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Early Detection and Treatment of Posterior Crossbites in Interceptive Orthodontics: A Review

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Abstract: ***Posterior crossbites represent a common malocclusion in orthodontics that, if left untreated, can lead to various dental and skeletal complications. This review article aims to provide a comprehensive overview of the early detection and treatment of posterior crossbites in interceptive orthodontics. By examining the current literature and clinical practices, we highlight the importance of early intervention, various diagnostic methods, and treatment modalities available to manage posterior crossbites effectively.***

Keywords: posterior crossbites, interceptive orthodontics, early detection, treatment modalities, patient compliance, technology, multidisciplinary, oral health, stability, innovations.

I. INTRODUCTION

Malocclusions, which refer to abnormal relationships between the upper and lower teeth, as well as between the teeth and the jaws, are prevalent in orthodontic practice. If these malocclusions are not addressed in a timely and appropriate manner, they can lead to a spectrum of dental and craniofacial issues, affecting both the functional aspects of the oral cavity and the aesthetics of an individual's facial appearance.[1] Among the various malocclusions encountered in orthodontics, posterior crossbites stand out as a particularly noteworthy concern due to their potential to significantly impact oral health and facial aesthetics. A posterior crossbite occurs when the upper teeth or arch are positioned inside the lower teeth when the jaws close. This misalignment can lead to a host of complications, including uneven wear on teeth, gum problems, and even temporomandibular joint disorders (TMD). Additionally, it may contribute to asymmetrical facial development, affecting a person's overall appearance. The importance of early detection and timely intervention cannot be overstated in the realm of posterior crossbites.[2] This is where interceptive orthodontics, a specialized branch of orthodontics, plays a pivotal role. Interceptive orthodontics involves identifying and addressing orthodontic issues in their early stages, before they can develop into more complex and severe problems. Posterior crossbites are no exception, and their management often begins with interceptive orthodontic techniques. Posterior crossbites are complex in nature, and their etiology can involve a combination of factors. These factors can include dental issues, where the individual teeth may be misaligned or improperly positioned; skeletal components, such as discrepancies in the size or positioning of the upper and lower jaws; and functional factors, including the way the teeth come together during biting and chewing. A holistic understanding of these causes is crucial for effective diagnosis and treatment.[3] This review article aims to provide a thorough exploration of the critical principles and practices associated with the early detection and treatment of posterior crossbites within the context of interceptive orthodontics.

II. POSTERIOR CROSSBITES

The prevalence of posterior crossbites in deciduous dentition has been documented to vary between 8% and 22%. Primarily caused by maxillary constriction and concomitant differences in maxillary arch length, these crossbites may cause tooth interferences that cause functional shifts in the mandible. This is particularly noteworthy because functional shifts account for around 80% of unilateral posterior crossbites observed in mixed dentition.[4] Although certain instances may resolve themselves, the probability of the crossbite enduring into the permanent dentition is greater. This can result in modified mandibular growth and asymmetrical muscle activity, both of which elevate the susceptibility to temporomandibular joint dysfunction in the future. In order to minimize the potential adverse effects of untreated posterior crossbites, it is highly advised that orthodontic intervention be initiated promptly following the patient's and parents' agreement to treatment. The primary objective of this proactive strategy is to restore occlusion to its normal state, thereby preventing the eruptive eruption of the first permanent molars in cases of crossbite and subsequent complex orthodontic interventions.[5] Anchored on the second deciduous molars, a tooth-borne Rapid Palatal Expander (RPE) is the optimal appliance for addressing this issue. In general, the RPE is employed once daily for a period of four to six weeks, subsequent to which it remains stationary for nine to twelve months, contingent upon the extent of the transverse discrepancy.6 When there are no further sagittal or vertical considerations, retention devices are not required.

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Contrary to the 30–40% relapse rates documented in some studies subsequent to palatal expansion in the deciduous dentition, other research has demonstrated exceptional long-term stability subsequent to early crossbite correction.

