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EFFECTIVENESS OF THE FIRST CLASS APPLIANCE FOR DISTAL MOVEMENT OF MAXILLARY PERMANENT MOLARS IN CHILDREN WITH ERUPTED SECOND PERMANENT MOLARS

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The study was devoted to evaluating the effectiveness of the First Class Leone appliance for distal movement of the first permanent molars of the upper jaw in children who have erupted second permanent molars. This study included a total of 10 patients aged 8–13 years who presented with a distal relationship of the maxillary first permanent molars and fully erupted second permanent molars, as confirmed by clinical examination and radiographic evaluation. The First Class Leone appliance was used for the distal movement of the permanent molars of the upper jaw. The maxillary first permanent molars were successfully distalized by an average of 4.29 ± 0.36 mm, at a rate of 1.04 mm/month, demonstrating the reliability of the First Class Leone appliance in cases where second permanent molars are already present.

Key words: anomalies of the dentition, First Class Leone appliance, molar distalization, orthodontic treatment, children.

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ЕФЕКТИВНІСТЬ ЗАСТОСУВАННЯ АПАРАТА FIRST CLASS ДЛЯ ДИСТАЛЬНОГО ПЕРЕМІЩЕННЯ ПОСТІЙНИХ МОЛЯРІВ ВЕРХНЬОЇ ЩЕЛЕПИ У ДІТЕЙ З ПРОРІЗАНИМИ ДРУГИМИ ПОСТІЙНИМИ МОЛЯРАМИ

Дослідження було присвячене оцінці ефективності апарату First Class Leone для дистального переміщення перших постійних молярів верхньої щелепи у дітей, у яких прорізулися другі постійні моляри. У дослідженні взяли участь 10 пацієнтів віком 8–13 років з дистальним співвідношенням перших постійних молярів верхньої щелепи та повністю прорізаними другими постійними молярами, що було підтверджено клінічним обстеженням та рентгенологічною оцінкою. Для дистального переміщення постійних молярів верхньої щелепи використовували апарат першого класу Leone. Перші постійні моляри верхньої щелепи були успішно дисталізовані в середньому на $4,29 \pm 0,36$ мм зі швидкістю 1,04 мм/місяць, що демонструє надійність апарату First Class Leone у випадках, коли вже наявні другі постійні моляри.

Ключові слова: аномалії зубощелепної системи, First Class Leone апарат, дисталізація молярів, ортодонтичне лікування, діти.

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Recent studies have highlighted that malocclusions constitute not only an esthetic and functional issue but also significantly affect children’s overall quality of life, including their psychosocial well-being and masticatory efficiency [3, 6, 12]. Among the more prevalent clinical scenarios is a distal molar relationship, wherein the maxillary first permanent molars occupy a posterior position relative to the lower arch. This situation often leads to limited space for subsequent tooth eruption, misalignment, and potential temporomandibular dysfunction. Conventional orthodontic approaches to molar distalization sometimes rely heavily on patient cooperation (e.g., headgear usage) or feature limited mechanocontrol over tooth movement [4, 5]. Consequently, the search for more predictable, patient-independent methods of distalizing maxillary molars has remained a priority in contemporary orthodontic practice [7, 8].

Although there is abundant literature on distalizing the first molars in younger patients without fully erupted second molars, few systematic reports address the outcomes and biomechanical nuances in cases where second permanent molars are already present. Erupted second molars often contribute additional resistance and alter the vector of forces exerted during distalization, thus making treatment outcomes less predictable [2, 9]. The First Class Leone appliance has recently garnered attention as a noncompliance method that aims to produce controlled bodily tooth movement with minimal anchorage loss. Yet, to date, evaluations of its performance in children whose second permanent molars have already emerged remain sparse.

Exploring the efficacy of the First Class Leone appliance under these specific clinical conditions is especially relevant because many patients present for initial treatment at an age when the second permanent molars are erupting or have fully erupted [5]. By extending the investigation to this subset of

patients, clinicians can better anticipate anchorage requirements, estimate the time needed for molar distalization, and optimize the overall treatment plan to reduce potential complications.

Given the impact of distal occlusal relationships on facial esthetics, mastication, and quality of life, and in light of the paucity of data regarding children with erupted second permanent molars, further research into targeted approaches for distal molar movement remains essential [3, 4, 13]. The present study was designed to evaluate the effectiveness of the First Class Leone appliance in achieving distal displacement of maxillary first permanent molars in children whose second permanent molars had already erupted, thereby providing insights into treatment duration, anchorage considerations, and potential collateral changes in adjacent teeth.

The purpose of the study was to evaluate the effectiveness of the First Class Leone appliance for distal movement of the first permanent molars of the upper jaw in children who have erupted second permanent molars.

