ORIGINAL ARTICLE

EVALUATING THE CLINICAL APPLICABILITY OF THE INJECTION TECHNIQUE IN THE MANUFACTURING OF FLEXIBLE REMOVABLE PARTIAL DENTURES

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Abstract: *Background*: In the current context of dental technology development, modern methods for manufacturing removable partial dentures hold an essential place in the current practice of the dental technician. The aim of the study was to evaluate the clinical applicability of the injection technique in the realization of elastic removable partial dentures. *Methods*: The study was conducted on a total of 90 clinical cases documented in the dental technique laboratory. Inclusion criteria in the study regarded patients with unilateral or bilateral, maxillary or mandibular partial edentulism, clear indication for the realization of an injected elastic prosthesis. *Results*: The injection technique in the realization of dental prostheses has demonstrated high versatility and effective adaptation to a variety of clinical situations, for both complete and partial dentures. *Conclusions*: The results obtained in this study support the idea that the injection method represents a viable and modern alternative to classical techniques, especially when applied in a well-controlled technical context and with efficient collaboration between the dentist and the dental technician.

Keywords: removable partial denture, injection technique, flexible materials

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1. Introduction

In the current context of dental technology development, modern methods for manufacturing removable partial dentures hold an essential place in the current practice of the dental technician.

The injection of flexible materials, such as thermoplastic PMMA, allows for obtaining prostheses with precise adaptation, reduced weight, and superior aesthetics. In addition, the increased comfort and biocompatibility of these materials contribute to a better acceptance of the prosthetic treatment by patients [1-4].

The injection technique is a modern procedure for manufacturing removable partial dentures, which consists of introducing a heated thermoplastic material under pressure into a negative space created by prior modelling. This method allows for obtaining excellent adaptation and a high level of detail, being frequently used in the fabrication of flexible dentures and aesthetic components [5-7].

The most commonly used materials for this technology are polyamides (nylon), polycarbonate, and flexible PMMA. These materials exhibit properties of elasticity, fracture resistance, biocompatibility, and superior aesthetics. Sabilex FlexiAcryl (Leopoldo Marechal, Buenos Aires, Argentina) is an example of flexible PMMA used in this technique, with favorable results regarding denture adaptation and patient comfort [1,8-10].

Among the major advantages of this technology are: precise adaptation to the prosthetic field, increased elasticity which offers comfort and stability, superior aesthetics through the elimination of visible metal clasps, long-term mechanical resistance, and the possibility of rapid repair in the laboratory [11,12]. The main benefit, however, lies in the biocompatibility of thermoplastic materials, which are well-tolerated by oral tissues, reducing the risk of irritation or allergic reactions [13].

Although the technique presents multiple benefits, there are also limitations, such as: the difficulty of subsequent modifications or repair to the prosthesis, the need for specialized equipment, the high cost of materials, and the technician's experience in correctly handling the system [6,12,14,15]. Another important aspect is the fact that thermoplastic resins can undergo deformation at high temperatures if not handled correctly, which requires strict adherence to the technological protocol [16-23]. Also, the lack of material rigidity can affect long-term functionality in cases with extensive edentulous spaces, where additional support is required [10].

Looking into the future, the development of hybrid injectable materials with improved biomechanical properties is recommended, which combine flexibility with superior structural strength. Also, optimizing digital CAD/CAM technologies for the design and modeling of injected prostheses can bring a higher standardization of the quality of the work [24,25].

Main purpose of this study is to evaluate the clinical applicability of the injection technique in the realization of elastic removable partial dentures and to highlight the advantages and limitations of the method, as well as to assess the degree of functional and aesthetic satisfaction of the prosthesis by

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performing a statistical analysis of the cases to determine the frequency of use of the method according to location (maxilla vs. mandible), extent of edentulous area, and other relevant clinical criteria and also to identify the limitations of this technique.

2. Materials and method

This study is retrospective and conducted by analyzing the results obtained in 90 clinical cases documented in the dental technique laboratory between October 2024 and June 2025.

