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EFFECTIVENESS OF DISTRACTION AND ORTHOGNATHIC INTERVENTION IN THE TREATMENT OF MESIAL OCCLUSION IN PATIENTS WITH MAXILLARY UNDERDEVELOPMENT

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Summary

Mesial occlusion is a complex orthodontic pathology that adversely affects facial aesthetics, masticatory function, and patient quality of life, making timely treatment critical. One of the modern methods of correction is distraction osteogenesis, which allows gradual expansion of bone structures while minimizing the risk of relapse. The choice of treatment is based on the patient's clinical presentation, with distraction being a priority in cases where traditional surgery is contraindicated.

***Aim of the study** was a detailed analysis of the effectiveness and safety of various treatment methods for mesial occlusion in adult patients with maxillary underdevelopment.*

***Material and methods.** The study included 15 adolescent patients between the ages of 19 and 23 with skeletal mesial occlusion. Baseline diagnostic data were obtained for each patient, and the volume of bone tissue in the vestibulo-oral direction at the site of planned implant placement was assessed during preparation for implant placement. Statistically significant differences between alternative quantitative characteristics with normal distributions were evaluated using Student's t-test. A difference was considered statistically significant at $p<0.01$. The study was carried out in compliance with the main provisions of the Council of Europe Convention on Human Rights and Biomedicine (4 April 1997), the World Medical Association Declaration of Helsinki on the Ethical Principles for Scientific Medical Research Involving Human Subjects (1964-2013), ICH GCP (1996), orders of the Ministry of Health of Ukraine No. 690 of 23.09.2009, No. 944 of 14.12.2009, No. 616 of 03.08.2012. The work is a fragment of the research project «Correction of violations of osteogenesis processes in the treatment and prevention of complications of dental diseases wartime» state registration No. 0123U103247.*

***Results.** The results of the study showed that in adult patients, orthognathic surgery ensures favorable skeletal outcomes for maxillary mesialization. However, when the replacement of lateral incisors with canines is feasible, this treatment approach may reduce the number of rehabilitation stages while achieving dentoalveolar relationships that conform to normal standards. The use of distraction osteogenesis in adult patients has yielded good results and may be justified in cases of critical reduction of maxillary body dimensions or contraindications to conventional orthognathic surgery.*

***Conclusion.** Distraction osteogenesis and orthognathic procedures effectively correct mesial occlusion, ensuring a stable increase in the sagittal dimension of the maxilla and improving occlusion. Replacement of lateral incisors with canines minimizes the need for additional surgery in cases of agenesis. The choice of treatment method should be based on individual clinical indications and risk assessment for each patient.*

***Key words:** Mesial Occlusion; Distraction Osteogenesis; Orthognathic Intervention; Maxilla; Adults.*

Introduction

Mesial occlusion is one of the most complex forms of orthodontic pathology, characterized by disruptions in the harmony of the facial skeleton and dental occlusion, significantly affecting aesthetics, functional capabilities, and the quality of life of patients [1, 2]. According to modern research, the severity of malocclusion directly impacts patients' ability to chew food and other aspects of daily life, emphasizing the importance of effective and timely treatment for such conditions [3].

In recent years, there has been increasing interest in the use of distraction osteogenesis as an alternative to traditional orthognathic surgery. Distraction osteogenesis allows for the gradual expansion of bone structures, facilitating soft tissue adaptation and reducing the risk of relapse commonly associated with more invasive surgical procedures [4, 5]. This approach is particularly relevant for patients with a pronounced deficiency in the sagittal dimension of the maxilla or in cases where traditional orthognathic surgery is contraindicated [6, 7].

In addition, the choice of method for replacing lateral incisors in patients with agenesis is a critical consideration. In certain cases, replacement of the lateral incisors with canines is a rational approach because it reduces the number of surgical procedures and shortens the treatment period while maintaining functionally and esthetically optimal dental relationships [8, 9]. However, the decision regarding the therapeutic strategy should be made on an individual basis, taking into account the clinical presentation and diagnostic data of each patient [10].

