Optimizing Closed-Approach Preservation Rhinoplasty by Ultrasonic Piezo-assisted Techniques for Enhanced Precision

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Abstract

Background: Preservation rhinoplasty, particularly dorsal preservation, has gained prominence with the advent of piezoelectric instruments, which minimize trauma and enhance precision in bone reshaping. This approach presents unique challenges, especially in closed techniques, where spatial limitations complicate the use of piezotomes.

Objectives: The aim of this study was to evaluate outcomes of piezo-assisted preservation rhinoplasty performed with specialized instrumentation to enhance visibility, precision, and postoperative recovery in closed rhinoplasty procedures.

Methods: In a cohort of 734 patients undergoing primary rhinoplasty between May 2021 and April 2023, piezoelectric instruments facilitated closed preservation techniques. Cases were documented with a focus on instrument adaptation, bone reshaping precision, and the mitigation of postoperative complications.

Results: A 6% revision rate was observed, predominantly for dorsal contour adjustments, with minimal intraoperative bleeding, swelling, and postoperative pain, demonstrating the effectiveness of piezoelectric assistance. Woodpecker (Guilin, China) SS18 and SS4 inserts were specifically optimized to enhance cutting efficiency for removal of the perpendicular plate of the ethmoid, and for lateral and transverse osteotomies.

Conclusions: Piezo-assisted rhinoplasty improves precision and reduces trauma, supporting advanced closed preservation rhinoplasty techniques. Although all osteotomies can now be performed with ultrasonic piezotomes, enhanced instrument design may further refine outcomes, facilitating minimally invasive, aesthetically superior results.

Level of Evidence: 4 (Therapeutic)

The resurgence of an age-old concept,[1-4] named "preservation rhinoplasty" by Daniel in 2018,[5] has ushered in the era of a more nuanced and sophisticated approach to the osteocartilaginous vault. At the core of this concept lies dorsal preservation, a cornerstone achieved through 2 pivotal maneuvers known as "let down" (LD) and "push down."[6] The success of this procedure hinges on meticulous control of osteotomies and ostectomies, which is crucial for appropriately addressing the nose blocking point to ensure the desired impact.

Several studies have highlighted that the conventional use of osteotomes often results in heightened intraoperative bleeding, subsequently causing swelling and bruising, which inevitably diminishes the surgeon's perception of the final result[7-9] In response to these challenges, powerful ultrasonic devices with tissue-selective cutting capabilities have been introduced to execute all bony work. Piezoelectric instrumentation facilitates remarkably precise osteotomies, minimizing intraoperative trauma to tissues and reducing postoperative pain[10-13]

From a marketing standpoint, the proliferation of the term "ultrasonic rhinoplasty" across social media has overshadowed traditional techniques, rendering them less appealing. The prevailing trend emphasizes "painless, fast recovery, bruising-free ultrasonic rhinoplasty." However, the reality belies such oversimplification, particularly in the context of piezo-assisted rhinoplasty, where advanced technical skills are indispensable to achieve the promised high standard of operation.

In this article, we comprehensively outline preservation rhinoplasty techniques, focusing on dorsal modification and preservation utilizing piezoelectric instruments (PEIs), along with the specific inserts required for a closed approach. These techniques not only delve into the intricacies of preserving the nasal dorsal structure but also highlight the precision achieved through the application of advanced piezotechnology. By elucidating the step-by-step methodology and the instrumental inserts involved, this article aims to contribute to the evolving field of rhinoplasty, emphasizing the efficacy and benefits of employing PEIs for dorsal preservation by the closed approach.

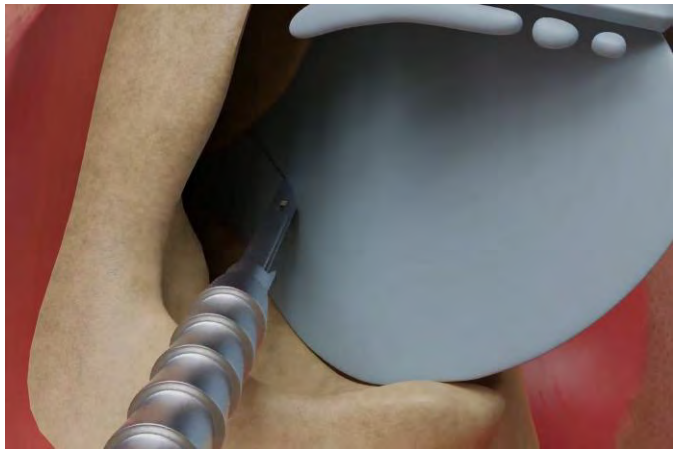
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Figure 1. Intraoperative image demonstrating subperichondral dissection at the bridge (upper lateral cartilage, ULC) and supraperichondral dissection at the tip (ULC). The image highlights the precise dissection planes used during closed preservation rhinoplasty to preserve structural integrity.



