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IMPROVING AND ENHANCING THE EFFICIENCY OF USING EXPANSION ORTHODONTIC PLATES WITH STATIONARY ANCHORAGE IN THE CORRECTION OF CROSSBITE

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ACTUALITY: Crossbite is one of the most common and complex pathologies in orthodontics, with a prevalence of approximately 8-22% in the population, adversely affecting masticatory function, facial aesthetics, temporomandibular joint function, and patients' overall quality of life. Untreated, this anomaly can lead to asymmetric facial growth, abnormal tooth wear, and periodontal disease. Expansion orthodontic plates are widely used as a traditional treatment method. However, their effectiveness is often limited by undesirable side effects, such as uncontrolled effects on the dentoalveolar component and excessive buccal tipping of the teeth. The use of stationary anchorage, particularly mini-implants, allows for more precise direction of orthodontic forces to achieve predominantly skeletal expansion. This can significantly increase treatment effectiveness, shorten its duration, and ensure the stability of the results. The relevance of this study is determined by the need to optimize the treatment of crossbite by developing improved designs of expansion plates with stationary anchorage and comparing their clinical and radiological effectiveness with traditional methods.
Keywords: crossbite, maxillary constriction, orthodontic treatment, expansion plates, stationary anchorage, mini-implants, skeletal expansion, dentoalveolar expansion, treatment efficiency.

ПОВЫШЕНИЕ И СОВЕРШЕНСТВОВАНИЕ ЭФФЕКТИВНОСТИ ПРИМЕНЕНИЯ РАСШИРЯЮЩИХ ОРТОДОНТИЧЕСКИХ ПЛАСТИН СО СТАЦИОНАРНОЙ ОПОРОЙ ПРИ КОРРЕКЦИИ ПЕРЕКРЕСТНОГО ПРИКУСА

АКТУАЛЬНОСТЬ: Перекрестный прикус в ортодонтии является одной из наиболее распространенных и сложных патологий, встречающейся у 8-22% населения и негативно влияющей на жевательную функцию, эстетику лица, функцию височно-нижнечелюстного сустава и общее качество жизни пациентов. Несвоевременное лечение этой аномалии может привести к асимметричному развитию лицевого скелета, патологической стираемости зубов и заболеваниям пародонта. Для лечения традиционно применяются расширяющие ортодонтические пластины. Однако их эффективность часто ограничена нежелательными эффектами, такими как неконтролируемое воздействие на зубоальвеолярный компонент и чрезмерное вестибулярное отклонение зубов. Использование стационарной опоры, в частности мини-имплантов, позволяет более точно направлять ортодонтические силы и добиваться преимущественно скелетного расширения, что может значительно повысить эффективность лечения, сократить его сроки и обеспечить стабильность результатов. Актуальность данного исследования обусловлена необходимостью оптимизации лечения перекрестного прикуса путем разработки

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усовершенствованных конструкций расширяющих пластин со стационарной опорой и сравнения их клинико-рентгенологической эффективности с традиционными методами.
Ключевые слова: перекрестный прикус, сужение верхней челюсти, ортодонтическое лечение, расширяющие пластины, стационарная опора, мини-импланты, скелетное расширение, зубоальвеолярное расширение, эффективность лечения.

KESISHGAN PRIKUSNI KORREKSIYA QILISHDA STASIONAR TAYANCHGA EGA BO‘LGAN KENGAYTIRUVCHI ORTODONTIK PLASTINKALARNI QO‘LLASH SAMARADORLIGINI OSHIRISH VA TAKOMILLASHTIRISH

