

CASE REPORT

Esthetic and functional rehabilitation of peg-shaped maxillary lateral incisors: Practical recommendations

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Abstract

Peg-shaped maxillary lateral incisors cause many functional and esthetic major consequences in affected patients. Their esthetic and functional rehabilitations are often multidisciplinary, involving different clinical procedures like periodontal, orthodontic, or prosthodontic procedures. No exhaustive protocol has been established to improve their comprehensive management by general dentists or specialists. The aim of this article is to elaborate a simplified clinical protocol of complete management of peg-shaped maxillary lateral incisors by a multidisciplinary team (general practitioners, orthodontists, and prosthodontists). A clinical case of two peg-shaped maxillary lateral incisors completely rehabilitated with multidisciplinary approaches including orthodontic treatment and restoration by veneers and direct composite resin, according to the established protocol. Extraoral, intraoral, and smile clinical analysis are crucial to ensure optimal rehabilitation. Treatment results previsualization via wax-up and/or mock-up play a key role in the communication between practitioner and patient to help the latter make decision. These options also facilitate the achievement of a multidisciplinary approach by accurately estimating the number of dental movements and the type of restorations that are most suitable to the presenting clinical situation.

KEYWORDS

esthetic, orthodontia, peg-shaped tooth, smile

1 | INTRODUCTION

Anomalies of maxillary lateral incisors including shape, size or even agenesis are quite common, with a prevalence varies from 1.6% to 4.9% with higher prevalence in women than men.^{1,8} They can be either unilateral or bilateral touching the left or the right side with a higher incidence on the left-side dental arch.⁷ Peg-shaped anomaly of lateral

incisors is one of the most common form of localized microdontia that affects the shape of permanent maxillary lateral incisors (peg lateral). It is characterized by the reduction of the incisal mesiodistal width compared with the cervical region.⁶ This shape anomaly leads to anterior diastemas, which causes functional and esthetic major concerns for the affected patients.^{4,5} Many treatment options of peg-shaped lateral incisors are available including

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one or many of these clinical procedures: no treatment, orthodontic treatment first, direct or indirect composite restorations, bonded ceramic crowns or veneers,³ and finally, extractions and implant placement. The multiple management possibilities make it difficult in some clinical situations to take the right therapeutic decisions by general dentists especially with growing esthetic demands of patients.

Many affected patients with peg-shaped lateral incisors present maxillary skeletal deformities and maxillo-mandibular teeth discrepancies (Bolton index is greater than 77.2% +/- 0.22).⁹ In these conditions, orthodontic treatment must be considered at the first line before prosthodontic rehabilitation of deformed lateral incisors. The final therapeutic options will depend on orthodontic objectives and methods. Several alternative therapeutic solutions must be considered like extractions or closing the interdental diastemas with possible consequences on the dental disharmony or morphological rehabilitation of these teeth to ensure the establishment of ideal occlusion.

When orthodontic treatment is considered before rehabilitation: definitive mesiodistal diameter and final vertical positioning of affected teeth must be determined before starting the orthodontic phase. To facilitate active

orthodontic treatment, peg-shaped lateral incisors may be provisionally reconstructed according to the esthetic and functional decided criteria (shape, mesiodistal width, and color according to the adjacent teeth) prior to the placement of any orthodontic appliance. This procedure cannot be achieved when maxilla arch exhibits other dental discrepancies (crowding, teeth rotation, and palatally tipped teeth), which require orthodontic treatment to be started for teeth aligning and leveling before proceeding to the temporary restoration.

The lack of established clinical recommendation in the literature encouraged us to establish such protocol to facilitate the therapeutic decisions by the general practitioner, the orthodontist, and the patient, and ultimately to guarantee the most suitable therapeutic solution according to the individual clinical situations. The patient is often referred to the general practitioner once the orthodontic treatment has been completed. This lack of coordination between specialties represents a real loss of chance for patients. In this article, we aimed to clearly define the different considerations to be evaluated and the steps to follow, before and after orthodontic treatment. Our ultimate objective was to ensure the most appropriate multidisciplinary rehabilitation of affected teeth (Figure 1).