Inclusion criteria in the study regarded patients with unilateral or bilateral, maxillary or mandibular partial edentulism, clear indication for the realization of an injected elastic prosthesis, in the absence of major contraindications, the possibility of complete photographic documentation of the laboratory stages and the application of a standardized technological protocol based on thermoplastic injection technology with a Sabilex 2AD device.

Cases not included in the analysis were the ones with incomplete information or insufficient photographic documentation and also prostheses obtained using mixed or conventional technologies.

All the prostheses were obtained in the dental laboratory using Sabilex FlexiAcryl flexible resin, dedicated insulation liquid for plaster and resin, Sabilex aluminum flask, 3rd class plaster for the plaster model and Sabilex 2AD injection device using the standard parameters: 280C temperature, 6 bar pressure and 25 minutes.

Each technological step was applied according to the equipment user manuals and the protocols recommended by the manufacturers [1,11]. The stages include wax modelling, mounting the model in the metal flask, applying the insulator, material injection, de-flasking, finishing, and final polishing of the prosthesis.

This method was chosen due to its efficiency in detail reproduction, the adaptability of the thermoplastic material, and the reduction of working time compared to classic methods [14,15].

The study was approved by the Ethics Committee of the University of Medicine and Pharmacy of Craiova, with no 65/29.01.2024.

3. Results

Demographic analysis of the study group

Distribution of patients by sex

The analysis of gender distribution among the 90 patients included in the study shows a predominance of the male sex, with a total of 55 male patients (61%), compared to the female sex (39%). The distribution was performed based on the cases selected during the analyzed period, without applying a criterion for balancing between sexes (Figure 1).

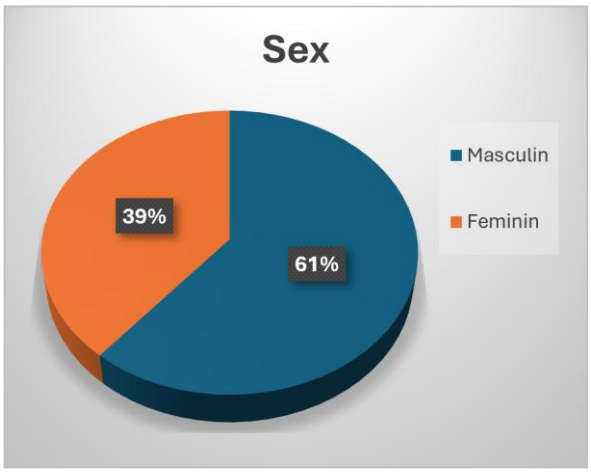

Figure 1. Sex distribution of patients.

Distribution of patients by age

The distribution by age group indicates that the predominant segment is between 40

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and 59 years old, represented by 13 patients (72%). Out of the total of 18 patients, 2 were aged between 30–39 years (11%), 6 between 40–49 years (33%), 7 between 50–59 years (39%), and 3 patients were over 60 years old (17%) (Figure 2).

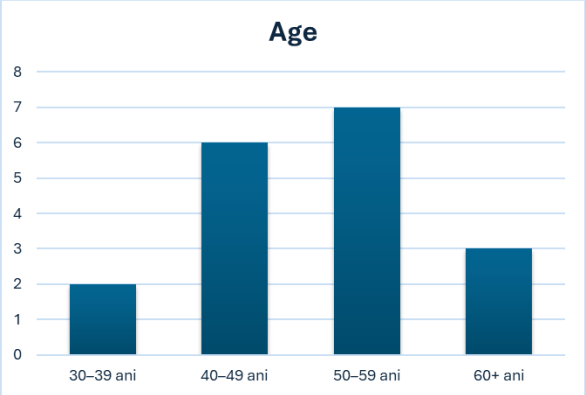

Figure 2. Age distribution of patients.

Technical aspects

Type of prostheses used

The distribution by type of prostheses shows that the majority of works made using the injection technique were full dentures (10 cases, 56%). Partial dentures represented 6 cases (33%), and injected partial frameworks were used in 2 cases (11%) (Figure 3).