Video 1. Watch now at http://academic.oup.com/asj/article-lookup/doi/10.1093/asj/sjaf006



Video 2. Watch now at http://academic.oup.com/asj/article-lookup/doi/10.1093/asj/sjaf006



Video 3. Watch now at http://academic.oup.com/asj/article-lookup/doi/10.1093/asj/sjaf006

METHODS

Between May 2021 and April 2023, a total of 734 closed rhinoplasty cases were conducted by the first author using the preservation rhinoplasty method and followed-up for at least 1 year (retrospective study). The follow-up period was 12 months for most patients; patients with thicker skin were followed-up for 18 to 24 months.

The patient selection criteria for inclusion in the study encompassed primary cases of rhinoplasty regardless of hump size, or the presence of a high nasal dorsum, a wide bone pyramid, or nontraumatic nasal deviations. However, patients with certain nasal deformities most likely to benefit from structural rhinoplasty were excluded from the study. Specifically, individuals with any deformation of the nose, whether acquired or congenital, involving integrity violation or underdevelopment of the nasal dorsum, as well as those with posttraumatic nasal deformities, cleft lip affecting the nose, or a history of previous nose surgery, were excluded from participation. These criteria ensured that the study focused on a specific cohort of patients undergoing primary rhinoplasty surgery for predetermined aesthetic concerns, while minimizing confounding variables related to previous surgical interventions or complex nasal deformities.

Patients underwent follow-up examinations at intervals of 2 weeks, 1 month, 3 months, 6 months, and 1 year postsurgery. Surgical details were meticulously documented.

Prior to the study, written consent was obtained from all patients who agreed to share their pictures or videos, and they were duly informed about the utilization of their data for research purposes.

All patients who underwent closed-approach rhinoplasty procedures underwent low septal strip preservation,[4,14] with or without additional surface techniques (STs).[15] Specifically, all impactions were addressed with a piezo-assisted LD technique. The decision to incorporate additional surface techniques was contingent upon the shape of the middle vault. This study was conducted in accordance with the principles outlined in the Declaration of Helsinki, and written informed consent was acquired from all patients.

Surgical Technique

Performing a closed approach in rhinoplasty presents challenges such as limited visibility and restricted space for manipulating the piezotome inside the nose. Introducing the hand device into the nose

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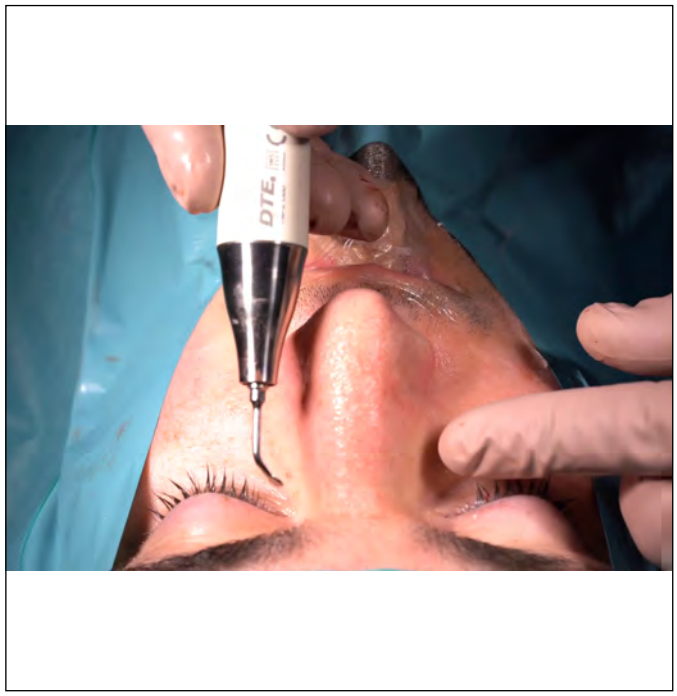
Figure 2. SS18 Piezo insert used for the perpendicular plate of the ethmoid removal and lateral osteotomies, illustrating its role in achieving precise and controlled bone modifications during rhinoplasty.