III. ETIOLOGY OF POSTERIOR CROSSBITES

The etiology of posterior crossbites is multifactorial and encompasses dental, skeletal, and functional causes. Dental causes often involve tooth misalignment, where one or more upper teeth are improperly positioned inside or outside the lower teeth due to factors like crowding or ectopic eruption. The presence of supernumerary teeth can also disrupt dental arch alignment. Skeletal causes include a narrow maxilla (upper jaw constriction) and mandibular asymmetry, where one side of the lower jaw is smaller or less developed. These skeletal issues can reduce the space for upper teeth and lead to posterior crossbites. Functional causes involve habits like thumb-sucking or tongue-thrusting, as well as abnormal masticatory function, which can exert pressure on the teeth and jaws, potentially causing posterior crossbites. Genetic predisposition may also play a role.

IV. CLASSIFICATION OF POSTERIOR CROSS BITES

The classification of posterior crossbites encompasses a range of transverse anomalies that can affect the alignment of the upper and lower dental arches. These anomalies are categorized into Unilateral Crossbites (UCB) and Bilateral Crossbites (BCB) based on their nature and presentation. Within the UCB category, there are instances of UCB with a normal maxilla and a constricted dentoalveolar process, as well as UCB with a normal maxilla and an asymmetrically constricted dentoalveolar process. These variations may result in a unilateral posterior crossbite where one side of the upper dental arch is in misalignment with the corresponding lower dental arch.[7] Conversely, Bilateral Crossbites (BCB) involve misalignments that affect both sides of the dental arches. Within this category, there are cases of BCB with a constricted maxilla and those with a constricted maxilla accompanied by buccoversion of the dentoalveolar processes. Additionally, there are BCB cases characterized by a constricted maxilla along with mandibular excess. The classification system provides a structured framework for identifying and understanding the diverse presentations of posterior crossbites, aiding orthodontists in selecting the most appropriate treatment approaches for each specific case.[8]

V. UNILATERAL CROSSBITE

When a patient presents with a unilateral crossbite and the maxilla remains unaltered, the constriction is observed to occur at the level of the dentoalveolar process in the posterior region.[9,10] This indicates that while the upper mandible (maxilla) remains unrestricted, the area containing the teeth and supporting bone is constricted. This causes a unilateral crossbite, primarily as a consequence of the lateral displacement of the lower mandible that occurs during occlusion and causes a deviation in the dental midlines.[9,11] Despite the observation of symmetrical constriction of the dentoalveolar processes on the clinical side, the patient exhibits a unilateral crossbite. In order to tackle this concern, the therapeutic strategy centers on the symmetrical expansion of dentoalveolar processes in the early phases of mixed dentition. The purpose of this expansion is to realign the lower mandible, given that if not corrected early, its functional deviation may endure. A Hawley appliance that is midline expansion screw-equipped. Twice per week, the screw should be engaged by a quarter turn. A Quad-Helix fixed appliance, which is affixed to the upper canines in a secure manner via bands. The activation of this apparatus is performed utilizing a three-prong plier within the clinic setting. The purpose of both of these appliances is to facilitate dentoalveolar expansion. In order to attain centric occlusion, the lower mandible is repositioned due to the symmetrical nature of the expansion process.[9] The primary objective of this therapeutic strategy is to rectify the crossbite and guarantee optimal alignment of the dental arches in the initial phases of mixed dentition. Regarding the present case, a patient exhibits a unilateral crossbite; however, no subclinical skeletal modification is detected in the maxilla. Conversely, the matter arises from a constriction of one of the posterior dentoalveolar processes, hence the crossbite on that particular side. It is worth noting that this case differs from the previous one in that the unilateral crossbite continues to exist despite the correct centric positioning of the lower mandible. A Hawley appliance is utilized, which is equipped with a lingual shield that does not necessitate expansion on the side.[12] This shield offers the essential support required to enable the opposite side to expand. By utilizing the Quad-Helix apparatus, asymmetric expansion is achieved. The design is modified such that the inner wire remains along the palatal surfaces of the canines and upper premolars on the side that does not require expansion, functioning as an anchorage. Conversely, on the side that does require expansion, the inner wire is eliminated. In an additional instance involving a patient who presents with a crossbite, a skeletal modification is noted in the upper mandible, more precisely maxillary constriction.[13]