It is also important to consider the potential complications and risks associated with different treatment modalities. Traditional orthognathic procedures, such as the Le Fort I osteotomy, can be associated with serious complications,

including blindness, making distraction osteogenesis a more attractive option for certain patient populations [11]. However, the need for prolonged treatment and the use of external devices are factors that must be considered when planning treatment [12].

Taking the above into consideration, the results obtained will allow the development of well-founded clinical recommendations for the selection of the optimal treatment strategy to achieve stable functional and aesthetic results, which have a significant impact on improving the patient's quality of life [1, 2, 13].

Aim of the study was to conduct a detailed analysis of the effectiveness and safety of various treatment methods for mesial occlusion in adult patients with maxillary underdevelopment.

Material and methods. The study included 15 patients with completed growth who presented to the Department of Orthodontics, Bogomolets National Medical University, aged 19 to 23 years, with skeletal mesial occlusion partially or completely caused by maxillary underdevelopment and agenesis of the maxillary lateral incisors.

Inclusion criteria for the group were bilateral absence of maxillary lateral incisors, absence of transverse anomalies, and mesial occlusion with normal SNB angle values.

For each patient, baseline diagnostic data were obtained, including gender, analysis of Bolton's diagnostic models [12] to exclude size discrepancies between the maxilla and mandible (in permanent occlusion), ANB angle values on lateral cephalometric radiographs (LCR), inclination angle of the maxillary central incisors to the maxillary plane on LCR, and WITS assessment.

The following procedures were performed for the patients:

– preparation for distraction in the area of the lateral incisors using a fixed technique and horizontal distraction;

– preparation for orthognathic intervention involving maxillary mesialization;

– preparatory measures for implantation;

– substitution of lateral incisors with canines and orthognathic intervention involving maxillary mesialization.

For patients undergoing preparation for implantation, the volume of bone tissue in the vestibulo-oral direction at the site of the planned implantation was also taken into account.

The results were processed by variational statistical methods of analysis using the software Microsoft Office Excel 2016. Statistical processing of experimental study results was carried out by the methods of variational analysis using Student's t-test. The difference was considered statistically significant at $p<0.01$ [14].

The study was carried out in compliance with the main provisions of the Council of Europe Convention on Human Rights and Biomedicine (4 April 1997), the World Medical Association Declaration of Helsinki on the Ethical Principles for Scientific Medical Research Involving Human Subjects (1964-2013), ICH GCP (1996), orders of the Ministry of Health of Ukraine No. 690 of 23.09.2009, No. 944 of 14.12.2009, No. 616 of 03.08.2012.

The work is a fragment of the research project «Correction of violations of osteogenesis processes in the treatment and prevention of complications of dental diseases wartime» state registration No. 0123U103247.

Results and discussion

Evaluation of the patients' initial diagnostic data revealed significant deviations from the norm. Depending on the specific characteristics of the shape, width, and color of the central incisors and canines, some patients underwent surgical maxillary mesialization with canine replacement of the lateral incisors after orthodontic preparation. In others, the approach was to create space for subsequent prosthetic replacement of the lateral incisors.

The systematized baseline diagnostic data and treatment outcomes are presented in Table 1.

Table 1

Average values of baseline diagnostic data and treatment outcomes in patients with agenesis of lateral incisors and mesial occlusion, M±m

Measures / Parameter	Before treatment	Fixed technique + distraction	Fixed technique + orthognathic surgery	Substitution with canines + orthognathic surgery
ANB, degrees	-2,8±0,2	1,2±0,3*	3,4±1,7*	2,4±0,6*
Proclination of central incisors, degrees	105,1±2,6	112,3±2,7	113,4±3,8*	110,4±4,1
WITS, mm	-1,1±0,4	1,2±0,3*	3,2±0,5*	2,3±0,5*
Space for lateral incisor crown, mm	-	7,2±0,7	6,4±1,8	-
Space between adjacent tooth apices, mm	-	4,9±0,4	3,8±0,5	-

*Note: * – values differ significantly from pre-treatment values, p<0,05*

The treatment results show a significant and statistically reliable increase in the ANB angle in both subgroups, averaging 3.4±1.7 mm and 2.4±0.6 mm, respectively. Hypercorrection of the maxillary position was intentionally included in the treatment plan to compensate for possible future relapse.