DOLZARBLIGI: Ortodontiyada kesishgan prikus eng keng tarqalgan va murakkab patologiyalardan biri bo'lib, populyatsiyaning taxminan 8-22% qismida uchraydi va chaynash funksiyasi, yuz estetikasi, temporomandibulyar bo'g'im faoliyati va bemorlarning umumiy hayot sifatiga salbiy ta'sir ko'rsatadi. Ushbu anomaliyani o'z vaqtida davolamaslik yuz skeletining assimetrik rivojlanishiga, tishlarning noto'g'ri eyilishiga va periodontal kasalliklarga olib kelishi mumkin. An'anaviy davolash usuli sifatida qo'llaniladigan kengaytiruvchi ortodontik plastinkalar keng qo'llaniladi. Biroq, ularning samaradorligi ko'pincha tish-alveolyar komponentga nazoratsiz ta'sir va tish qatorining haddan tashqari vestibulyar og'ishi kabi nojo'ya ta'sirlar bilan cheklanadi. Statsionar tayanch, xususan, mini-implantlardan foydalanish ortodontik kuchlarni aniqroq yo'naltirish va asosan skelet kengayishiga erishish imkonini beradi. Bu esa davolash samaradorligini sezilarli darajada oshirishi, uning muddatini qisqartirishi va natijalarning barqarorligini ta'minlashi mumkin. Ushbu tadqiqotning dolzarbligi statsionar tayanchga ega bo'lgan takomillashtirilgan kengaytiruvchi plastinkalar konstruksiyasini ishlab chiqish va ularning klinik-rentgenologik samaradorligini an'anaviy usullar bilan taqqoslash orqali kesishgan prikusni davolashni optimallashtirish zarurati bilan belgilanadi.
Kalit so‘zlar: kesishgan prikus, yuqori jag' torligi, ortodontik davolash, kengaytiruvchi plastinkalar, statsionar tayanch, mini-implantlar, skelet kengayishi, tish-alveolyar kengayish, davolash samaradorligi.

INTRODUCTION

Crossbite is a type of malocclusion where a misalignment of the dental arches causes some maxillary teeth to be positioned lingually to the mandibular teeth. This condition can be unilateral or bilateral, and it can affect anterior or posterior teeth. If left untreated, crossbite can lead to various complications, including asymmetric jaw growth, temporomandibular joint (TMJ) disorders, excessive tooth wear, and periodontal problems (Proffit, 2018). Therefore, early diagnosis and intervention are crucial for successful treatment and long-term oral health. The primary goal of crossbite correction is to achieve a normal buccolingual relationship between the maxillary and mandibular teeth, thereby establishing a stable and functional occlusion. One of the most common methods for treating posterior crossbite, especially in growing patients, is rapid maxillary expansion (RME). This is typically accomplished using fixed or removable expansion appliances that apply lateral forces to the maxilla, separating the midpalatal suture and promoting skeletal expansion.

While conventional removable expansion plates are widely used due to their ease of fabrication and patient acceptance, they primarily produce dentoalveolar expansion through buccal tipping of the posterior teeth. This can lead to undesirable side effects, such as limited skeletal expansion, root resorption, and instability of the treatment results (Garib et al., 2005). To overcome these

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limitations, orthodontic research has focused on developing appliances that can provide more effective and stable skeletal expansion. The concept of stationary anchorage, utilizing miniscrews or other forms of temporary anchorage devices (TADs), has emerged as a promising approach to enhance the efficiency of orthodontic treatment. By providing a fixed point of force application, stationary anchorage can minimize unwanted tooth movement and maximize the desired skeletal effects (Kanomi, 1997). This study aims to investigate the effectiveness of using expansion orthodontic plates with stationary anchorage in the correction of crossbite, comparing the outcomes with conventional treatment methods. The null hypothesis of this study is that there is no significant difference in the skeletal and dental effects between crossbite correction using a conventional expansion plate and a miniscrew-supported expansion plate.

LITERATURE REVIEW

The literature extensively documents various approaches to crossbite correction, reflecting the evolution of orthodontic principles and technologies. Traditional removable appliances, such as the Schwarz plate, have been a mainstay for decades. These appliances rely on dental anchorage, where the forces generated by the expansion screw are transmitted to the maxillary suture through the teeth and alveolar bone. Studies by Sandikcioglu and Hazar (1997) have shown that while these plates can correct crossbite, the expansion is often predominantly dentoalveolar, with significant buccal tipping of the anchor teeth. This can compromise periodontal health and increase the risk of relapse.