Furthermore, the relationship between the dentoalveolar processes and the basal bone is asymmetrical: while one side maintains a harmonious relationship, resulting in a crossbite, the other is buccally displaced, which maintains normal occlusion on that particular side. Asymmetric constriction is achieved via unilateral palatal displacement of the buccally displaced dentoalveolar process using a modified Quad-Helix appliance. With maxillary constriction, this transforms a unilateral crossbite into a bilateral crossbite and harmonizes the dentoalveolar processes with their respective basal bones. As orthopaedic treatment is subsequently indicated, symmetric expansion of the bony bases of the maxilla is advised to occur as soon as feasible, usually upon the eruption of the first upper molars.[14] The Haas expander, a fixed appliance featuring bands and a central expansion bolt that, when activated, releases the mid-palatal suture, is the preferred appliance for this purpose. The observation of an inter-incisor diastema may occur intraorally.[15,16] Every treatment strategy is customized to the particular condition and seeks to rectify the fundamental problem. This may entail addressing maxillary constriction and restoring harmonious dentoalveolar relationships, or it may entail asymmetric expansion of a constricted dentoalveolar process.

VI. BILATERAL CROSSBITE

The characteristics of bilateral crossbite (BCB) cases may differ. A bilateral posterior crossbite of skeletal origin occurs when a patient presents with a constricted maxilla and a harmonious relationship between the alveolar processes and basal bones. Orthodontic treatment in this instance seeks to accomplish symmetrical maxillary skeletal expansion by means of the Haas expander, which is utilized to release the mid-palatal suture. Prompt orthopaedic intervention is administered in order to rectify the confinement of the maxillary bone.[17] Furthermore, if a disparity exists between the maxilla and the teeth, it may be imperative to proceed with a secondary phase of treatment that incorporates a fixed orthodontic appliance. Conversely, a patient might present with buccally-displaced dentoalveolar processes despite having a constricted maxilla, possibly as a compensatory mechanism for the bone deficiency. Although the patient does not exhibit bilateral crossbite, a discernible deficiency in maxillary development is evident. In such circumstances, a cautious differential diagnosis is essential to avert alveolar resorption. In order to establish a bilateral crossbite, the treatment criteria call for the palatal displacement of the buccoversion dentoalveolar processes and the use of a Quad-Helix appliance to restrict the bite.[18] When the first upper molars erupt, early orthopaedic treatment with the Haas expander seeks to open the mid-palatal suture. When excessive mandibular development rather than maxillary bone deficiency is the cause of BCB, early orthopaedic treatment of the maxilla is considered; however, surgical intervention is often necessary in the long run. Dentoalveolar decompensation with a Quad-Helix appliance, if required, is among the treatment criteria. If that is not possible, orthopaedic treatment is implemented to expand the maxilla using the Haas expander, which is utilized to release the mid-palatal suture during the initial phase of mixed dentition. In certain cases, fixed orthodontic appliances may be necessary to achieve proper dental alignment. Periodic reassessment is performed to ascertain whether further surgical intervention is necessary.[19] The aforementioned all-encompassing treatment approaches tackle the intricate challenges linked to BCB, with the ultimate goal of attaining stable and functional outcomes via a blend of orthodontic and, when required, surgical procedures.[20]