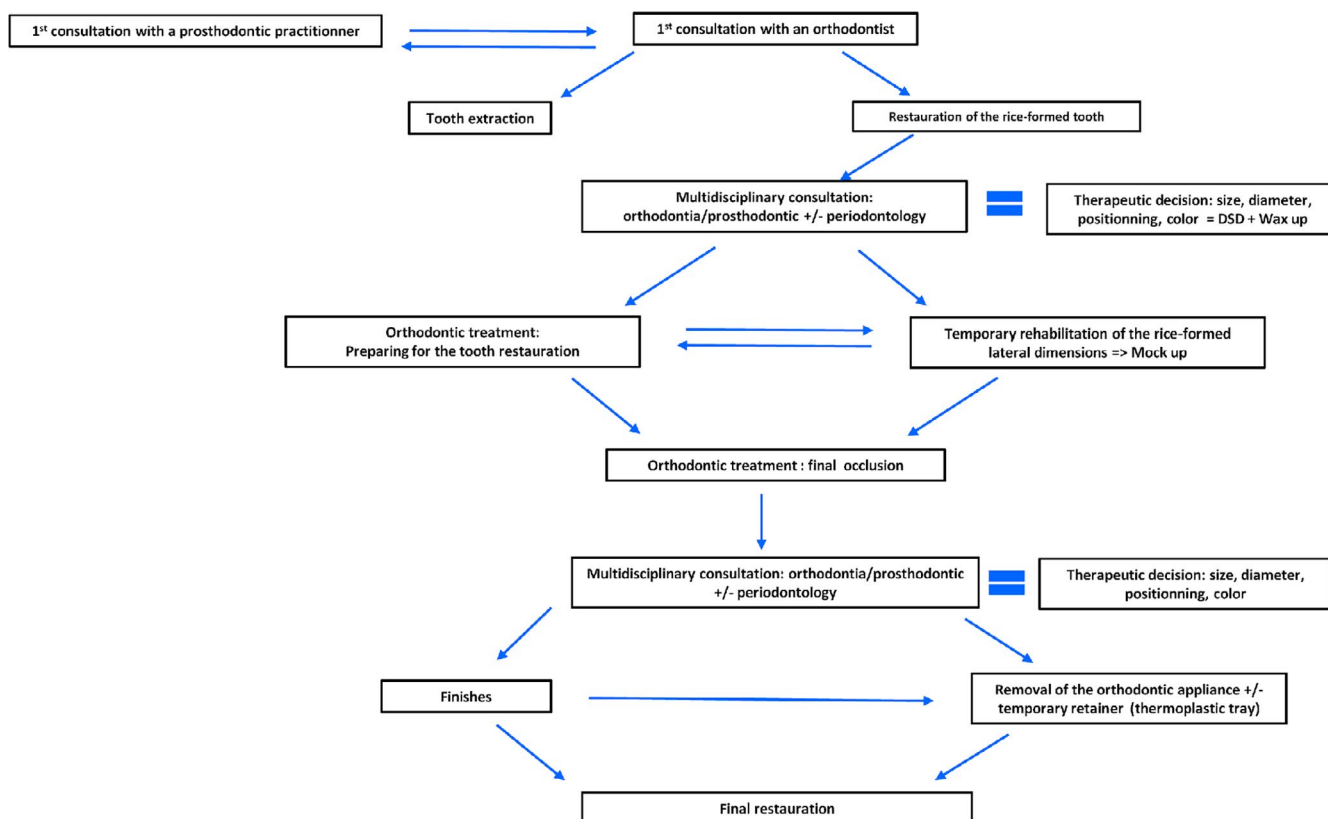


FIGURE 1 Interdisciplinary coordination for the management of peg-shaped maxillary lateral incisors

2 | DEFINING THE TREATMENT OBJECTIVES

Before any therapeutic decision, three main biological, esthetic, and functional objectives (bio-esthetic-functional triad) must be defined between practitioners and then be validated with the patient to establish the adequate individual treatment plan (Table 1). Healthy periodontal tissues will assure the esthetic results of the prosthodontic reconstitution.^{10,11}

The clinical analysis of the patient consists of extraoral examination, intraoral environment examination, and then the analysis of the affected teeth.

