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(REVIEW ARTICLE)

Malocclusions and oral disorders associated with cleft lip and palate; Prevention and treatment

Berrezueta Reyes Eva Estefanía [1], Loja Arpi Paola Abigail [1], Méndez Álvarez Paúl Santiago [1], Padilla Viñanzaca Érika Paola [1], Peralta Quezada Jéssica Daniela [1,*] and Yunga Picón María Yolanda [2]

[1] *Student of Faculty of Dentistry of the University of Cuenca, Ecuador.*
[2] *Professor of Orthodontics. Faculty of Dentistry, Universidad de Cuenca, Ecuador.*

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Abstract

Cleft lip and palate are congenital malformations with the highest prevalence worldwide, its etiology is multifactorial and produces different dental anomalies and occlusal alterations. The present study aims to review the literature to gather information on the association of cleft lip and cleft palate in the development of occlusal disorders that cause problems in swallowing, speech, feeding and breathing. A descriptive review was performed with a qualitative approach of the literature, including original articles, systematic reviews and bibliographic reviews published after 2019. Once the information was analyzed, it is evident that congenital malformations play an important role in the establishment of occlusal alterations that affect the correct development of the stomatognathic system. In conclusion, cleft lip and palate have a negative impact on facial and occlusal structures.

Keywords: Cleft lip; Cleft palate; Occlusal alterations caused by malocclusions

1. Introduction

Congenital malformations are responsible for the development of craniofacial defects, anomalies and certain bone discrepancies. Cleft lip and cleft palate are malformations caused by the nonunion of embryonic facial processes. Most of these congenital anomalies are structural alterations that have a considerable impact on facial development with clinical relevance. [1,2,3]

The alterations in form and function related to cleft lip and palate include difficulty in feeding, speaking clearly, learning complications, social interaction, dental problems and/or occlusal alterations, affecting their growth, development and psychological well-being. It is important that professionals recognize these alterations in order to provide multidisciplinary care according to what is established by health systems worldwide. [4,5,6]

Cleft lip and palate cause negative consequences at the esthetic level and in the normal development of the stomatognathic system, altering the balance and facial harmony as well as the maxillary growth and the dento-occlusal development. Consequently, these patients present a concave facial profile, differences in the relationship of the vertical facial structures, in the base of the skull, as well as in the length of the arch, which leads to maxillary hypoplasia. Maxillary hypoplasia is a facial deformity caused by cleft lip and palate, it presents different degrees of severity in transverse, vertical and sagittal sense, depending on the severity of the anomaly, if it is complete/incomplete or unilateral/bilateral. Transverse malocclusions caused by maxillary hypoplasia should be solved with early treatment of the jaws with expansion, in growth stages, obtaining condylar stability, dental symmetry and favorable mandibular rotation during the mixed dentition. This is the optimal stage to guide occlusion and intercept malocclusions. [2,6,7,8]

*Corresponding author: Peralta Quezada Jéssica Daniela https://orcid.org/0009-0003-1116-5011

The objective of the present study was to review the literature in order to gather information on how cleft lip and palate are associated with the development of facial structures and occlusal alterations, and to establish possible solutions or treatments to benefit these patients.

2. Material and methods

This scientific article has been developed under a descriptive research methodology with a qualitative approach where the tools used to organize scientific articles and data obtained were Mendeley and Google Drive. A search and compilation of scientific articles in English and Spanish was carried out in relation to the association of cleft lip and cleft palate in occlusal alterations and facial structures. Different databases were used such as Pubmed, Scopus and Scielo using keywords together with Boolean operators such as "AND", "AND", "OR", "IN".

The inclusion criteria used were: scientific articles published from 2019 to 2023, articles related to the topic of study, articles in English and Spanish, availability of full text, descriptive article, systematic reviews. On the other hand, the exclusion criteria were: scientific articles prior to 2018, animal studies, studies with undetermined research methods and results obtained, and articles repeated in the databases analyzed.

