

The Impact of an Additional Osteotomy Maneuver for Nasal Bone Convexity on Let-Down Rhinoplasty

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Abstract

Objective: To evaluate the effect of an additional piezo-assisted transverse osteotomy on C-shaped nasal deformities in let-down rhinoplasty. **Material and Methods:** A retrospective review was conducted on 24 patients who underwent closed preservation rhinoplasty with an additional transverse osteotomy using piezoelectric instrumentation between 2021 and 2023. Preoperative and postoperative aesthetic and functional outcomes were assessed using the Rhinoplasty Outcome Evaluation (ROE) and Nasal Obstruction Symptom Evaluation (NOSE) questionnaires. Statistical analysis included correlation and multiple linear regression to identify predictors of outcome. **Results:** Postoperative ROE scores showed a significant increase from 4.3 ± 2.7 to 18.6 ± 3.4 ($p < 0.001$), indicating a marked enhancement in aesthetic satisfaction following the procedure. Likewise, NOSE scores decreased significantly from 14.8 ± 2.7 to 5.5 ± 2.2 ($p < 0.001$), reflecting substantial improvement in nasal breathing function. Notably, age was found to be the only significant predictor of functional improvement, with older patients experiencing less favorable outcomes. A significant inverse correlation was observed between age and the change in NOSE scores ($r = -0.480$, $p = 0.018$). Other demographic and operative variables—including gender, follow-up duration, and operative time—did not show any statistically significant relationship with changes in either ROE or NOSE scores. These findings highlight the value of individualized surgical planning, particularly in younger patients, to maximize both functional and aesthetic outcomes. **Conclusion:** The addition of a piezo-assisted transverse osteotomy in the surgical treatment of C-shaped nasal deformities appears to significantly improve both aesthetic and functional outcomes. This maneuver offers precise correction of lateral convexities with minimal tissue trauma, supporting its role as a valuable adjunct in preservation rhinoplasty techniques.

Keywords: Crooked nose, preservation rhinoplasty, piezoelectric osteotomy, transverse osteotomy, nasal bone convexity, functional outcome, aesthetic outcome

1. Introduction

The nose is one of the most critical anatomical structures of the face, both aesthetically and functionally¹. Structural deformities of the nasal framework can lead to both

respiratory problems and cosmetic concerns in individuals. Therefore, nasal surgery is frequently performed not only for cosmetic purposes but also with the aim of improving function ². Structural abnormalities such as the crooked nose deformity require special consideration in surgical planning ³.

A crooked nose is a complex deformity characterized by deviation of the nasal structure to the right or left of the midline, often involving asymmetry in both cartilaginous and bony components ⁴. Correction of this deformity requires a holistic approach in terms of both nasal aesthetics and function. The success of surgery is evaluated not only by the improvement in appearance but also by the restoration of airway patency ⁵.

Rhinoplasty techniques have significantly evolved over time, with tissue-preserving approaches and technologies that enhance surgical precision coming to the forefront ⁶. The use of closed techniques, let-down rhinoplasty, and piezoelectric surgical devices contributes to minimizing tissue trauma and achieving more predictable outcomes ⁷. These approaches offer a more controlled intervention, particularly in the correction of bony convexities ⁸. Among these, piezoelectric instruments allow precise osteotomies with minimal soft tissue trauma. Their selective action makes them ideal for correcting lateral nasal convexities, supporting their combination with let-down rhinoplasty to enhance both functional and aesthetic outcomes.

This study evaluates the outcomes of a piezo-assisted transverse osteotomy performed in addition to the conventional let-down rhinoplasty technique in patients with crooked nose deformity and lateral nasal bone convexity. The aim is to objectively assess the contribution of this adjunct maneuver to nasal symmetry and overall surgical success.

2. Material and Methods

2.1. Study Design

This study was designed as a retrospective observational analysis conducted at our otorhinolaryngology clinic between 2021 and 2023. The study aimed to evaluate the surgical outcomes of an additional piezo-assisted transverse osteotomy maneuver performed in patients undergoing let-down rhinoplasty for crooked nose deformity. Ethical approval was obtained from the Çukurova University Faculty of Medicine Ethics Committee (Meeting No: 150, Date: 06.12.2024) prior to data collection. All data were collected from archived patient records, including standardized clinical photographs and validated symptom questionnaires. Patient data were evaluated in accordance with confidentiality principles, and the study was conducted in compliance with the principles of the Declaration of Helsinki.