Figure 3. SS4 Piezo insert used for transverse radix osteotomy.



Figure 4. The SS4 Piezo insert with teeth modification. The teeth modification facilitates a faster radix osteotomy.



Video 4. Watch now at http://academic.oup.com/asj/article-lookup/doi/10.1093/asj/sjaf006

requires careful dissection and the use of specialized instruments to navigate these constraints effectively.

Notably, all our rhinoplasties are conducted through an infracartilaginous closed incision. It is worth emphasizing that there is no necessity for an intercartilaginous incision to elevate the piezotome to the highest osteotomy levels at the radix.

All rhinoplasties were performed according to the following sequence: septal dissection, alar cartilage dissection in a subperichondrial or supraperichondrial plane, subperichondrial dissection of the upper lateral cartilages (ULCs), subperiosteal dissection of the nasal bones, low strip septoplasty, resection of the pyramidal process of the maxilla, transverse osteotomy, rotation of the septal flap and fixation in the anterior nasal spine (ANS), dorsal surface technique, tip plasty, membranous tongue in groove, scroll reconstruction, lateral turning point extension grafts, and camouflage techniques at the nasal tip.

Within the infracartilaginous incision, we meticulously dissect the lower lateral cartilages in either a subperichondral or supraperichondral plane, depending on the specific characteristics of the patient. In contrast, the ULCs and the bones are consistently dissected in a subperichondral and subperiosteal plane, ensuring a broad dissection (Figure 1). This approach not only facilitates the maneuverability of the piezotome but also contributes to achieving precise and controlled osteotomies in the desired anatomical areas.

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Figure 5. Demonstration of the simultaneous introduction of the Piezo insert and the retractor-aspirator in a closed approach while avoiding any skin damage, ensuring a controlled and atraumatic surgical procedure.



Video 5. Watch now at http://academic.oup.com/asj/article-lookup/doi/10.1093/asj/sjaf006



Figure 6. A 29-year-old female presented with a straight nose characterized by irregularities of the bony vault, a wide dorsum, a distinct kyphion point (K point), resulting in a kyphion angulation and an "S-shape" nasal bone configuration, as well as a bulbous and droopy tip (A, C, E, G, I, K, and M). The patient underwent preservation rhinoplasty procedures, including LD and ST, utilizing a closed approach with full subperichondrial and subperiosteal dissection of the nose. Postoperative photographs depict the patient's results 1 year after surgery (B, D, F, H, J, L, and N). LD, let down; ST, surface technique.

In every preservation rhinoplasty, we consistently incorporate the LD technique to reduce potential breathing issues associated with a "push-down" approach.[16] To allow a correct LD we first remove a strip of the perpendicular plate of the ethmoid (PPE) (Video 1), followed by the removal of a banana-shaped strip from the lateral bone wall, as described by Haack and co-workers.[16] The first cut or bone removal is done at the PPE using the piezotome with the maximum precision needed to avoid radix dropping. After doing this, the upper cut of this

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Figure 6. Continued

banana-shaped strip originates from the junction of the lowest edge of the upper laterals and the nasal bones (Video 2). Conversely, the lower cut level is tailored based on the required bone excision, which varies according to the specific convexity and impaction needs of each nasal bridge (Video 3).

Over the years, our preferred piezotome instruments have been the Piezotome Implant Center by Acteon (Mérignac, France) and Surgery X by Woodpecker (Guilin, China). Previously, Acteon inserts were thinner and faster than Woodpecker ones, but they posed challenges due to being shorter and more expensive. Today, however, Woodpecker inserts have matched Acteon's thinness at 0.3 mm, with the added advantages of being longer, more ergonomic, and more cost-effective. Additionally, Woodpecker piezotome machines incorporate a safety feature that halts the operation in case of resistance or heating, a crucial mechanism to prevent potential skin burns during the procedure. This ensures a safer and more controlled use of the instrument.