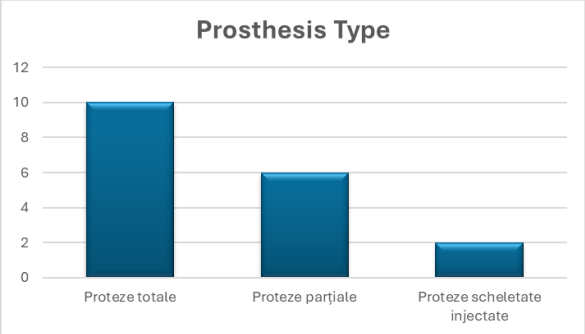

Figure 3. Types of prosthesis used.

Materials used for the injection technique

In the 90 analyzed cases, the materials used were: PMMA (45 cases, 50%), nylon (25 cases, 28%), acetal (15 cases, 17%), and PEEK (5 cases, 5%). The choice of material varied depending on clinical indications, peculiarities of the prosthetic field, and the preferences of the medical-technical team. (Figure 4).

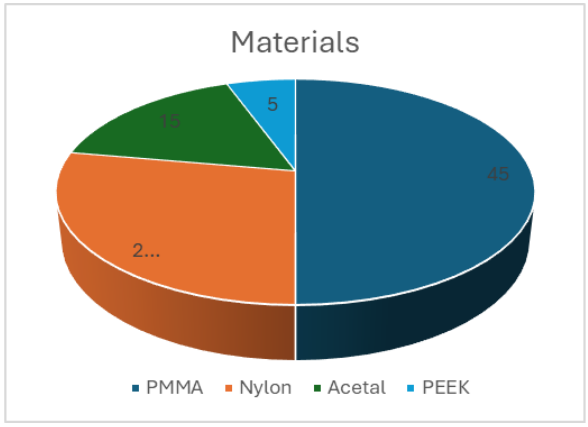

Figure 4. Materials used for the injection technique.

The duration of prosthesis manufacture

The execution time of the analyzed prosthetic works varied between 3 and 6 days, with a higher frequency for the intervals of 4 and 5 days (6 and 7 cases respectively). Fewer cases were completed in 3 days (10 cases) or 6 days (15 cases), with the overall average execution time being approximately 4.4 days (Figure 5).

Figure 5. The duration of prosthesis manufacture.

Post-insertion complications

Complications observed after the insertion of the injected prostheses were absent in 45 cases (50%). In 25 cases (28%), minor discomfort was reported, 15 cases (17%) required adjustments to improve retention,

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and in 5 cases (5%), a localized mucosal lesion was recorded (Figure 6).

The mucosal tolerance to the materials used was good, and the adjustments were limited, in most cases, to slight retouching performed in the laboratory. The low incidence of lesions or major discomfort validates the efficiency of the injection method from a clinical point of view.

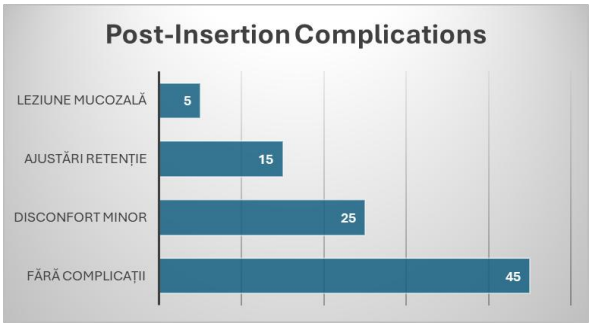

Figure 6. Post-insertion complications.

Number of adjustments necessary after insertion

The distribution of adjustments made after the insertion of dentures produced by the injection technique indicates that in 35 cases (39%), no intervention was necessary, and in 30 cases (33%), only a single adjustment was required. More extensive adjustments were reported in 15 cases (17%) which required two interventions, and in 10 cases (11%) where three or more adjustments were performed. These corrections primarily focused on improving retention and eliminating pressure points identified in the period immediately following the delivery of the prostheses (Figure 7).