The extraoral analysis that is very important in our bio-esthetic-functional triad. Practitioners should evaluate: 1) the proportion and the equality of three parts of the face and their symmetry including the vertical esthetic and occlusal dimensions, 2) maxillary labial protrusion as well as the nasolabial angle in order to determine the amount of labial and dental support, 3) the orientation of the horizontal lines of the face, and 4) the position of the chin. At the same time, practitioners should evaluate the different orofacial functions including 5) phonation and speech and finally evaluate 6) the patient's smile in three different situations: without the appearance of teeth, social, and spontaneous smiles.^{13,14}

3 | STUDY AND ANALYSIS OF THE CLINICAL SITUATION

3.1 | Extraoral environment: The smile

The smile represents a real importance in everyone's social life. It influences physical, social, and intellectual attraction.¹⁵ Several smile variables must be evaluated before reconstructing a maxillary anterior tooth (Table 2). The study of smile can be carried out either dynamically (video) or statically (images).¹⁶

3.2 | Analysis of the intraoral environment of the tooth

3.2.1 | Periodontium

As mentioned previously, the periodontium has all its importance in esthetics¹⁷ but also in the biofunctional integration of the reconstitution.^{10,11} The position of the gingival edges of the maxillary anterior teeth can be modified by gingival or osteogingival plasties,^{18,19} for esthetic reasons.²⁰

3.2.2 | Adjacent teeth

Determining the color shade of affected lateral incisors can be complex due to the high saturation of the adjacent canine and the less saturated central incisor. Besides, teeth may have dyschromic anomalies like white stains of fluorosis or brown stains of molar-incisor hypomineralisation (MIH).²¹ Patient's desire to reproduce or not these anomalies in the final prosthetic rehabilitation should be also verified.

3.2.3 | Tooth size

Several studies agree that the golden ratio (width/height) of maxillary lateral incisor are of 62%, but this ratio is not the reference for patients as they seem to prefer a ratio ranged from 67% to 72%.²²⁻²⁴ German et al. have concluded that the ideal mesiodistal width of a maxillary lateral incisor is to be 2 mm narrower than one of the maxillary central incisors.²⁵

3.2.4 | Teeth position on the dental arch

A smile is considered esthetic if the maxillary central incisal edge is at the same level as the maxillary canine edge²⁶ and if the maxillary lateral incisal edge is between 0.5 and 1.5 mm coronally to this of central incisor.^{2,7,27}

3.2.5 | Occlusion (static and dynamic)

The evaluation of the anterior guidance as well as the occlusal plane are necessary to select the most appropriate restoration materials and shape.²⁸

3.2.6 | Position of the tooth in the mouth

Affected teeth should be analyzed according to its position in the oral cavity. This includes its relations to the adjacent central incisors and canines and to its inclination (vestibular and palatal). This step is very important to achieve our bio-esthetic-functional triad. The amounts of dental tissues of the affected laterals are then evaluated (the quantity of remaining enamel, dentinal exposure, and pulpal vitality). The chromic color shade plays a crucial role in determining the final prosthodontic options (for example, making a crown instead of a veneer). Once this global analysis is done, a virtual project can be elaborated to make a wax-up of the future rehabilitation.

Biological objectives	<ul style="list-style-type: none"> • Preservation of remaining dental tissues by being as conservative as possible⁴¹ • Preservation of the biological space after rehabilitation¹⁰
Functional objectives	<ul style="list-style-type: none"> • Re-establishing a functional anterior guide • Ensuring food incision • Ensuring an intelligible phonation^{11,42}
Esthetical objectives	<ul style="list-style-type: none"> • Harmonious integration of the restauration in the patient's smile • Respecting the color and position of the peg-shaped teeth and their periodontium.