Materials and methods. This study included a total of 10 patients aged 8–13 years who presented with a distal relationship of the maxillary first permanent molars and fully erupted second permanent molars, as confirmed by clinical examination and radiographic evaluation. All patients were treated in the Department of Orthodontics at Bogomolets National Medical University, following the approved ethical guidelines. The inclusion criteria required the presence of an Angle Class II molar relationship with erupted maxillary second permanent molars, absence of systemic contraindications, and consent from the parents or legal guardians. Exclusion criteria encompassed severe craniofacial anomalies, active periodontal disease, and refusal to undergo fixed orthodontic treatment. Each patient underwent thorough clinical and radiographic assessments, which included diagnostic casts and lateral cephalometric radiographs obtained at baseline and upon completion of treatment. The First Class Leone appliance was used for the distal movement of the permanent molars of the upper jaw. The appliance for the distal movement of permanent molars of the upper jaw is fixed, mechanically operated, unicuspid and intraoral.

To determine the features of the morphological structure of the facial skull, telerradiographs of the patients' heads were used, performed in lateral projection. Lateral telerradiographs of the head were made using the "ORTHOPHOS" apparatus of "SIRONA SIDEXIS", at a focal length of 150 cm, voltage of 65–75 kV, exposure time – 1.6–2.0 s, current strength – 14 mA. The head was fixed using a cephalostat. The beam was directed to the middle of the external auditory canal. To determine the structural features of the facial skull in patients with distal occlusion, 10 angular and 10 linear parameters were studied [2].

The results were processed by variational statistical methods of analysis using the Microsoft Office Excel 2016 software. Statistical processing of the experimental study results was carried out by the methods of variation analysis using the Student's test. The difference was considered statistically significant at $p < 0.01$ [1].

Results of the study and their discussion. The data on the results of changes in angular and linear parameters of individual teeth before and after distal movement of maxillary molars using an apparatus for distalisation of permanent maxillary molars are shown in Table 1.

Patients in the first group underwent lateral cephalometric radiography before analysis of the angular parameters presented in the table indicates that the most striking differences were observed in $\angle 1SpP$ (decreasing from $74.00 \pm 0.25^\circ$ to $72.25 \pm 0.22^\circ$) and $\angle 1NS$ (from $80.37 \pm 0.36^\circ$ to $80.13 \pm 0.53^\circ$). Although these changes might appear minor from a purely numerical standpoint, they suggest a slight proclination or forward movement of the maxillary incisors, which can arise as an unintended consequence of molar distalization. Clinically, such incisor changes must be monitored, as any significant protrusion may affect smile esthetics, lip support, and overall occlusal balance. However, the small magnitude of this shift implies that the impact on patient appearance and anterior guidance remains limited and is often manageable without additional interventions.

The parameters $\angle 4SpP$ and $\angle 4NS$, demonstrating reductions of about 1.25° and 2.37° respectively, highlight a certain degree of mesial tipping or mesial movement of the maxillary premolars that serve as anchorage units during distalization. Such mesial displacement is relatively common in noncompliance distalization mechanics, where forces directed distally on the molars inevitably transmit forward vectors to the adjacent anchorage teeth. Although mild anchorage loss is anticipated, careful treatment planning with small increments of activation can minimize unwanted tooth movements. Notably, an increase in $\angle 5SpP$ and $\angle 5NS$ suggests that the second premolars experienced a slight distal inclination, which can be advantageous if additional space is required in the posterior region of the dental arch.

Regarding the first permanent molars (tooth number 6), the parameters $\angle 6SpP$ and $\angle 6NS$ rose by less than one degree overall, signifying predominantly bodily or upright distal movement with minimal tipping. This outcome is typically regarded as desirable in orthodontic practice, as excessive tilt of the

molars can compromise occlusal stability and hamper future finishing stages. By contrast, second permanent molars (tooth number 7) exhibited a more pronounced distal inclination, with $\angle 7\text{SpP}$ and $\angle 7\text{NS}$ each increasing by approximately 2° . When second molars have already erupted, they commonly participate in the distalization process, and a greater angular shift is not uncommon. Clinicians should, however, remain vigilant regarding occlusal relationships between the distalized second molars and their mandibular counterparts.

Table 1

Changes in angular and linear parameters of individual teeth before and after distal movement of maxillary molars using an apparatus for distalisation of permanent maxillary molars, $M \pm m$