The WITS values and the incisor proclination were significantly higher in the subgroup where the treatment plan included the creation of spaces for the lateral incisors compared to the subgroup where the lateral incisors were replaced with canines. These values were 3.2±0.5 mm versus 2.3±0.5 mm and 113.4±3.8° versus 110.4±4.1°, respectively.

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Comparing these two treatment plans, we believe that when it is feasible to replace missing lateral incisors with canines, this approach is preferable. First, it reduces the «treatment burden» on the patient by automatically eliminating implant placement and prosthetic restoration from the treatment plan. Second, this plan preserves the inclination of the central incisors, which is optimal both functionally and esthetically.

In certain cases, distraction osteogenesis can serve as an alternative to classical orthognathic surgery. Distraction is more commonly used for the mandible because significant one-time movements of its fragments can lead to relapse due to muscle traction attached to the mandibular body. The gradual nature of distraction helps to avoid this by allowing time for muscle adaptation. However, in some cases, distraction may be the method of choice for adult maxillofacial surgery. This may be justified by individual structural features of the facial skeleton that place them at higher risk for surgical complications. Given that blindness is one of the potential complications of Le Fort I osteotomy, distraction may be a reasonable option despite its drawbacks, such as longer treatment time and, in complex cases, the need to use extraoral devices.

In our opinion, maxillary distraction can also be justified when there is a pronounced deficiency in the sagittal dimension of the maxilla and its base, along with the absence of not only the lateral incisors but also other teeth, either due to agenesis or loss from other causes. In such situations, the grafting of additional bone volume may be practically essential for a complete reconstruction of the dental arch.

In the patients of the third subgroup, the application of distraction yielded positive results: the ANB angle averaged 1.2±0.3° after treatment, the WITS value averaged 1.2±0.3 mm, and the incisor inclination remained at the pre-treatment level with an average of 112.3±2.7°. As in the second subgroup, distraction allowed the creation of significant space for the lateral incisors – 7.2±0.7 mm at the crown level and 4.9±0.4 mm at the root apex level (Table 1).

Thus, in adult patients, orthognathic surgery provides favorable skeletal results for maxillary mesialization. However, when the replacement of lateral incisors with canines is feasible, such a treatment plan may reduce the number of rehabilitation phases while achieving normal dentoalveolar relationships. The use of distraction osteogenesis in adult patients has shown good results and may be justified in cases of critical reduction of maxillary body dimensions or in the presence of contraindications to classical orthognathic surgery.

Conclusions

1. Distraction osteogenesis and orthognathic intervention are effective methods for correcting mesial occlusion in adult patients with maxillary underdevelopment. Both methods provide a stable sagittal enlargement of the maxilla and an improvement in the occlusal relationships, as evidenced by a statistically significant increase in the ANB angle and WITS values after treatment.

2. Replacement of the lateral incisors with canines is a reasonable approach for patients with agenesis because it reduces the number of rehabilitation stages and allows achieving optimal dentoalveolar relationships while minimizing the need for additional surgical procedures such as implantation.

3. The use of distraction osteogenesis may be justified in cases of significant deficiency in maxillary body dimensions, especially when there are contraindications to classical orthognathic surgery. This method prevents relapse by gradually moving bone fragments and facilitates soft tissue adaptation.

4. The results confirm that both methods – distraction and orthognathic surgery – have their advantages and can be used successfully depending on individual clinical indications. The choice of a specific method should be based on a comprehensive analysis of diagnostic data and risk assessment for each patient.