To enhance skeletal effects, fixed appliances like the Hyrax and Haas expanders were developed. These appliances are bonded or banded to the teeth and are considered more efficient in opening the midpalatal suture. However, they also rely on dental anchorage and can produce some degree of buccal tipping (Haas, 2004). The search for methods to maximize skeletal expansion while minimizing dental side effects has led to the exploration of bone-anchored expanders.

The introduction of temporary anchorage devices (TADs) has revolutionized orthodontic biomechanics. Miniscrew-assisted rapid palatal expansion (MARPE) is a technique where miniscrews are placed in the palate to provide direct skeletal anchorage for the expander. This approach has demonstrated a greater ratio of skeletal to dental expansion compared to conventional methods (Lee et al., 2010). Studies by Carlson et al. (2016) using cone-beam computed tomography (CBCT) have confirmed that MARPE produces nearly parallel opening of the midpalatal suture with minimal dental side effects. Despite the proven effectiveness of MARPE, its application can be limited by factors such as patient age, bone density, and surgical intervention requirements. This has prompted interest in developing hybrid appliances that combine the benefits of removable plates with the stability of stationary anchorage. These designs typically incorporate miniscrews to support a removable expansion plate, aiming to provide a more controlled and efficient force delivery system. The current study builds upon this body of research by evaluating a specific design of an expansion plate with stationary anchorage and assessing its clinical performance in a comparative context. A systematic review by Liu et al. (2018) concluded that bone-borne and hybrid expanders produce greater skeletal effects and less dental tipping than conventional tooth-borne expanders, supporting the rationale for this investigation.

MATERIALS AND METHODS

This prospective clinical study was conducted at the Department of Orthodontics, Andijan State Medical Institute, after receiving approval from the Institutional Ethics Committee (Protocol

AMERICAN ACADEMIC PUBLISHER
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ISSN NUMBER: 2692 - 5206 Volume 5,October ,2025

#2023-04-A). A total of 30 growing patients (15 males, 15 females, mean age 10.5 ± 1.5 years, skeletal age CVM 2-3) with unilateral or bilateral posterior crossbite and a transverse maxillary deficiency of at least 4 mm were included. The inclusion criteria were: mixed or early permanent dentition, and no history of previous orthodontic treatment. Exclusion criteria included craniofacial syndromes, cleft lip/palate, and poor oral hygiene.

The patients were randomly divided into two groups of 15 each using a computer-generated randomization list: 1) Group A (Control Group): Treated with a conventional removable Schwarz expansion plate. The plate was fabricated from acrylic resin with Adams clasps on the first permanent molars, retaining clasps on the first premolars, and a midline expansion screw (Forestadent, Germany). 2)Group B (Study Group): Treated with a modified expansion plate supported by two orthodontic miniscrews (Jeil Medical Corp, South Korea; 1.6 mm diameter, 8 mm length). Under local anesthesia, the miniscrews were placed by a single operator in the paramedian region of the palate, 3-4 mm lateral to the midpalatal suture at the level of the first premolars. The acrylic plate was then fabricated to have passive, direct contact with the heads of the miniscrews, providing stationary anchorage.

For all patients, initial (T0) and post-retention (T1) dental casts and lateral cephalometric radiographs were taken. The following measurements were performed on the dental casts using a digital caliper: 1) Intermolar Width: The distance between the central fossae of the maxillary first permanent molars. 2) Intercanine Width: The distance between the cusp tips of the maxillary canines. 3) Palatal Vault Height: The maximum height of the palatal vault from a line connecting the gingival margins of the first molars. 4) Molar Inclination: Measured on posterior cross-sectional images of the casts.

The activation protocol was standardized for both groups. The expansion screw was activated one-quarter turn (0.25 mm) twice a week until the crossbite was overcorrected (palatal cusps of maxillary molars occluding on the buccal cusps of mandibular molars). The active expansion phase was followed by a retention period of 3 months, during which the appliance was worn passively.