TABLE 1 The bio-esthetic-functional triad

TABLE 2 Smile characteristics

Buccal corridor	<ul style="list-style-type: none"> • Intermediate buccal corridor is considered the most esthetic. • Narrow buccal corridor is considered as more esthetic than a wide buccal corridor (higher than 16%).^{12,43,44}
Maxillary central incisors width/height proportion and asymmetry	<ul style="list-style-type: none"> • The esthetic ratio width/height of the central maxillary incisor varies between 75 and 85%.²⁵ • A smile is considered as unesthetic if the central incisors have asymmetrical incisal edges.⁴
Midline and tooth angulation	<ul style="list-style-type: none"> • Midline deviation greater than 2 mm is considered as unesthetic.⁴⁵ • An angulation greater than 3,5° is notable to nonexperts.⁴⁶
Gingival exposure	<ul style="list-style-type: none"> • According to various studies, a smile is considered as unesthetic if the gingival margin exposure exceeds 2 to 3 mm.^{38,47}
Gingival margin	<ul style="list-style-type: none"> • Gingival margin difference between the central incisors and the maxillary canines varies between 0 and 1 mm.⁴⁸ • Lateral incisors have a gingival margin of 0.5 mm below the central incisor.⁴⁹
Smile arc	<ul style="list-style-type: none"> • Depends on the vertical positioning of the maxillary incisors.⁵⁰ • A smile is considered esthetic when the incisal edges of the maxillary incisors are below the cuspid tip of the canines.^{40,51}
Lips and teeth positioning	<ul style="list-style-type: none"> • Voluminous lips are considered as most esthetic.²⁵ • Maxillary incisal edges must touch the lower vermilion of the lip.⁵²
Tooth color and anatomical shape	See text above
Anterosuperior teeth ratio	See text above
Diastema	See text above

4 | DIGITAL SMILE DESIGN (DSD) AND WAX-UP: DETERMINING THE LATERAL INCISOR DIMENSIONS

This step must be done during the orthodontic finishing phase. Using DSD, we can determine the ideal dimensions of the future restoration (height and width), its morphology and gingival margin. The DSD also allows us to determine whether modifications of the other anterior teeth are necessary.

When the DSD is validated by the practitioner and the patient, it will be communicated to the orthodontist to guide the positions of the anterior teeth. To facilitate the movement of the peg-shaped affected teeth, DSD can be

transformed into a wax-up and then a mock-up when it is possible.^{29,30} In our clinical case, DSD was not performed because it would not have provided any additional information (Figure 3).

4.1 | Determining the final position of anterior teeth

This step plays a key role in our protocol. Determining the ideal position of the tooth and its placement will allow us to maximize the preservation of dental tissues and guarantee an optimal durability of the restoration. One of the main goals when defining the final position of teeth is to provide a sufficient space for a veneer, crown, or direct

composite resin restoration. It is interesting to cite that temporary rehabilitation of peg-shaped teeth with the mock-ups will stabilize the final position of the anterior tooth during and after orthodontic treatment.

- a. **Mesiodistal position:** sufficient space must be maintained for the final restoration (0.5 mm for veneers and 1.5 to 2 mm for the direct technique or crowns).²⁷ The mesial and distal spaces must be evenly distributed to better reproduce anatomical form of the tooth with the same proportion of enamel/dentin of natural maxillary lateral incisor. In case of dental disharmony with persistent anterior space, we recommend either a diastema distal to the lateral (studies show that this is the least unesthetic location in a smile)^{4,31} or a diastema distal to the canine. The decision should be discussed with the patient especially when this diastema is considered unesthetic by the general population.²⁶
- b. **Vertical position:** within the framework of a rehabilitation with a laminate veneer, a palatal covering cap can be performed depending on the patient's occlusion.^{32,33} This is recommended when anterior overlap ranges between 0 and 2 mm to avoid excessive preparation of the incisal edge of the peg-shaped tooth. In addition, when the affected tooth is taller, width/height proportion will be lower, which gives a more esthetic appearance.^{23,24,34} This notion is to be considered if the space of the peg-shaped tooth is too large and therefore requires an increase in its mesiodistal width. According to the clinical situation, to avoid any periodontal surgery, we recommend taking advantage of the orthodontic treatment to harmoniously position the gingival edges.³⁵
- c. **Vestibulo-palatal position:** since an additional thickness will be added to the vestibular face of the peg-shaped tooth, we recommend placing the tooth in a more palatal position, which avoids an alignment of the incisal edge with the other teeth to limit dental preparations.

When closing interdental spacing becomes an indispensable procedure for practitioners, this may result in wide lateral incisors (square form). This happens especially when dental disharmony is presented at the dental arch.³⁴ If the mesiodistal space is too large, either the diameter of the adjacent teeth can be increased or the anterior portion (incisors and canines) can be retrieved. If these solutions are unesthetic or nonfunctional, the orthodontic mesial advancement of canines (about 1 mm or more depending on clinical situation) may be a good alternative solution. However, this solution should not interfere or disturb the anterior guidance.