Prospects for further research

Future research on the treatment of mesial occlusion with distraction osteogenesis and orthognathic surgery offers the opportunity to refine the methods for correcting this condition. Emphasis should be placed on long-term stability of results and prevention of relapse. Continued research into the tissue biological responses to distraction, particularly in the context of bone regeneration and soft tissue adaptation, is essential. An important avenue for advancement is the implementation of personalized treatment protocols based on individual patient characteristics. In addition, further integration of minimally invasive techniques and bioactive materials could reduce the risk of complications and accelerate healing processes.

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ЕФЕКТИВНІСТЬ ДИСТРАКЦІЇ ТА ОРТОХІРУРГІЧНОГО ВТРУЧАННЯ У ЛІКУВАННІ МЕЗІАЛЬНОГО ПРИКУСУ У ПАЦІЄНТІВ ІЗ ДЕФІЦИТОМ РОЗВИТКУ ВЕРХНЬОЇ ЩЕЛЕПИ

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Резюме.

Мезіальний прикус – це складна ортодонтична патологія, яка негативно впливає на естетику обличчя, функції жування та якість життя пацієнтів, тому важливе своєчасне лікування. Одним із сучасних методів корекції є дистракція остеогенезу, яка дозволяє поступово розширювати кісткові структури, знижуючи ризик рецидивів. Вибір лікування залежить від клінічної картини пацієнта, причому дистракція може бути пріоритетною у разі протипоказань до традиційних операцій.

Мета дослідження – детальний аналіз ефективності та безпечності різних методів лікування мезіального прикусу у дорослих пацієнтів із дефіцитом розвитку верхньої щелепи.

Матеріал і методи. У дослідженні брали участь 15 пацієнтів із завершеним ростом у віці від 19 до 23 років із скелетним мезіальним прикусом. Для кожного пацієнта було визначено значення базового набору діагностичних даних; при підготовці до імплантації враховували об'єм кісткової тканини у вестибулооральному напрямку в місці запланованої імплантації. Статистично значущу відмінність між альтернативними кількісними ознаками з розподілом, відповідним нормальному закону, оцінювали за допомогою t-критерію Стьюдента. Різницю вважали статистично значущою при $p<0,01$. Дослідження виконано з дотриманням основних положень Конвекції Ради Європи з прав людини та біомедицини (від 4.04. 1997 р.), Гельсінської декларації Всесвітньої медичної асоціації про етичні принципи проведення наукових медичних досліджень за участю людини (1964-2013 рр.), ICH GCP (1996 р.), наказів МОЗ України № 690 від 23.09.2009 р., № 944 від 14.12.2009 р., № 616 від 03.08.2012 р. Робота є фрагментом науково-дослідної роботи «Корекція порушень процесів остеогенезу при лікуванні та профілактиці ускладнень стоматологічних захворювань у воєнний час» № держреєстрації 0123U103247.

Результати. Результати обстеження показали, що у дорослих пацієнтів ортогнатична хірургія забезпечує хороші скелетні результати при мезіалізації верхньої щелепи. Проте при можливості заміщення латеральних різців іклами такий план лікування може зменшити кількість етапів реабілітації, при цьому можна отримати дентоальвеолярні співвідношення, що відповідають нормі. Застосування дистракційного остеогенеза у дорослих пацієнтів давало хороші результати та може бути виправданим при критичному зменшенні розмірів тіла верхньої щелепи та наявності протипоказань до класичної ортогнатичної хірургії.

Висновок. Дистракція остеогенезу та ортохірургічні втручання ефективно коригують мезіальний прикус, забезпечуючи стабільне збільшення сагітального розміру верхньої щелепи та покращення оклюзії. Замінення латеральних різців іклами мінімізує необхідність додаткових хірургічних втручань при агенезії. Вибір методу лікування повинен базуватися на індивідуальних клінічних показаннях та оцінці ризиків для кожного пацієнта.

Ключові слова: мезіальний прикус; дистракція; ортохірургічне втручання; верхня щелепа; дорослі.

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