2.2. Patient Selection

A total of 24 patients diagnosed with C-shaped nasal deviation and lateral nasal bone convexity who underwent closed let-down preservation rhinoplasty were included in the study. Standardized preoperative and postoperative photographs were available for all patients. In addition, the NOSE (Nasal Obstruction Symptom Evaluation) and ROE (Rhinoplasty Outcome Evaluation) questionnaires were administered both preoperatively and postoperatively to assess functional and aesthetic outcomes. Patients with a history of previous nasal surgery, major traumatic deformities, or systemic comorbidities were excluded from the study. Written informed consent was obtained from all patients for the use of their preoperative and postoperative photographs for scientific purposes.

2.3. Surgical Technique

All procedures were performed under general anesthesia with endotracheal intubation. Following sterile preparation and draping, local anesthetic infiltration was administered. A closed dorsal preservation approach using the let-down technique was employed in all patients. Intercartilaginous and marginal incisions were made, followed by

meticulous suprapraperichondrial and subperiosteal dissection. Wide subperiosteal dissection was performed to provide adequate exposure of the bony pyramid and facilitate precise assessment and planning of the osteotomies. Subperichondrial elevation of the septum was subsequently performed, and the inferior portion of the septal cartilage was resected as required. A horizontal incision was made at the perpendicular plate of the ethmoid bone. The excised septal cartilage was preserved for potential use as a columellar strut graft or septal extension graft. When correction of the septal cartilage alone was insufficient, the septum was detached from the ethmoid bone, repositioned, and fixed anteriorly to the anterior nasal spine. Additional corrective maneuvers, including cartilage scoring or limited excision of the triangular cartilage, were performed when necessary to improve septal alignment and stability.

Following septal correction, the bony pyramid was carefully evaluated for asymmetry. Differences in the width, projection, and orientation of the right and left lateral nasal walls were assessed. In patients with a pronounced curvature at the K-point, precise bony contouring was performed to reduce the prominence and obtain a smoother dorsal contour.

During the initial stage of the osteotomy, bilateral piezoelectric osteotomies were performed along the nasal bones approximately 2–3 mm below the bony cap, as described in our previous publication⁹. This approach preserved the structural integrity and continuity of the bony cap and upper lateral cartilages. Asymmetric bony thickening along the lateral nasal wall was then carefully reduced.

When residual lateral nasal bone convexity persisted and satisfactory symmetry could not be achieved using the standard let-down maneuvers alone, an additional piezo-assisted osteotomy was performed through the apex of the convex segment. This maneuver enabled controlled mobilization and flattening of the convex lateral nasal bone, thereby improving the symmetry and contour of the bony pyramid. The osteotomy design and its clinical application are illustrated in Figure 1.