In our current practice, we have experimented with various inserts for PPE removal, and for lateral and transverse fractures. Currently, for PPE and lateral osteotomies, we have found the SS18 insert by Woodpecker to be highly effective (Figure 2). This insert features a length sufficient to address radix transverse fractures, a 0.3 mm width at its teeth, and an ergonomic shape due to its round end shape with numerous teeth. These characteristics contribute to its exceptional speed and precision in cutting bones both vertically and horizontally as it progresses laterally, forming a banana-shaped cut. The extent of bone excision will depend on the degree of dorsal convexity and the desired amount of dorsal impaction. To avoid postimpaction instability, excessive bone removal should be minimized.

For transverse osteotomies, we utilize a different insert, specifically the SS4 insert by Woodpecker. (Figure 3). Although this insert possesses a sharp cutting edge, it is inherently slow because it has no teeth. To enhance its speed, we have incorporated additional teeth, and in recent months, we have undertaken manual modifications with the support of Selam Medical (Üsküdar, Istanbul) (Figure 4). The radix bones tend to be thicker, making the inclusion of teeth particularly beneficial for achieving fast, efficient, and precise transverse osteotomies. This adaptation ensures optimal performance in addressing the specific anatomical challenges posed by the radix region. It is important to note that by folding the handpiece vertically, it is possible to achieve a 90° or greater angle in the transverse fracture to accomplish a better bridge impaction. If the goal is to lower or depress the radix, a complete cut is performed. If no lowering is required, a greenstick fracture is sufficient (Video 4).

Given the narrow opening through which the piezotome is introduced, a thorough but not wide dissection is imperative. To assist in this process, we use the thinnest retractor available on the market. For PPE removal we use a nonaspirating Z-shaped retractor from

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Figure 7. A 28-year-old female presented with a long and slightly right-deviated nose characterized by a high radix and a large hump on the bridge, as well as a bulbous and droopy tip (A, C, E, G, I, K, and M). The patient underwent preservation rhinoplasty procedures, including LD and ST, utilizing a closed approach with full subperichondrial and subperiosteal dissection of the nose. Postoperative photographs depict the patient's results 1 year after surgery (B, D, F, H, J, L, and N). LD, let down; ST, surface technique.

Epidec Surgical Instruments (Barcelona, Spain) (Figure 1) due to the lack of space. For lateral ostectomies a retractor-aspirator featuring 2 holes at its end for effective aspiration is used (Figure 5). The use of this retractor is crucial for pulling the skin flap outside, providing optimal visibility and maneuverability during the procedure. For bony cap rasping or bone shaping (Video 5), any of these devices can be used.

Ensuring proper aspiration of the piezotome irrigation is essential for clear visualization of the surgical field. To achieve this, for each patient we prepare a solution of 1 liter of physiological saline solution containing 1 gram of tranexamic acid. The components are meticulously mixed at a temperature of 1°C, contributing to an effective and well-controlled irrigation solution that enhances visibility and precision throughout the preservation rhinoplasty procedure.

RESULTS

During the 12-month postoperative period we recorded a surgical revision rate of 6% (including both early and late postoperative revisions); 44 patients required nasal surgery revision. The observation period for each case ranged from 6 to 20 months postsurgery. Of these 44 revisions, 38 were to improve the dorsum shape (minihumps or irregularities) and 6 to resolve tip problems.

The age range of the patients included in the study was 18 to 53 years (average, 28 years). Of the 734 patients, 672 were women and 62 were men.

All surgeries were performed by the first author under general anesthesia between May 2021 and April 2023. Closed preservation rhinoplasty techniques were consistently employed in all cases, focusing on the preservation of the columellar skin, scroll, and Pitanguy ligaments, as well as the nasal dorsum scaffold.[17]

Among the 734 patients included in the study, surface techniques were employed in 75% of cases, specifically electroshaving at the ULCs, rasping of the bony cap (the bone over the ULCs at the keystone joint), and burning of the remaining perichondrium at the keystone area. A surface technique was chosen only when minor readjustments of less than 1 mm were required.