The initial selection in the digital databases was made by means of keywords resulting in 945 articles, subsequently by reading the title and abstract a total of 75 articles related to the topic were selected. After this, the selected articles were read by reading the introduction to determine if the study included the topic of interest of this review, otherwise they were excluded. Twenty-eight articles were included in this review to obtain the corresponding data.

3. Theoretical framework

3.1. Cleft lip and cleft palate

Cleft palate and cleft lip are common congenital malformations and are caused by a failure in the fusion of the tissues that will give rise to the upper lip and palate. The embryonic development of the primitive mouth begins between 28 and 30 days of gestation, with the migration of cells from the neural crest to the frontal part of the face; later between the fifth and sixth week the frontonasal and mandibular processes, which are derived from the first pharyngeal arch, form the primitive mouth. Following development, the palatine processes fuse with the middle nasal septum forming the palate and uvula around 60 days of formation. [9,10]

Lip palatal fissures are the result of nonunion of the medial and lateral processes of the face during embryonic development. They may occur in the lip or palate or combined. [10]

According to Philip, Lewis and Wysocki's Contemporary Oral and Maxillofacial Pathology (2012), cleft lip is defined "As a developmental disorder, characterized by a wedge-shaped defect resulting from an absence of fusion of the two parts of the lip into a single structure" and cleft palate "as a developmental defect of the palate characterized by the absence of complete fusion of the two palatal ridges, resulting in communication with the nasal cavity" [11].

Cleft lip and palate is considered to be of multifactorial etiology, which can be genetic, environmental or nutritional. When describing the environmental factors we can highlight the action of teratogens which modify embryonic development and produce malformations, which when acting in an environment with the interaction of other variables result in these malformations. It is worth mentioning that in most cases, the prevalence of these oral malformations is related to risk factors that include the greater number of gestations of the mother, maternal age, family history. Research suggests that taking vitamin supplements with folic acid before and during pregnancy prevents cleft lip. Prevention is especially important if either parent had cleft palate. In these families, folic acid supplementation may reduce cases by less than half[9,10] .

Cleft lip and/or palate research aims at the appropriate treatment of the most common congenital craniofacial anomaly worldwide, which affects 1 in every 500 to 700 newborns, according to data from the World Health Organization. Cleft lip, whether it involves the palate or not, occurs in 1 in 1000 births, being more frequent in males, while cleft palate only occurs in approximately 1 in 2500 births and is more common in females. [9,11,12]

The areas affected by the malformations are usually the upper lip, alveolar ridge, hard palate and soft palate. Slightly more than 50% are combined clefts of the lip and palate and about a quarter of them are bilateral. The consequences of these malformations not only affect the physical appearance of the face, but also cause complications in feeding, hearing,

language, occlusion, self-esteem and influence upper respiratory diseases (affecting the nose and paranasal sinuses) and lower respiratory diseases (affecting the lungs), hypoplasias of the upper maxillary bone. At the dental level, enamel hypoplasias, dental caries, anodontia, ectopic eruption, gingivitis and periodontitis occur more frequently. [9,12]

Cleft lip, with or without cleft palate, can be diagnosed during pregnancy by routine ultrasound. They can also be diagnosed after the baby is born, especially cleft palate. The treatment of patients with these malformations is comprehensive, multidisciplinary (several disciplines, the treatment can be in different stages) and interdisciplinary (cooperation of several disciplines in a single phase), obtaining very satisfactory results, both functional and aesthetic. The usual surgical procedures can be more than 15 surgeries depending on the case. Sometimes early surgical treatment, such as surgical closure of the hard palate, generates fibrosis during healing, preventing normal development of the upper jaw, resulting in Angle class III occlusion and the development of a pseudoprognathic profile. [11,12,13.]