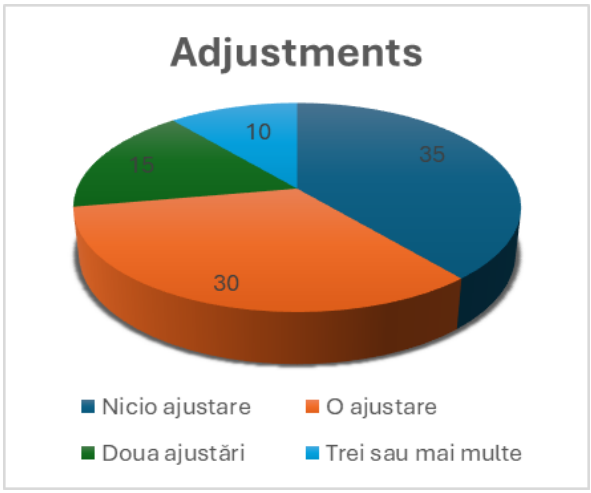

Figure 7. Number of adjustments necessary after insertion.

Prosthesis lifespan estimation

The estimated lifespan of the dentures was distributed as follows: under 1 year – 5 cases (6%), between 1–3 years – 55 cases (61%), and over 3 years – 30 cases (33%). The estimations were based on the type of material used, the predictable degree of wear, and the particular clinical conditions of each case (Figure 8).

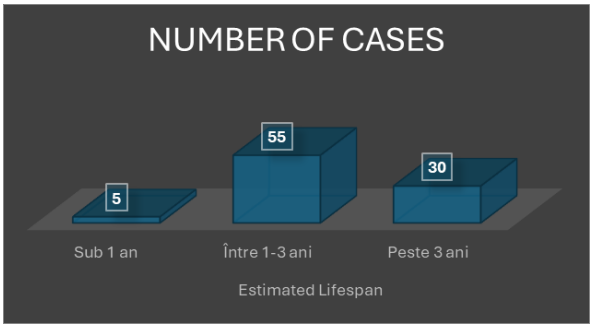

Figure 8. Prosthesis lifespan estimation.

Prosthesis cost

The estimated cost of the prosthetic works fell within the following ranges: under 1000 RON – 5 cases (28%), between 1000 – 1500 RON – 9 cases (50%), and over 1500 RON – 4 cases (22%) (Figure 9).

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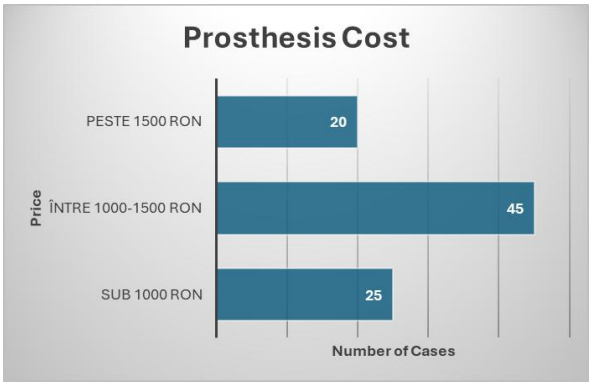

Figure 9. Prosthesis cost.

Patient satisfaction

The evaluation of patient satisfaction with dentures made using the injection technique was performed using a rating scale from 1 to 5, where 1 represented a very low level of satisfaction, and 5 a maximum level. The collected results showed that 40 patients (44%) gave a score of 5, 30 patients (33%) a score of 4, 15 patients (17%) a score of 3, and 5 patients (6%) gave a score of 2. No minimum scores (score 1) were recorded (Figure 10).

Figure 10. Patient satisfaction degree.

4. Discussions

The injection technique in the realization of dental prostheses has demonstrated high versatility and effective adaptation to a variety of clinical situations, for both complete and partial dentures. The analysis of the 90 prosthesis made using this method highlights a good clinical success rate, a short execution time, and increased patient satisfaction, especially in cases where modern materials such as acetal or PEEK were used. These results are consistent with the specialized literature, which emphasizes the advantages of injection concerning fitting precision and patient comfort [26,27].

One of the most notable benefits of the method is the optimal initial fit of the work, due to the precision of the impression taking and the constant pressure applied during injection. This contributed to reducing the number of post-insertion adjustments and limiting complications, confirming observations that modern methods of processing prosthetic materials significantly improve denture retention and stability. Recent studies indicate superior biological tolerance of injected materials, especially in cases of patients with fragile mucosa or difficult denture bearing areas [28].