The sequence of the surgical procedure involved initiating the bony work laterally before proceeding medially. In cases where modification or removal of the bony cap was required, it was executed by cutting the bones with an SS18 insert and then using a piezoelectric scraper to make them smoother.

It is crucial to note that due to the middle vault remaining unopened, complete osteotomies were significantly more stable. This

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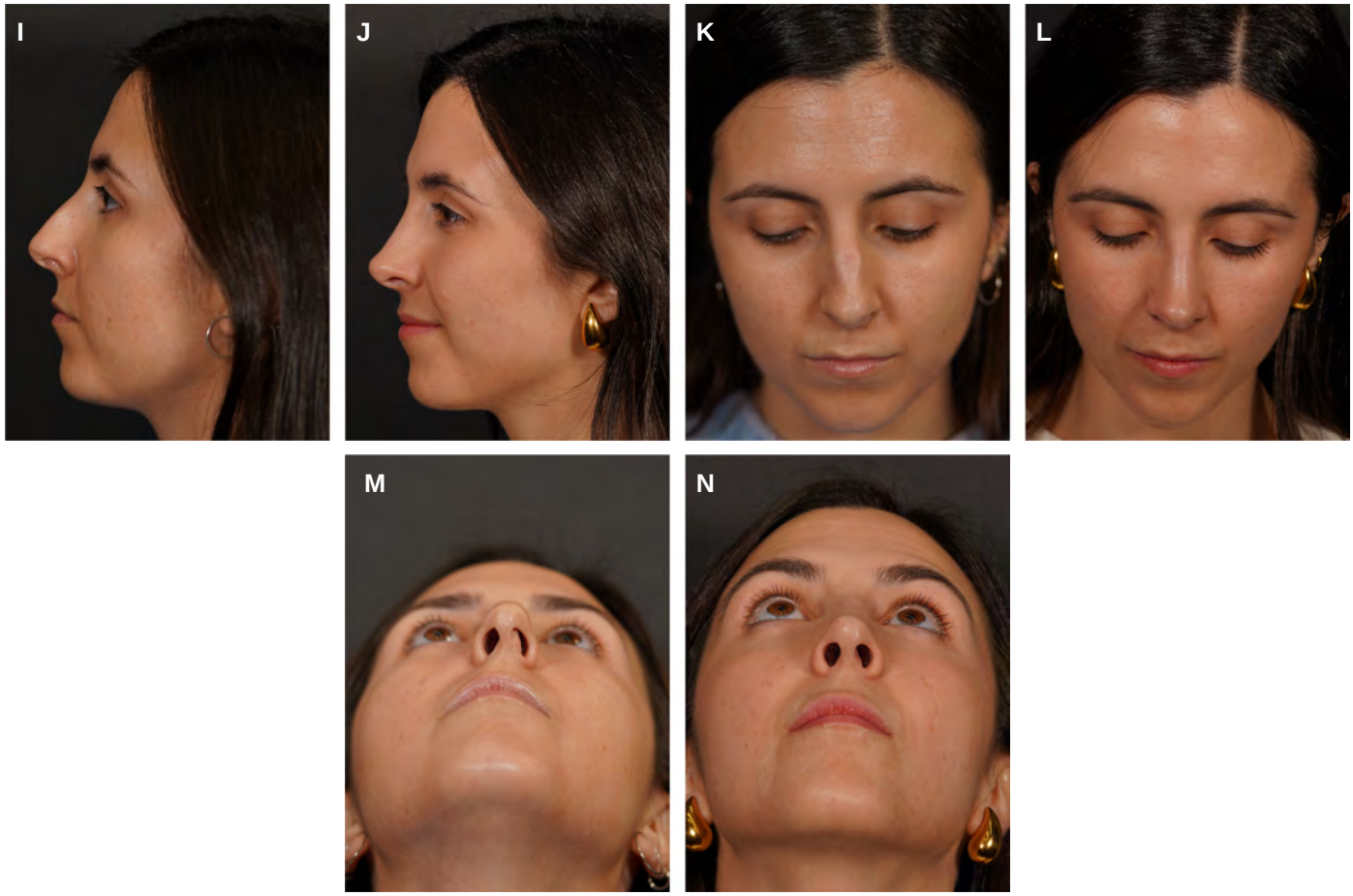


Figure 7. Continued

approach ensured optimal stability and precision in achieving the desired aesthetic outcomes while minimizing disruption to the nasal framework.