3.2. Occlusal alterations

The term "occlusion" means closing, so "dental occlusion" refers to the closing of the antagonist teeth, in the strict and etymological sense of the term; However, the diversity of types of occlusion and the marked individual differences in occlusal patterns have led to the evolution of the concept of dental occlusion from a static idea to a dynamic concept, where teeth, the maxilla, the mandible, the temporomandibular joint and the muscles remain in a dynamic equilibrium that guarantees the functional state of the stomatognathic system. [13]

The basic functions of the stomatognathic system are chewing, swallowing and phonation, and they depend not only on the teeth, but also on the relationship of the antagonist teeth when they come into occlusion. [13]

According to the World Health Organization, malocclusions rank third in prevalence of oral health diseases, after dental caries and periodontal disease. The behavior of malocclusions worldwide ranges from 35 to 75 %. Latin America is no exception, as the region has high levels of incidence and prevalence of malocclusions that exceed 85 % of the population. It is estimated that between 20 and 30 million children in Latin America suffer from some type of dentomaxillofacial anomaly. [13]

A frequent problem in the infant dentition is occlusal interferences, which can generate functional malocclusions such as anterior open bites, midline deviations, anterior and posterior crossbites. Cleft palate affects craniofacial growth and the sum of these conditions results in vertical, sagittal and transverse malocclusion that can be difficult to treat. [13,14]

3.3. Influence of cleft lip and cleft palate on malocclusions

Cleft lip and palate present anatomical alterations that generate a low potential for growth and development of the maxillofacial structures. In the primary dentition stage in patients with cleft lip and palate, successful treatment of the malocclusion is important for oral function, speech development and maintenance of space for the permanent dentition; however, there are particular characteristics that influence the treatment such as the anatomy of the cleft area, dental anomalies of shape, structure, number and position, alterations in dental eruption and scar fibrosis secondary to surgery that affects correct oral hygiene. [11,15]

The development of craniofacial structures in the presence of cleft lip and palate are analyzed to establish mechanisms and determinants of facial development. Consequently, growth problems of the dentofacial complex in patients with these congenital malformations are generally reflected in the anteroposterior and transverse dental relationship. [15,16].

Different methods of recording these dental relationships have been used to document the outcome of surgery in cleft patients. The most common malocclusions in patients with cleft lip and palate are: an Angle molar class III, Angle molar class II, similarly, anterior crossbite is greater than posterior crossbite and anterior overcrowding is greater than anterior undercrowding. [11,15,16]

Treatments to improve or decrease cleft characteristics are divided into two major areas: surgical and nonsurgical, the surgical option encompasses maxillofacial and plastic procedures. The non-surgical area includes stomatology, otorhinolaryngology, phonoaudiology, pediatrics, psychology, genetics, orthodontics, social work, and nutrition. [11,15]

Within the non-surgical treatment there is a pre-surgical option which consists of a procedure based on maxillary functional orthopedic plates that will favor the stimulation and remodeling of the nasal and alveolar segments, and the cleft palate, which decreases the width of the cleft during the first months of life. This allows to obtain a more natural anatomy before surgery. Three types of braces are used: active, semi-active and passive. The purpose of the orthopedic

plate and nasal shaper is to promote and redirect the growth of the oral and nasal structures. There is evidence of problems secondary to surgical procedures that can increase the affected areas, making orthodontic therapy indispensable to achieve the required balances and ensure a harmonious and congruent final result. [17,18]

Children with this condition are the main beneficiaries because it improves their quality of life and they integrate into society in a less traumatic way, improves their self-esteem and also provides parents with the essential tools for their nutrition and care, giving the family the important role it deserves in the process. [11, 18]

4. Discussion

This article presents a review of the literature with the aim of determining which oral alterations and malocclusions are associated with cleft lip and palate. It also establishes their possible diagnoses and treatments in order to provide better care to patients.

