nose is depressed and wide. In addition, midfacial hypoplasia, related to the shortened anterior cranial base, and a prognathic mandible are craniofacial anomalies frequently associated with the condition. Patients also have reduced height of the lower third of the face and a skeletal Class III tendency. The oral findings usually are retained deciduous teeth without root resorption and supernumerary teeth that displace the developing permanent teeth and obstruct their eruption, resulting in multiple impacted permanent teeth and a serious malocclusion. Rocha., *et al.* [30] describes the treatment and long-term follow-up care of such patient who was treated with a multidisciplinary therapeutic protocol including orthodontic and surgical procedures, and traction of 11 permanent teeth.

Van der Woude's syndrome

Van der Woude's syndrome (VDW) is characterized by cleft lip and/or palate and lower lip pit (fistula). Treatment of a Japanese girl had been reported [31] who had treatment with a removable maxillary expansion appliance, followed by an edgewise multibracket appliance in both arches. Retention began at 11 years of age, and a secondary bone graft was performed for the alveolar cleft. She received prosthetic treatment and achieved a desirable occlusion at 18 years of age.

Williams's syndrome

Williams's syndrome (WS) is a rare congenital disorder with distinctive craniofacial features, cardiovascular abnormalities, mental retardation, and behavior characteristics. Stephan Axelsson., *et al*. [32] investigated the size and morphology of the sella turcica on profile cephalograms in a group of individuals with WS. Five different morphological types were identified; oblique anterior wall, extremely low sella turcica, sella turcica bridging, irregularity (notching) in the posterior part of the dorsum sellae, and pyramidal shape of the dorsum sellae. The occurrence of these morphological types was more frequent in the WS subjects compared with the reference material, except for sella turcica bridging, which was equally frequent. The females had more dysmorphic sella turcicas than males.

Binder Syndrome

Binder's Syndrome (Maxillo-Nasal Dysplasia) is a developmental disorder primarily affecting the anterior part of the maxilla and nasal complex. The syndrome involves hypoplasia of variable severity of cartilaginous nasal septum and premaxilla. It includes complete total absence of the anterior nasal spine. There are also associated anomalies of muscle insertions of the upper lip and the nasal floor and of the cervical spine. Bodil Rune., *et al.* [33] examined the effect of posteroanterior traction in an 11-year-old boy with maxillonasal dysplasia. Face-mask therapy mainly influenced the position of the mandible while the recorded advancement of the maxillary bones was slight (0.6 mm). It is possible that the limited maxillary response to traction may be due to insufficient growth capacity of the circummaxillary sutures in a child with maxillonasal dysplasia. While movement of the maxillary bones and of the mandible during traction conformed with the pattern of treatment effect described by Delairea total maxillary relapse occurred in the posttreatment observation period (no retention), possibly in adaptation to the retropositioned mandible. McCol-

lum and Wolford [34] presented two cases treated by two different techniques with long-term follow-up. The first patient was treated with traditional orthognathic procedures, whereas the second was treated with a growth-center implant to the nose and orthodontics to treat the occlusion. Nordenram., *et al*. [35] studied the influence of orthodontic treatment on facial growth in subjects with maxillonasal dysplasia. No influence on craniofacial growth could be demonstrated. The growth pattern seemed, however, to follow about the same rate in both groups.

Ellis-van Creveld syndrome

Diagnostic criteria include postaxial polydactyly of the hands, short limb dwarfism and dysplastic fingernails and teeth. Margarita Varela and Carmen Ramos [36] presented case report of a girl, who showed bilateral postaxial polidactilia (hexadactilia) of both hands and the left foot. Orthodontic treatment was started with a cervical headgear and a full fixed appliance to correct the Angle Class II, division 1 malocclusion and to prepare the spaces for implants in the place of the anodontic incisors. The most prominent fraenula were eliminated and both bell-shaped central incisors were recontoured.

Down syndrome

Individuals with Down syndrome present with various characteristic physical and systemic manifestations, with the craniofacial manifestations being the most distinctive. Craniofacial features reported include midface deficiency, mandibular prognathism, depressed nasal bridge, slanting eyes with epicanthic folds, ocular hypotelorism, and strabismus. Perioral muscles are also affected by muscle hypotonia, leading to a descending of the angle of the mouth. Frostad., *et al.* [37] found that the overall size of the craniofacial complex was smaller in DS subjects. Fink., *et al.* [38] concluded that the sagittal area of the endocranium, the area of the midfacial region, and the area of the mandible in subjects with DS is significantly smaller than normal. Fischer-Brandies., *et al.* [39] reported that both the maxilla and mandible in DS patients exhibit hypoplasia at birth. In a subsequent study, Fischer-Brandies [40] revealed that the maxilla was underdeveloped when compared to normal subjects. Quintanilla., *et al.* [41] added that DS subjects usually demonstrate reduction of the anterior skull base and protrusion and proclination of lower incisors. Suri., *et al.* [42] found that DS patients have a larger cranial base angle, reduced elevation of sella from Frankfort horizontal plane, reduced anterior and posterior cranial base lengths and facial heights, smaller maxilla with reduced anterior basal and apical dimensions, and smaller mandibular ramus and body. Anterior open bite was frequently noted with a forward rotation pattern of both maxillary and mandibular planes. Alio., *et al.* [43] concluded that the maxilla in DS subjects showed hypoplasia in both the vertical and the sagittal planes, with a mean deficit of almost 10 mm in the latter.

Discussion

Orthodontic treatment is an elective procedure and clinicians should consider all the treatment options to ensure a satisfactory risk-benefit ratio for each and every case. Comprehensive treatment may not always benefit the patient. Orthodontists should be well aware of the patient's syndromic condition and all the features associated with it. The treatment plan should be formulated in such cases cautiously taking care of possible factors like increased root resorption, delayed healing, hypomaturation of bone and teeth, missing teeth, supernumerary teeth, possibility of presence of cyst etc. In Oculofaciocardiodental syndrome open apices, delayed eruption, persistent deciduous teeth, extreme overbite, and constricted maxilla are often seen. Treacher Collins syndrome expansion of the maxillary arch to correct the transverse discrepancy, and extraction of permanent teeth to correct the arch length tooth-size discrepancy were necessary. Ehlers-Danlos syndrome share cardinal features of joint hypermobility and hyperextensibility, plus fragility and tendency toward bruising of the connective tissues, grossly characterized as excessive elasticity of the skin and laxity of the joints. Dental characteristics of Pfeiffer's syndrome are similar to those of Apert's syndrome, Crouzon's syndrome, and other craniofacial synostoses. General dental characteristics are maxillary hypoplasia, Class III malocclusion, anterior and posterior crossbites, anterior open bite, and severe crowding of the maxillary arch due to hypoplasia. Management of individuals with Apert syndrome requires a team of experienced specialists and extends over the entire growth period from infancy to adulthood. Turner syndrome is the combination of short stature, sexual infantilism, webbed neck, and cubitus valgus in females. Marfan syndrome patients typically have a long, narrow face. A high-arched palate produced by a narrow maxilla and skeletal Class II malocclusion due to mandibular retrognathia are other common features.

Conclusion

Orthodontists should be well aware of the patient's syndromic condition and all the features associated with it. Consult and involvement of other specialties might be needed in both diagnosis and treatment planning.

The treatment plan should be formulated in such cases cautiously taking care of possible factors like increased root resorption, delayed healing, hypomaturation of bone and teeth, missing teeth, supernumerary teeth, possibility of presence of cyst etc.

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