One of the potential limitations of this study is that we did not make any objective photographic evaluation or undertake subjective questionnaire evaluation. We focused mainly on the surgical benefits, while the patients shared the aesthetic and breathing benefits.

Clinical Case 1

A 29-year-old woman presented with a straight nose characterized by irregularities of the bony vault, a wide dorsum, a distinct kyphion point (K point), resulting in a kyphion angulation and an "S-shape" nasal bone configuration, as well as a bulbous and droopy tip. The patient underwent preservation rhinoplasty procedures, including LD and ST, utilizing a closed approach with full subperichondrial and subperiosteal dissection of the nose (Figure 6).

Upon examination, the septum was found to be straight, and only a fixation of the septum to the ANS in the midline was performed. Subsequently, a sharp tangential osteotomy of the base of the pyramid on the right and left sides of the kyphotic hump was executed. Following this, the surface of the bony vault and dorsum was meticulously smoothed using PEIs.

For the LD procedure, the low strip technique was employed, involving the removal of 8 mm of the cartilaginous part and 3 mm of the bone part of the septum. Subsequently, PEI-associated lateral osteotomies of the nasal pyramid were performed, resulting in the removal of 7 mm of bony strips on both sides. Additionally, bone dust was utilized for nasion augmentation and to camouflage the transverse osteotomy line, ultimately achieving aesthetically pleasing dorsal lines.

Finally, to refine the tip, a lateral steal suture of 3 mm and cephalic dome sutures were performed, following the polygon tip steps as described by Çakir,[18] aiming to enhance tip definition and projection.

Clinical Case 2

A 28-year-old woman presented with a long and slightly right-deviated nose characterized by a high radix and a large hump on the bridge, as well as a bulbous and droopy tip. The patient underwent preservation rhinoplasty procedures, including LD and ST, utilizing a closed approach with full subperichondrial and subperiosteal dissection of the nose (Figure 7).

Upon examination, the septum was found to be left-deviated due to a left caudal luxation, and a swinging door maneuver with a subsequent fixation of the septum to the ANS in the midline was performed.

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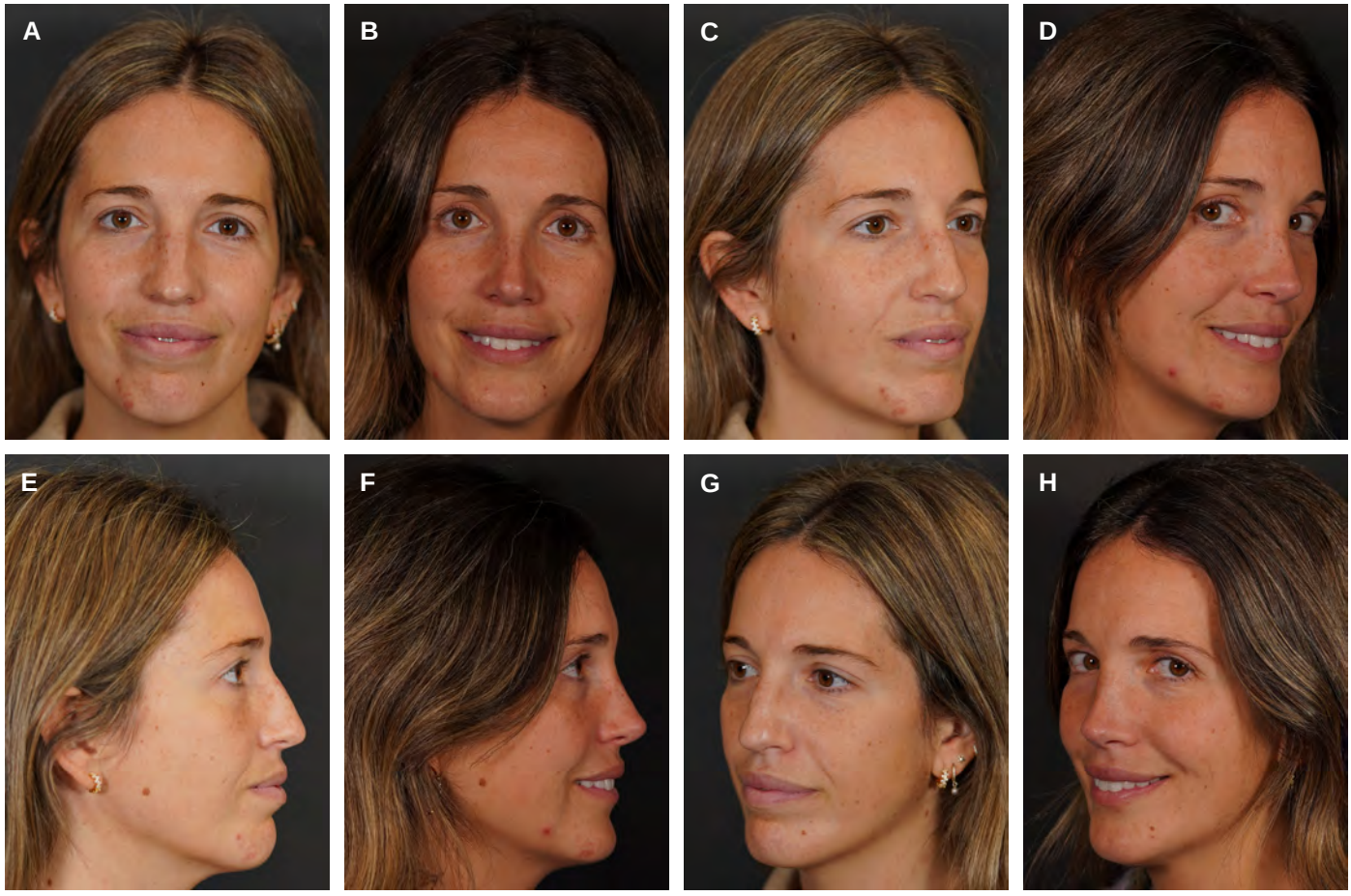