VII. CONCLUSION

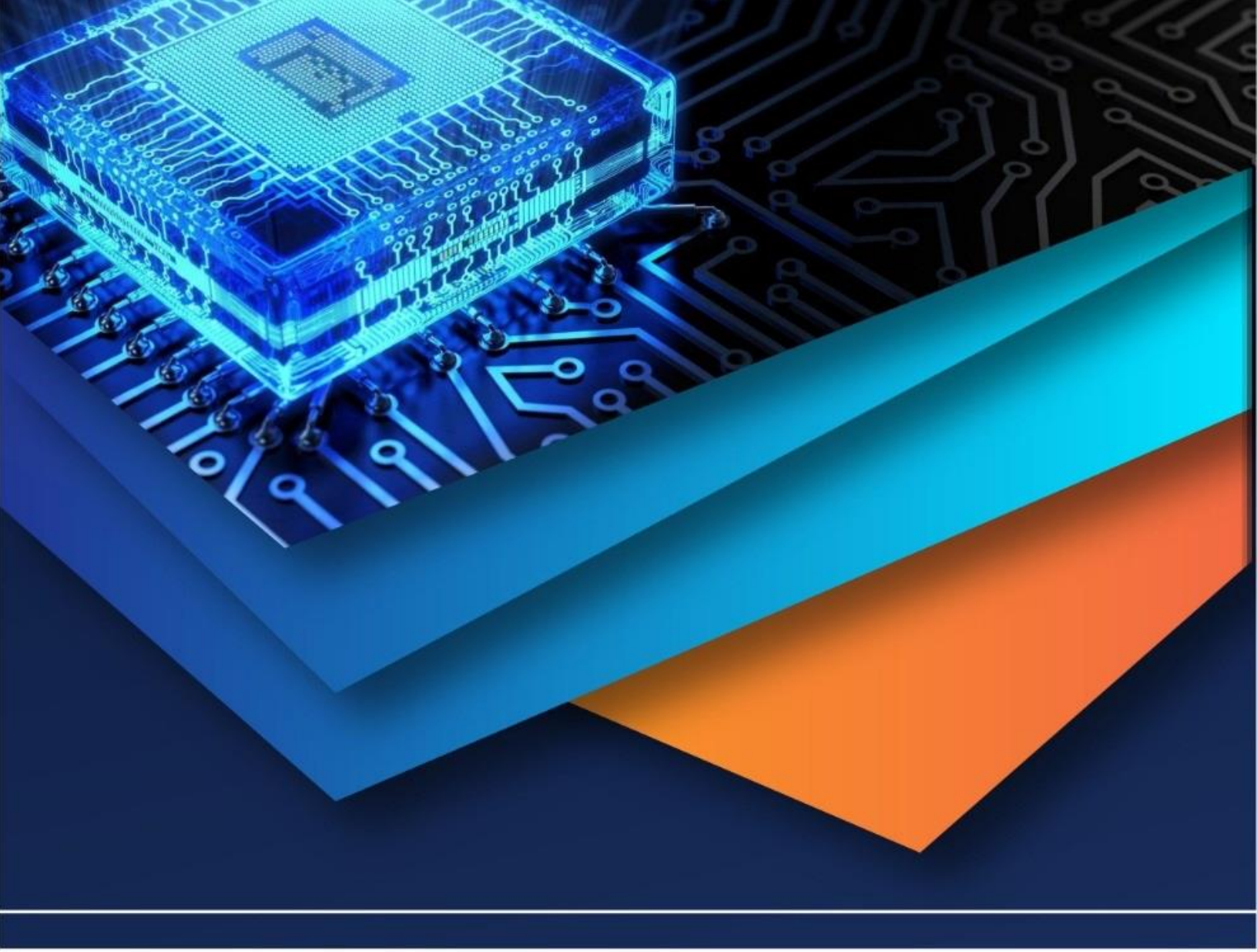
In conclusion, the early detection and treatment of posterior crossbites in interceptive orthodontics play a pivotal role in ensuring optimal oral health and overall well-being. This review has highlighted key takeaways, emphasizing the critical importance of early intervention to prevent complications such as asymmetrical muscle activity, unfavorable mandibular growth, and the risk of temporomandibular joint dysfunction. The integration of advanced technologies, including 3D imaging, digital models, and CAD, has transformed orthodontics by providing precise diagnostics and customized treatment plans. Teleorthodontics and teledentistry have expanded access to care, enabling remote monitoring and expert guidance. Looking to the future, ongoing research in genetics and biomarkers offers promise for even earlier detection, while the pursuit of innovative treatment methods is essential to enhance intervention efficacy. Ultimately, proactive interceptive orthodontics not only resolves immediate concerns but also lays the foundation for a lifetime of improved oral health. Orthodontists and researchers have a crucial role in advancing the field and delivering innovative solutions to benefit patients of all ages.

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