Statistical analysis was performed using SPSS software (Version 25.0). All measurements were repeated after two weeks by the same examiner to assess intra-examiner reliability using the Intraclass Correlation Coefficient (ICC), which showed excellent agreement (ICC > 0.95). The paired t-test was used to compare the changes within each group, and the independent t-test was used to compare the changes between the two groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

The active treatment phase was successfully completed for all 30 patients. The mean duration of active expansion was 4.2 ± 0.8 months for Group A and 3.5 ± 0.6 months for Group B, a statistically significant difference (p=0.03). The results of the dental cast analysis are presented in Table 1.

Table 1: Comparison of dental cast measurements before and after treatment (Mean ± SD)

Measurement	Group	Before treatment	After treatment	Change	P-value (Within group)	P-value (Between groups)
Intermolar width (mm)	A	32.5 ± 2.1	37.8 ± 2.3	5.3 ± 0.9	<0.001	0.002
	B	32.8 ± 2.4	39.5 ± 2.5	6.7 ± 1.1	<0.001	
Intercanine	A	28.1 ± 1.8	31.5 ± 1.9	3.4 ± 0.7	<0.001	0.015

AMERICAN ACADEMIC PUBLISHER
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width (mm)	B	28.4 ± 2.0	32.9 ± 2.1	4.5 ± 0.8	<0.001	
Palatal vault height (mm)	A	14.2 ± 1.5	14.5 ± 1.6	0.3 ± 0.2	>0.05	<0.001
	B	14.4 ± 1.7	15.8 ± 1.8	1.4 ± 0.4	<0.001	

Both treatment modalities were effective in correcting the posterior crossbite. However, the study group (Group B) showed a significantly greater increase in both intermolar and intercanine widths compared to the control group (Group A). This indicates that the use of stationary anchorage resulted in a more substantial transverse expansion of the maxillary arch. The most notable difference between the two groups was observed in the change in palatal vault height. In Group B, there was a statistically significant increase in palatal vault height, which is an indicator of true skeletal expansion and the lowering of the palatal vault. In contrast, Group A showed a negligible and statistically insignificant change in this parameter. This finding strongly suggests that the expansion achieved with the conventional Schwarz plate was primarily dentoalveolar, involving the buccal tipping of the teeth, while the miniscrew-supported plate produced a significant skeletal effect.

These results are consistent with previous studies that have highlighted the advantages of skeletal anchorage in maxillary expansion (Wilmes et al., 2011). By applying forces directly to the bone, the miniscrew-supported appliance bypasses the teeth, minimizing the tipping effect and maximizing the orthopedic separation of the midpalatal suture. This leads to a more parallel and stable expansion, which is crucial for long-term success. The shorter treatment duration observed in Group B can also be attributed to the increased efficiency of the force delivery system. With stationary anchorage, the applied forces are not dissipated through unwanted tooth movement, allowing for a more direct and effective translation of the expansion screw activation into skeletal change.

From a clinical perspective, the use of expansion plates with stationary anchorage offers a less invasive alternative to surgically assisted rapid palatal expansion (SARPE) in select adolescent and young adult patients. It provides clinicians with a powerful tool to achieve significant skeletal expansion with a simple and well-tolerated procedure. However, this study has limitations, including a relatively small sample size and a short-term follow-up. Future research with larger cohorts and long-term evaluation is needed to confirm the stability of these results.

CONCLUSION

Based on the findings of this prospective clinical study, the null hypothesis was rejected. The following conclusions can be drawn: 1) Both conventional removable expansion plates and miniscrew-supported expansion plates are effective in correcting posterior crossbite in growing patients. 2) The use of stationary anchorage with expansion plates leads to a significantly greater amount of maxillary transverse expansion (skeletal and dental) compared to conventional appliances. 3) Expansion plates with stationary anchorage produce a predominantly skeletal expansion, as evidenced by the significant increase in palatal vault height, whereas conventional plates result in mainly dentoalveolar expansion with minimal skeletal changes. 5) The treatment duration for crossbite correction can be significantly reduced by using miniscrew-supported expansion plates due to their enhanced biomechanical efficiency.

In conclusion, the integration of stationary anchorage into removable expansion appliances represents a significant advancement in the treatment of maxillary transverse deficiency. This approach improves the quality and stability of the treatment outcome, offering a more efficient and predictable method for the management of crossbite in growing patients.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
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