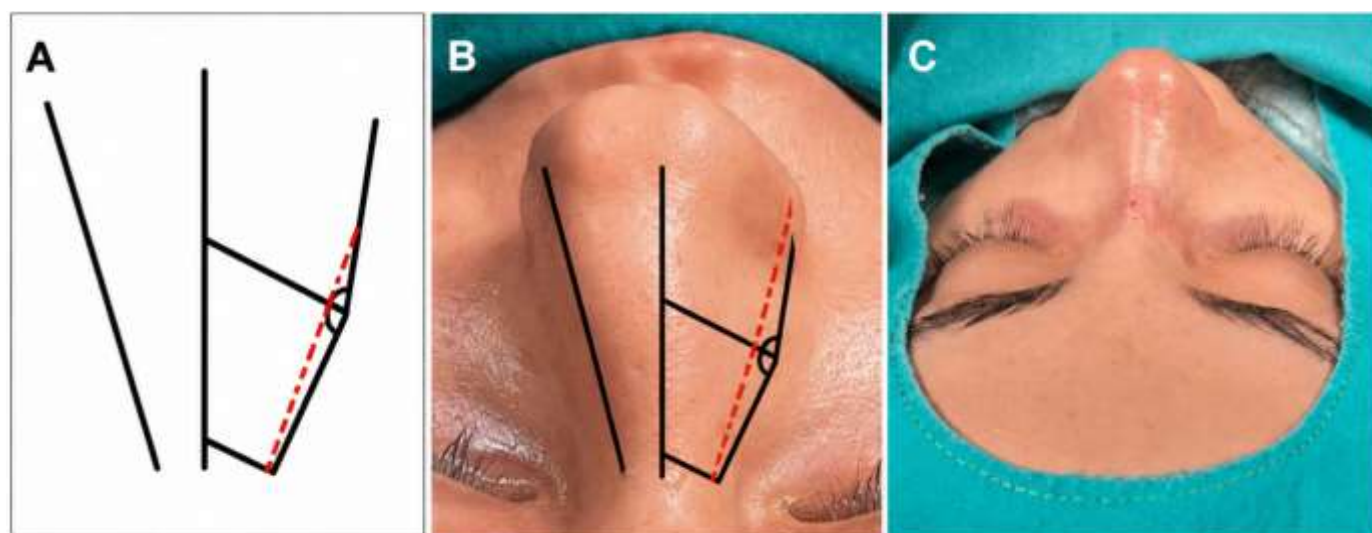


Figure 1. Schematic and clinical illustration of the additional piezo-assisted osteotomy for correction of lateral nasal bone convexity

(A) Schematic representation of the osteotomy design. The black solid lines indicate the standard osteotomy lines, whereas the red dashed line indicates the additional osteotomy passing through the apex of the lateral nasal bone convexity. The circle identifies the most prominent point of the convexity. (B) Preoperative marking of the planned osteotomy lines on the nasal dorsum. (C) Intraoperative superior view of the nasal dorsum following correction of the bony convexity.

Representative preoperative and postoperative views of female and male patients treated using this technique are presented in Figures 2 and 3, respectively.



Figure 2. Preoperative and postoperative views of a female patient with C-shaped nasal deformity



Figure 3. Preoperative and postoperative views of a male patient with C-shaped nasal deformity

2.4. Evaluation Method

Postoperative appearances of the patients were assessed at follow-up intervals ranging from 6 to 24 months. For objective evaluation, standardized high-resolution preoperative and postoperative photographs were compared. In addition, both preoperative and postoperative NOSE (Nasal Obstruction Symptom Evaluation) scores and ROE (Rhino-plasty Outcome Evaluation) questionnaire results were analyzed. All interventions were performed as part of the standard surgical protocol without any additional procedures outside of routine clinical practice. No extra surgical or diagnostic interventions were applied during the course of this study.

2.5. Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). The normality of the distribution of continuous variables was assessed using the Shapiro-Wilk test. Since the data showed normal distribution, parametric tests were employed for further analysis. Descriptive statistics were presented as

mean $\pm$ standard deviation (SD) for continuous variables and as frequency (percentage) for categorical variables. The comparison of preoperative and postoperative ROE and NOSE scores was conducted using the paired samples t-test. Independent samples t-test was used to compare continuous variables between female and male patients. Categorical variables were compared using the chi-square test. Pearson's correlation analysis was performed to evaluate the linear relationships between the change scores (Δ ROE and Δ NOSE) and continuous variables including age, follow-up duration, and operative time. In cases where the assumption of normality could not be verified for a specific variable, Spearman's rank correlation coefficient was used as a non-parametric alternative. To identify independent predictors of changes in ROE and NOSE scores, two separate multiple linear regression models were constructed. The models included age, gender, follow-up duration, and operative time as independent variables. Multicollinearity was assessed through tolerance and variance inflation factor (VIF) values. A p-value less than 0.05 was considered statistically significant.

3. Results

A total of 24 patients (9 females, 15 males) were included in the study. The mean age was calculated as 27.4 ± 7.2 years, the mean follow-up duration was 18.8 ± 2.1 months, and the mean operative time was 205.4 ± 24.0 minutes. The ROE scores, which assess aesthetic satisfaction before and after surgery, were 4.3 ± 2.7 and 18.6 ± 3.4 , respectively; this change was statistically significant ($p < 0.001$). Similarly, the NOSE scores evaluating functional improvement decreased from 14.8 ± 2.7 in the preoperative period to 5.5 ± 2.2 postoperatively, and this difference was also found to be significant ($p < 0.001$) (Table-1).