However, the technique is not without limitations. The higher cost of high-performance materials (e.g., PEEK), the need for specific equipment, and the complexity of preparing the metal flask can limit the applicability of the method in some laboratories. Also, in cases with complicated anatomies or the need for frequent repairs, the technique may become more difficult to manage in the absence of corresponding experience.

The relatively small difference between the two groups of patients, males and females, may influence certain functional aspects [29] or adaptation, but it does not generate significant imbalances in the overall analysis. The relevance of this distribution lies in highlighting a demographic profile [30] which

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can contribute to the interpretation of other variables such as the degree of satisfaction, post-insertion complications, or the type of prosthesis produced.

Gender distribution may indirectly influence material choice [31], psychological adaptability to the prosthesis, or the level of collaboration during the clinical and technical stages. For example, some authors have highlighted a slight tendency for female patients to prioritize the aesthetic aspect [32], while male patients may place greater emphasis on functionality [25].

This distribution of patients by age highlights an increased frequency of extensive edentulism in the fifth and sixth decades of life, a period during which an intensification of demands for modern prosthetic treatments is observed [22]. At the same time, the group over 60 years old was less represented, possibly due to preferences for other types of work or limited access to new technologies.

The most frequent age range corresponds to a period of life where tooth loss becomes more common due to periodontal disease and cumulative complications [33]. Injected prostheses offer clear advantages from an aesthetic and functional point of view, adapting well even in complex cases, regardless of age.

Injectable PMMA was the most frequently used material, due to good mechanical characteristics, dimensional stability, and accessible cost [34]. It is easy to finish, repairable, and versatile for a wide range of clinical cases. Nylon was preferred in works where increased flexibility and superior aesthetic appearance were desired, but it is more difficult to adjust and polish, requiring special equipment.

Acetal was chosen for its increased resistance and adaptability in the clasp area, offering an aesthetic alternative to metallic elements, available in multiple shades. PEEK, a high-performance material with excellent mechanical properties and high biocompatibility, was used in only 5 cases, being rarely applied due to high costs and strict technical requirements [35].

The choice of injected material was dictated by both the clinical specifics of each case and the availability of equipment and materials in the dental technical laboratory.

Regarding the types of prosthesis used, the high frequency of full dentures can be associated with the increased demand for this type of treatment, especially in cases of complete edentulism [36]. Partial dentures were made in situations with stable remaining teeth, and injected partial frameworks were reserved for cases where an aesthetic and resistant solution, without visible metal, was desired.

The types of the prostheses obtained reflects both the clinical needs of the patients and the therapeutic orientation of the collaborating dentists involved in the treatment. Full dentures were often recommended in cases with atrophied maxillae or old edentulous areas, where stability and retention are priorities. Partial dentures were preferred for patients with healthy remaining teeth, offering a balance between functionality and the preservation of the oral structure. In contrast, injected partial frameworks, although used less frequently, were chosen for patients who presented favorable conditions for support and retention, but required a light design without visible metal components [26].

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This diversity of options demonstrates the adaptability of the injection technique depending on the specifics of each prosthetic case.

Complications observed after the insertion of the injected prostheses indicate an appropriate functional adaptation in most cases. Minor discomfort and the need for adjustments are considered normal post-insertion reactions, especially in the case of atrophied prosthetic fields [37]. The mucosal lesion was treated by recontouring the prosthesis, with no subsequent complications.

Although the complications were quantitatively reduced, they offer valuable information about the need for fine adjustment of the injected works, especially in areas with concentrated pressure or an irregular prosthetic field. In general, injected works tend to have a better initial adaptation compared to those made classically [38].

Regarding the duration of prosthesis manufacture, the distribution confirms the efficiency of the injection technique in obtaining rapid results while maintaining quality standards [6].

The short realization time is supported by the fact that the injection method involves a coherent and compact technological flow, with well-defined stages and a reduced rate of re-interventions. Especially in the case of using injectable PMMA, the homogeneity of the material and the precise adaptation to the model contributed to shortening the working time [39]. In situations where the duration exceeded the average, the determining factors were the need for additional impressions, technical adjustments, or delays related to patient scheduling. Overall, the execution time falls within an efficient range adapted to the work rhythm of the dental technical laboratory.