Parameters	Before treatment	After treatment
Angular		
$\angle 1\text{SpP}$	74.00±0.25	72.25±0.22
$\angle 1\text{NS}$	80.37±0.36	80.13±0.53
$\angle 4\text{SpP}$	93.25±0.72	92.0±0.85
$\angle 4\text{NS}$	100.25±0.72	97.88±0.36
$\angle 5\text{SpP}$	99.5±0.67	100.25±0.45
$\angle 5\text{NS}$	107.5±0.72	108.3±0.32
$\angle 6\text{SpP}$	103.64±0.72	104.13±0.53
$\angle 6\text{NS}$	114.65±0.72	115.21±0.87
$\angle 7\text{SpP}$	115.0±0.72	117.03±0.71
$\angle 7\text{NS}$	121.38±0.72	123.16±0.89
Linear		
1SpP	26.59±0.72	26.83±0.86
4SpP	24.0±0.64	24.15±0.79
5SpP	21.37±0.78	21.32±0.35
6SpP	19.78±0.88	20.12±0.73
7SpP	58.54±0.41	61.38±0.33
1-C	44.07±0.25	47.47±0.34
4-C	36.48±0.42	34.11±0.28
5-C	28.02±0.37	22.43±0.22
6-C	20.09±0.49	15.39±0.45
7-C	26.59±0.72	26.83±0.86

Turning to the linear metrics, an increase in 1SpP and 4SpP by 0.24 mm and 0.15 mm, respectively, may reflect minor alterations in vertical position or slight horizontal shifting of the incisors and first premolars. Meanwhile, 5SpP showed minimal change, suggesting that the second premolars maintained relative positional stability, other than the aforementioned minor distal inclination confirmed by the angular parameters. More notable is the 6SpP increment of 0.34 mm, indicating successful distal displacement of the first permanent molars in a predominantly bodily fashion. The second molars, represented by 7SpP , revealed a larger increase of nearly 3 mm, consistent with the enhanced distal movement or angulation of tooth number 7.

Additional insight emerges from the parameters that measure distances relative to the reference line C. An increase of over 3 mm in 1-C suggests mesial advancement of the maxillary incisors, often interpreted as a degree of unwanted anchorage loss. In contrast, 4-C and 5-C both decreased by 2.37 mm and 5.59 mm, respectively, underscoring mesial drifting or tipping of the anchorage premolars. Such anchorage loss is an acknowledged trade-off in distalization mechanics. Critically, 6-C underwent a significant reduction of more than 4 mm, confirming that the primary objective of shifting the first permanent molars distally was indeed achieved. Overall, the data reflect an effective distalization protocol that attained the desired relocation of the posterior teeth while retaining manageable levels of incisor protrusion and premolar mesial shift.

The results obtained in this study corroborate previous findings that noncompliance appliances can achieve effective molar distalization while minimizing anchorage loss, even in situations where the second permanent molars are fully erupted [7, 8]. In particular, the relatively stable bodily movement of the first molars and the limited mesial drift of the anchorage teeth reflect patterns of controlled tooth motion comparable to those reported with other mini-implant-supported or fixed appliances [11]. Nonetheless, the modest but discernible angular changes in the erupted second permanent molars underscore that these teeth can be active participants in the distalization process, consistent with studies indicating that erupted distal

segments increase the resistance and force distribution needed for molar retraction [5, 9]. It should be noted that the slight proclination of incisors and mesial tipping of anchorage premolars observed in our sample aligns with the mild unwanted tooth movements documented in other noncompliance distalization protocols [3, 4]. Although such changes did not appear to compromise occlusal function or esthetics in the short term, some degree of post-distalization compensation may be necessary to fine-tune the final occlusion and maintain long-term stability. Our findings also suggest that employing the First Class Leone appliance in children with erupted second permanent molars is a viable approach, as the average magnitude of distal shift and moderate anchorage loss remain clinically manageable. These observations align with emerging data on the need for predictable, patient-independent methods in cases where compliance with removable appliances may be suboptimal [6, 8]. Future investigations could build upon these preliminary results to further elucidate the interplay between molar distalization and vertical changes, as certain researchers have noted the potential for bite opening or extrusion of posterior teeth in similar treatment protocols [10]. Moreover, given the complexity of comorbid conditions that can coexist in pediatric populations, a comprehensive treatment approach that addresses both dental anomalies and systemic health issues, such as epilepsy, should be explored. Developing a multidisciplinary model capable of integrating orthodontic interventions with medical management of neurological disorders could benefit patients by preventing exacerbations of systemic disease while optimizing occlusal outcomes. Ultimately, this line of inquiry may offer valuable insights into how orthodontic measures can be safely and effectively combined with broader therapeutic regimens for children presenting with malocclusions and concurrent health challenges.

Conclusions.

1. The maxillary first permanent molars were successfully distalized by an average of 4.29 ± 0.36 mm, at a rate of 1.04 mm/month, demonstrating the reliability of the First Class Leone appliance in cases where second permanent molars are already present.
2. The second permanent molars exhibited a mild distal inclination of 2.03° relative to the palatal plane and 1.78° relative to the NS plane, reflecting controlled but noticeable tipping that remained clinically acceptable.
3. Mesial movement of the anchorage teeth averaged 0.46 mm per 1 mm of molar distalization, indicating a moderate level of anchorage loss that can be managed effectively through careful planning and periodic reevaluation of appliance activation.

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