Table 1. Demographic Characteristics, Operative Times, and Preoperative-Postoperative Clinical Scores of the Patients Included in the Study

Gender (n, %)	Female	9 (37.5)
	Male	15 (62.5)
Follow-up Duration (months)		18.8 ± 2.1
Age (years)		27.4 ± 7.2
ROE Score - Preoperative		4.3 ± 2.7
ROE Score - Postoperative		18.6 ± 3.4
NOSE Score - Preoperative		14.8 ± 2.7
NOSE Score - Postoperative		5.5 ± 2.2
Operation Time (min)		205.4 ± 24.0

No statistically significant differences were observed between female ($n=9$) and male ($n=15$) patients regarding the evaluated parameters. The mean age was 30.4 ± 8.7 years in female patients and 25.5 ± 5.6 years in male patients ($p=0.105$). Preoperative ROE scores were 5.4 ± 2.8 in females and 3.5 ± 2.4 in males; postoperative scores were 19.8 ± 2.5 and 17.9 ± 3.8 , respectively. NOSE scores in the preoperative period were 14.8 ± 2.7 in females and 14.7 ± 2.9 in males, and in the postoperative period, 5.0 ± 2.4 and 5.8 ± 2.1 , respectively. The mean operative time was 213.9 ± 20.6 minutes for female patients and 200.3 ± 25.1 minutes for male patients ($p=0.186$). There were no significant differences between the groups in terms of change in ROE scores (Δ ROE: 14.3 ± 4.7 and 14.3 ± 3.8) or NOSE scores (Δ NOSE: 10.0 ± 3.5 and 8.9 ± 3.8) (Table-2).

Table 2. Gender-Based Comparison of Patient Characteristics and Surgical Outcomes

	Female (n=9)	Male (n=15)	
	Mean±S.D.	Mean±S.D.	p value
Follow-up Duration (months)	18.6±2.0	18.9±2.3	0.519 b
Age (years)	30.4±8.7	25.5±5.6	0.105 a
ROE Score - Preoperative	5.4±2.8	3.5±2.4	0.088 a
ROE Score - Postoperative	19.8±2.5	17.9±3.8	0.263 b
NOSE Score - Preoperative	14.8±2.7	14.7±2.9	0.907 b
NOSE Score - Postoperative	5.0±2.4	5.8±2.1	0.379 b
Operation Time (min)	213.9±20.6	200.3±25.1	0.186 a
Δ ROE	14.3±4.7	14.3±3.8	0.998 a
Δ NOSE	10.0±3.5	8.9±3.8	0.478 a

The mean ROE score increased from 4.3±2.7 preoperatively to 18.6±3.4 postoperatively ($p<0.001$). This increase indicates a marked improvement in patient satisfaction from an aesthetic perspective. The NOSE score, which was 14.8±2.7 in the preoperative period, showed a significant decrease to 5.5±2.2 postoperatively ($p<0.001$) (Table-3).

Table 3. Comparison of Preoperative and Postoperative ROE and NOSE Score

	Preoperative	Postoperative	
	Mean±S.D.	Mean±S.D.	p value
ROE Score	4.3±2.7	18.6±3.4	<0.001
NOSE Score	14.8±2.7	5.5±2.2	<0.001

Correlation analysis revealed a statistically significant negative relationship between age and the ΔNOSE score ($r = -0.480$, $p = 0.018$). This result suggests that functional improvement (i.e., the change in NOSE score) decreases with increasing age. In contrast, no significant correlations were found between the ΔROE score and age ($r = 0.066$, $p = 0.761$), follow-up duration ($r = -0.110$, $p = 0.608$), or operative time ($r = 0.079$, $p = 0.715$). Similarly, no significant correlations were observed between the ΔNOSE score and follow-up duration ($r = -0.317$, $p = 0.132$) or operative time ($r = -0.058$, $p = 0.788$) (Table-4).

Table 4. Correlation of ΔROE and ΔNOSE Change Scores with Demographic and Operative Parameters

		ΔROE	ΔNOSE
Follow-up Duration (months)	Spearman Correlation	-0.110	-0.317
	p value	0.608	0.132
Age (years)	Pearson Correlation	0.066	-0.480
	p value	0.761	0.018
Operation Time (min)	Pearson Correlation	0.079	-0.058
	p value	0.715	0.788

Multiple linear regression analysis revealed no significant relationship between the ΔROE score and age, gender, follow-up duration, or operative time (all $p > 0.05$). None of the variables included in the model were significant predictors of changes in the ΔROE score. The highest standardized coefficient (Beta) was observed for age (0.045), but this was not statistically significant ($p = 0.870$) (Table-5).