Patient satisfaction degree showed that no minimum scores (score 1) were recorded, which indicates a generally favorable perception among patients regarding the quality of the prosthetic work received [40].

The information regarding the patient satisfaction was obtained indirectly, through discussions and follow-up consultations conducted shortly after the insertion of the prostheses, without the application of standardized questionnaires. The high level of satisfaction scores reflects both the quality of the work carried out in the laboratory and the efficiency of the collaboration between the technical team and the dentist [37]. Among the most frequently mentioned positive aspects were comfort during speech and mastication, good denture retention, and harmonious aesthetic integration into the facial context.

Regarding the total cost of the prosthesis, the distribution reflects the differences generated by the materials used, the applied technology, and the complexity of the case. The most accessible dentures were those made with PMMA, while works with nylon or PEEK recorded higher costs [41].

The cost structure is influenced by both the material used and the complexity of the work (partial vs. complete denture) and the number of technological stages involved. The prostheses with costs under 1000 RON were, in general, simple, made from PMMA, without special aesthetic demands or special components.

In contrast, works that exceeded the 1500 RON threshold included either special materials (e.g., PEEK) or more complex

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configurations, with aesthetic clasps or personalized functional modifications. Cost remains an important variable in the patient's choice of the type of prosthetic work and must be correlated with the long-term functional and aesthetic benefits [6].

The distribution of adjustments made after the insertion of dentures produced by the injection technique reveals a good functional adaptation of the majority of the injected dentures, right from the first post-insertion stages. The quality of the adaptation is closely linked to the precision of the impression taking [42], the fidelity of the working model, and the careful control of the injection parameters. The fact that most dentures did not require additional adjustments or only needed minor modifications confirms the efficiency of the method and the stability of the prostheses [43].

The cases that involved multiple corrective interventions were generally associated with anatomical difficulties, such as atrophied alveolar ridges, mobile mucosa, or unstable denture bearing areas. Even in these situations, all adjustments were carried out in the laboratory, without requiring the complete remake of the work, which highlights the flexibility of the injection technique and its ability to offer tailored solutions even in more complex clinical conditions.

Most prostheses are expected to have a usage duration of between 1 and 3 years, especially those made with PMMA. Dentures made with materials such as acetal or PEEK showed a better prognosis regarding durability [44], due to their superior mechanical resistance and dimensional stability.

The durability of the dentures is influenced by several factors: the material used, oral hygiene conditions, the degree of functional wear, and the correct conformation of the prosthesis. In particular, poor hygiene or parafunctions (bruxism) can accelerate the degradation of the material, reducing the lifespan of the denture, regardless of its initial composition. In this context, educating the patient about the correct maintenance of the prosthesis has an essential role in extending its use.

Injected dentures made from modern materials, such as PEEK or acetal, have demonstrated superior performance in terms of fracture resistance and chemical aging [45]. However, the choice of these materials remains conditioned by the availability of adequate equipment and the patient's budget. The lifespan estimation, although theoretical, aligns with clinical observations in the specialized literature, which support an average usage of 2–3 years for injected dentures, with the possibility of extension under optimal usage conditions.

The injection technique has the potential to become a standard option in the realization of modern dentures, provided that the medico-technical teams are familiar with the correct application parameters and the specific indications of each material [46,47].

5. Conclusions

The results obtained in this study support the idea that the injection method represents a viable and modern alternative to classical techniques, especially when applied in a well-controlled technical context and with efficient collaboration between the dentist and the dental technician. The general recommendation is that the choice of method

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should be personalized according to the complexity of the case, available resources, and the patient's profile, with an emphasis on post-insertion comfort and the long-term stability of the prosthesis.

The injection method is notable for its flexibility and efficiency, but it involves a higher initial investment in equipment and good technical training. At the same time, the choice of material and the configuration of the prosthesis must be personalized according to the particularities of each case to ensure long-term prosthetic success.

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Conflict of interest statement

The authors declare no conflicts of interest concerning this study.

Data availability statement

Will be provided on request.

Ethics statement

This study was approved by the Ethics Committee of the University of Medicine and Pharmacy of Craiova (approval data no. 65/29.01.2024).

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