5 | MOCK-UP

When a mock-up is realized during orthodontic treatment, a temporary removal of the bracket of the concerned tooth will allow for the placement of the mock-up. Mock-ups allow to validate the final position of the tooth as well as the prosthetic project. A mock-up is normally placed with the mean of a silicon tray. Once the project is validated, the bracket can be rebonded and orthodontic appliance can be restored. Meantime, the temporary restoration can be modified as needed to facilitate orthodontic movements according to the final objectives (Figure 4).

6 | REMOVAL OF THE ORTHODONTIC APPLIANCE AND RETENTION

If the coronary reconstruction appointment with the general practitioner does not take place on the day of the removal of the orthodontic appliance, then we recommend the installation of a transformed thermoformed resin tray to avoid parasitic movements between appointments.

7 | RECONSTRUCTION OF THE CONCERNED TOOTH

Depending on the results of clinical analysis, the reconstruction of the peg-shaped teeth can then begin. The mock-up previously placed can either be used as a reduction guide (if the practitioner and the patient opt for a veneer), or the mock-up can be used to make a palatal key for the direct composite resin restoration.³⁶ The various steps of our protocol are summarized in Figure 1 and illustrated in our clinical case (Figures 2–7).

8 | DISCUSSION

Management of peg-shaped maxillary lateral incisors must be achieved with a multidisciplinary approach. This allows to re-establish esthetic and functional treatment goals with minimally invasive clinical procedures. Being the most conservative one, orthodontic treatment plays a very important role in the management of peg-shaped lateral incisors and allows in certain cases to avoid useless periodontal surgeries.³⁵ Orthodontic treatment achieves better position of lateral incisor and redistributes the interproximal diastemas to facilitate their direct or indirect restorations.

It is important to understand that the term "beautiful smile" remains a subjective issue. Miyoshi et al. have

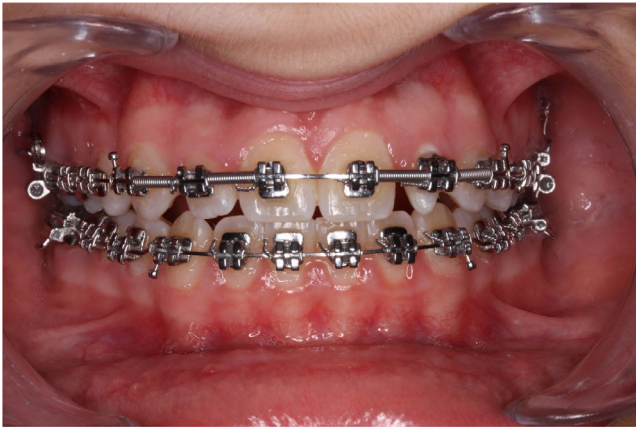


FIGURE 2 Initial situation: The mesiodistal width of the right lateral incisor, right central incisor, the left central incisor, and the left lateral incisor, respectively, is 6.0 mm, 8.2 mm, 8.2 mm, and 4.5 mm. The mesiodistal width of the right lateral incisor is 6.7 mm and of the left lateral incisor 6.5 mm



FIGURE 3 Wax Up showing that there are no diastemas between the anterior maxillary teeth

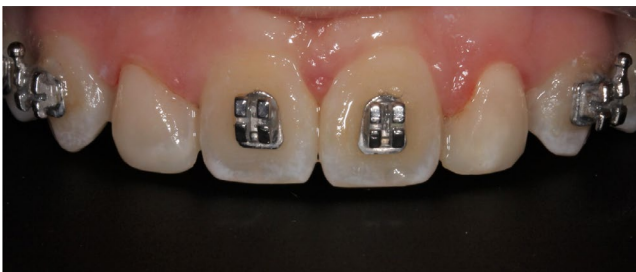


FIGURE 4 Mock-up validated by the patient, the orthodontist, and the general practitioner

shown that the appreciation of a smile varies according to the age of the evaluator. Elderly patients seem to be less concerned about interdental black triangles or gummy smile than younger patients.²⁰ Even though there are no intersex differences in smile appreciation, it has been



FIGURE 5 Conservative tooth preparations for ceramic veneer



FIGURE 6 Direct composite resin restoration



FIGURE 7 Final result: Direct composite resin restoration (right lateral incisor) and ceramic veneer (left lateral incisor)

reported that women seem to be more concerned about the size of their maxillary lateral incisors than men,³⁷ while other studies show that there are no intersex differences, especially concerning the appreciation of the mesiodistal diameter of the maxillary lateral incisors.³⁸

Orthodontists seem to have a more critical point of view toward smile than a general practitioner, and people in the general population seem less critical than general practitioners.^{24,39,40} However, it has been shown that smile arc analysis seems to be evaluated identically between orthodontists, general practitioners, and the general population.⁴¹ For this, from an esthetic point of view, it is important to focus more on the patient's appreciation than on our own professional appreciation as practitioners and to consider the individual differences of each patient (sex, age, origin, and profile).