Table 5. Multiple Linear Regression Analysis of the Relationship Between Δ ROE Change Score and Demographic and Operative Parameters

	B (Unst. Coef.)	Beta (St. Coef.)	t	p value	Tolerance	VIF
Follow-up Duration	-0.187	-0.098	-0.419	0.680	0.946	1.057
Age (years)	0.026	0.045	0.166	0.870	0.701	1.426
Gender	0.282	0.034	0.141	0.890	0.869	1.15
Operation Time	0.007	0.043	0.157	0.877	0.7	1.428

According to the multiple linear regression analysis, age was identified as the only statistically significant predictor of changes in the Δ NOSE score ($\beta = -0.689$, $p = 0.002$). This finding suggests that functional improvement decreases with increasing age. Although follow-up duration ($p = 0.061$) and gender ($p = 0.081$) were close to the threshold of statistical significance, they were not considered significant. No significant relationship was found between operative time and the Δ NOSE score ($p = 0.548$) (Table-6).

Table 6. Multiple Linear Regression Analysis of the Relationship Between Δ NOSE Change Score and Demographic and Operative Parameters

	B (Unst. Coef.)	Beta (St. Coef.)	t	p value	Tolerance	VIF
Follow-up Duration	-0.587	-0.339	-1.994	0.061	0.946	1.057
Age (years)	-0.355	-0.689	-3.487	0.002	0.701	1.426
Gender	-2.441	-0.327	-1.845	0.081	0.869	1.15
Operation Time	0.019	0.121	0.611	0.548	0.7	1.428

4. Discussion

In this study, the impact of an additional transverse osteotomy on both aesthetic and functional outcomes in the surgical correction of C-shaped nasal deformities was evaluated. A significant increase in aesthetic satisfaction and a marked reduction in functional symptoms were observed postoperatively. These findings suggest that the additional osteotomy maneuver contributes to the correction of convexities and asymmetries in nasal structures, thereby improving both the appearance and nasal breathing of patients. Notably, age was identified as a factor influencing functional improvement; the diminished gains observed in older patients may be attributed to reduced regenerative capacity and healing potential of the tissues. No significant associations were found between clinical outcomes and other parameters such as gender, follow-up duration, or operative time. This may indicate that the surgical technique yields comparable effectiveness across patients with varying demographic characteristics.

The direction and level of osteotomy play a crucial role in correcting nasal bone deviations. Symmetrical osteotomy lines applied bilaterally may not always be sufficient to achieve symmetrical height and positioning of the lateral nasal walls. In most cases, the nasal wall on the side opposite to the direction of the deviation is wider than the deviated side and is often accompanied by surface irregularities. Additionally, the frontal projection of the maxillary bone is generally more prominent on the wider side. Previous studies have reported various lateral osteotomy techniques aimed at correcting asymmetric nasal bones. Unilateral lateral osteotomy has been shown to be effective in the correction of crooked noses ^{10, 11}. However, it has also been suggested that double or multiple osteotomies may be more traumatic, increasing the risk of complications such as ecchymosis, bleeding, nasal collapse, step deformities, and impaired stability of the nasal wall ^{10, 12}. Some authors have argued that in patients with a highly prominent and thick maxillary

projection, performing a double lateral osteotomy on the longer nasal wall is more effective and results in better aesthetic outcomes, particularly in broad noses ¹³⁻¹⁶. In both single and double lateral osteotomy, the level of the inferior osteotomy should be close to the nasofacial groove; otherwise, the bony support below the osteotomy level may become prominent, leading to step deformity. It has been recommended that this bony support be reduced through rasping ^{10, 17} or infracturing the bony segment ¹⁴.