In the study conducted by Téllez et al, (2021) on the analysis of craniofacial growth of individuals with and without cleft lip and palate (CLP) in Colombia, 541 profile radiographs of 126 patients with unilateral CLP, 126 with bilateral CLP and 289 without CLP were evaluated. Significant differences were obtained between the study groups, the skeletal structures of patients with LPH were smaller compared to the control group, together with increased vertical measurements and deflection of the skull base. In addition, patients with unilateral LPH had flat profiles and a majority of class III bite problems. On the other hand, patients with bilateral LPH were mostly class II at early ages, however in the prepubertal stage, the condition of patients with bilateral LPH progressively worsened and they tended to have class III malocclusion at the end of the growth period. This information coincides with the results obtained in the study of Portero et al, (2020) where cephalometric measurements of people with cleft lip and palate (CLP) and people without this oral-facial disorder were compared; in the group of patients with CLP there was a predominance of class III and negative angulations of the incisors with very marked retro inclinations were shown. [19, 20]

Similarly, the study by Bruggink (2020) studied 28 newborns and compared maxillary characteristics in newborns with complete unilateral cleft lip and palate (UCLP) with healthy newborns before and after cheiloplasty. For the analysis of the maxillary arch, 5 anatomical points were taken into account: the two tuberosities, the two canine points and a point located on the alveolar ridge. It was observed that before cheiloplasty there was an increase in alveolar width and length, while palatal depth decreased. After surgery, the widths trended toward normal, but were still significantly greater than before surgery. The results of Bruggink's study show that the distance between the tuberosities, distance between maxillary canines, and anterior maxillary arch depth and alveolar length were significantly greater in the UCLP group. [21]

Additionally, Villora et al, (2023) identified that cleft lip and palate (UCLP) patients who were at different stages of skeletal maturation (prepubertal and pubertal) had different patterns of craniofacial morphology, especially in the sagittal component of the maxilla and the posterior cranial base. The value of maxillary retrusion relative to the skull base, posterior cranial base length, and upper facial height were significantly higher in pubertal than in prepubertal patients. [22]

Regarding prevention, in Tolarová Marie's (2016) review many studies focused on the roles of maternal nutrition, smoking, stressful lifestyle, high sugar diet, obesity, diabetes and other environmental factors. Sufficient intake of folic acid and some other vitamins (Vitamin B6) and minerals (Zn) has been found to be critical. In one study it was shown that recurrences of cleft lip and palate were reduced by 65% when mothers were supplemented daily with multivitamins containing 10 mg of folic acid and the occurrences were reduced by 27%-50%, when the mother's diet contained 400 mcg of folic acid per day. [23]

Depending on the treatment needs of each patient, the multidisciplinary team may include specialists in plastic surgery, oral and maxillofacial surgery, dentistry, orthodontics, otolaryngology, neurosurgery, genetics, nutrition, speech therapy, and child development. [24, 25]

The review by Martín del Campo et al (2019), provides us with an in-depth analysis of the studies that have reported on the use of biomaterials and cell therapies for cleft lip and palate regeneration, concluding that the use of bioceramics such as calcium phosphate in combination with biomimetic polymer scaffolds are currently considered as the most promising alternative for cleft lip and palate regeneration. However, in a more recent article published by Mundra Leela et al (2022), he concludes that alveolar bone grafting with pre- and postoperative orthodontics is currently the standard of care for the treatment of alveolar defects in patients with LPH. [26, 27]

In the study by Fariña et al (2021), the criteria for choosing the best treatment approach for cleft lip and palate midfacial hypoplasia are discussed, which may range from maxillary orthopedics and orthognathic surgery to reconstructive plastic surgery. After analysis of 42 patients, it is concluded that orthognathic surgery may be indicated for advancement ≤ 7 mm not requiring orbitozygomatic advancement, whereas distraction osteogenesis may be indicated for advancement > 8 mm with or without the need for orbitozygomatic advancement. [28]

5. Conclusion

It is very important to keep in mind the occlusal and facial alterations that occur as a consequence of these malformations since, as mentioned, there is a highly significant relationship of dependence on dental caries and periodontal disease in patients with malocclusion and who present cleft lip and/or palate. These congenital anomalies are susceptible to a series of complications that affect the normal development of the sucking and swallowing functions, contributing to the appearance of malocclusion, therefore, it is necessary to have a multidisciplinary treatment to obtain a successful outcome.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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