The most conservative approach to re-establish lateral incisor shape is the direct resin composite bonding because it can be achieved without removal of any dental tissues. Recent esthetic composite resin materials have similar physical and mechanical properties to those of natural teeth. They offer a wide range of color shades and varying opacities designed specifically for the layering technique. In addition, direct resin composite bonding treatment is less expensive compared with ceramic veneers. In our case, we decided to set up a veneer on the left lateral incisor because of its shape and the high interproximal space to fill. We decided to establish a direct resin composite on the right lateral because of the low interproximal space. If a veneer was set up, it would have led to unnecessary deterioration of the enamel.

Adhesive ceramic veneers constitute a minimally invasive therapeutic approach and can replace defective natural enamel with a ceramic laminate veneer. This conservative technique is very suitable to treat many clinical situations where preserving the vitality of the tooth is essential. However, the indication must be well defined, and the protocol must be strictly followed.

Digital smile design and mock-up play a crucial role in our protocol. Not only they facilitate the orthodontic finishing process (determination of the final desired position of the teeth, provision of a better bonding surface for orthodontic brackets), but also they help with the preparation of the tooth.³⁶ In the reported clinical case, the mesiodistal diameter of the laterals was within the normal compared with the mesiodistal diameters of the central incisors; therefore, the DSD provided little additional information. However, mock-up is of high interest in the case of severe dental anomalies where restoration results in excessively high mesiodistal diameters of the lateral incisors. In such a case, interdental diastemas are some kinds unavoidable.

Furthermore, no study has discussed the esthetic aspect of the diastema between the canine and the maxillary first premolar in comparison with the one between the maxillary lateral incisor and the canine. Despite the efforts made to limit diastema, it is sometimes unavoidable, which may alter a patient's smile esthetics.²⁶

Several indexes have been developed to estimate the ideal mesiodistal diameters of the 6 maxillary anterior teeth, such as the Mavroskousfis or Lee indexes. Mavroskousfis index states that the sum of the mesiodistal diameters of the 6 maxillary anterior teeth is equal to the interalar distance +7mm. The Lee index states that the mesiodistal diameter of the maxillary central incisor is equal to one quarter of the interalar distance. In our reported case, the interalar distance is 46 mm, and the sum of the maxillary intercanal mesiodistal diameters is 44.6 mm. If we applied the Mavroskousfis index, this would result in an excessively palatal position of the maxillary sector and consequently a subnasal profile in retroposition. The Lee index was not applicable in our clinical case because the diameter of the central incisor was 8.2 mm, and the quarter of the interalar distance was 11.2 mm. For these reasons, we therefore applied the rule of German et al. cited above.

9 | CONCLUSION

The prevalence of peg-shaped maxillary lateral incisors is relatively high in the general population. We aimed to precise the role of general dentistry and orthodontics with the proposition of a reproducible and easy to follow multi-disciplinary approach for the management of peg-shaped teeth to guarantee an optimal result for the patient.

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CONFLICTS OF INTEREST

The authors declare no conflict of interests.

AUTHOR CONTRIBUTION

NO involved in the study conception and design, material preparation, prosthodontics treatment of patient, and wrote most of the manuscript; AN involved in the English proof-reading and the scientific reviewing of the article. SF involved in orthodontic treatment of patient; BV involved in criticizing the content of the manuscript; JB contributed to writing a part of the manuscript and did the final review.

ETHICAL APPROVAL

No statement of ethics approval from the ethics committee was required for this publication.

CONSENT

The authors confirm that patient consent has been signed and collected in accordance with the journal's patient consent policy.

DATA AVAILABILITY STATEMENT

Raw versions of all presented data are available upon simple request of the corresponding author.

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