In the study published by Demir in 2019, successful aesthetic outcomes were reported through the use of asymmetrical osteotomy levels and unilateral spreader graft application in the correction of crooked nose deformities ¹⁸. In that study, meaningful improvements in nasal axis deviations were achieved by surgically correcting the asymmetry between bony and cartilaginous structures using tailored techniques. Similarly, in our study, the application of an additional transverse osteotomy targeting lateral nasal wall asymmetries resulted in significant postoperative improvements in both aesthetic satisfaction and nasal function. These parallel findings suggest that targeted osteotomy maneuvers performed on asymmetric bony structures can enhance both functional and aesthetic success in crooked nose surgery. While Demir's study assessed surgical outcomes through angular measurements, our study demonstrated comparable clinical efficacy through patient-reported outcomes, supporting the multidimensional effectiveness of this approach.

Crooked nose deformity presents a complex problem not only from an aesthetic but also from a functional perspective, and therefore long-term surgical success requires a thorough analysis of all pathological components of the nasal pyramid and their correction using tailored techniques ¹⁹⁻²¹. In particular, in C-shaped and reverse C-shaped nasal deviations, correcting the asymmetrical bony structures shaped by the concave and convex sides of the deformity is critically important for achieving permanent correction ²². Lateral osteotomies, widely used in the surgical management of such deformities, allow for repositioning of the nasal wall, while the precise level of the osteotomy plays a key role in achieving a smooth aesthetic contour ^{3, 23}. Osteotomies performed with piezoelectric devices have been reported to act selectively on bone, minimizing unwanted fracture lines and enabling the safe correction of high septal deviations ^{24, 25}. In our study, the piezo-assisted additional transverse osteotomy approach utilized these advantages to specifically address residual lateral convexities, which are frequently encountered in let-down rhinoplasty techniques. Furthermore, previous studies have demonstrated high levels of patient satisfaction following preservation rhinoplasty, as reflected by improved ROE scores ²⁶⁻²⁸, and our results similarly showed significant improvements in both aesthetic satisfaction and functional outcomes.

In the study by Tremp et al. ²⁹, crooked nose deformities were classified as C-shaped, reverse C-shaped, I-shaped, and S-shaped, and customized surgical algorithms were proposed for each type. Particularly in C-shaped deformities, it was emphasized that the bony excess on the concave side should be corrected through rasping or osteotomy, and that managing lateral wall asymmetries in this way is effective in achieving an aesthetically smooth nasal contour. In our study, the addition of a piezo-assisted transverse osteotomy to the let-down rhinoplasty technique was similarly effective in eliminating residual lateral convexities and led to a significant increase in patient satisfaction. Tremp et al. also reported that piezoelectric instruments, due to their selective action on bone, reduce surgical trauma and allow for more controlled osteotomy lines, thereby enhancing aesthetic outcomes. This finding aligns with the significant improvement in ROE scores observed in our study. Furthermore, the principles highlighted by Tremp et al. regarding nasal valve widening and axial septal realignment as factors contributing to functional improvement are consistent with the significant reduction in NOSE scores found postoperatively in our patient group. Accordingly, both studies demonstrate that deformity-

specific surgical planning and the use of piezo-assisted techniques contribute to successful aesthetic and functional outcomes.

This study has certain limitations. Firstly, the relatively small sample size and the single-center, retrospective design limit the generalizability of the results. Additionally, the use of subjective, patient-reported outcome measures such as ROE and NOSE scores instead of objective evaluation methods may lead to variability based on patient perception. Due to the limited availability of long-term follow-up data, it is not possible to draw definitive conclusions about the durability of the surgical outcomes. Furthermore, the absence of radiological imaging or three-dimensional analysis methods prevented an objective evaluation of the symmetry improvements in nasal structures.

5. Conclusion

In conclusion, the addition of a piezo-assisted transverse osteotomy to the let-down rhinoplasty technique in the surgical correction of C-shaped nasal deformities was found to have a significantly positive impact on both aesthetic and functional outcomes. Targeted correction of lateral nasal wall asymmetries enhanced patient satisfaction and helped to prevent residual deformities. Moreover, the precision offered by piezoelectric technology minimized tissue trauma, which in turn positively influenced the postoperative healing process. This study is among the limited number of investigations in the literature specifically evaluating the efficacy of piezo-assisted additional osteotomy maneuvers in C-shaped deformities and provides a novel contribution by emphasizing the importance of deformity-specific surgical planning and the role of piezo technology within that context. Future prospective studies with larger sample sizes and longer follow-up periods are needed to further validate the effectiveness and generalizability of this approach.

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