Figure 8. A 32-year-old female presented with a long and wide nose characterized by a high radix and a large hump on the bridge, as well as a tip without the proper support (A, C, E, G, I, K, and M). The patient underwent preservation rhinoplasty procedures, including LD and ST, utilizing a closed approach with full subperichondrial and subperiosteal dissection of the nose. Pictures 1 year after the surgery. Postoperative photographs depict the patient's results 1 year after surgery (B, D, F, H, J, L, and N). LD, let down; ST, surface technique.

Subsequently, a sharp tangential osteotomy of the base of the pyramid on the right and left sides of the kyphotic hump was executed. Following this, the surface of the bony vault and dorsum was meticulously smoothed using PEIs.

For the LD procedure, the low strip technique was employed, involving the removal of 7 mm of the cartilaginous part and 4 mm of the bone part of the septum. Subsequently, PEI-associated lateral osteotomies of the nasal pyramid were performed asymmetrically, resulting in the removal of 7 mm of bony strip on the right side and 4 mm on the left one.

Finally, to refine the tip, a lateral steal suture of 5 mm and cephalic dome sutures were performed, following the polygon tip steps.

Clinical Case 3

A 32-year-old woman presented with a long and wide nose characterized by a high radix and a large hump on the bridge, as well as a tip without proper support. The patient underwent preservation rhinoplasty procedures, including LD and ST, utilizing a closed approach with full subperichondrial and subperiosteal dissection of the nose (Figure 8).

For the LD procedure, the low strip technique was employed, involving the removal of 6 mm of the cartilaginous part and 3 mm of the bony part of the septum. Subsequently, PEI-associated lateral osteotomies of the nasal pyramid were performed symmetrically, resulting in the removal of 6 mm of bony strip on each side. After performing a low strip, the ULCs were resecting following the dorsal Y preservation as described by Çakir.[18]

Finally, to refine the tip, a lateral steal suture of 3 mm and cephalic dome sutures were performed, following the polygon tip and a shield graft due to the intermediate crura agenesia.

Clinical Case 4

A 28-year-old woman presented with a long nose characterized by a high radix and a large hump on the bridge, as well as an alar divergency deformity. The patient underwent preservation rhinoplasty procedures, including LD and ST, utilizing a closed approach with full subperichondrial and subperiosteal dissection of the nose (Figure 9).

No work on the surface of the bony vault and dorsum was needed.

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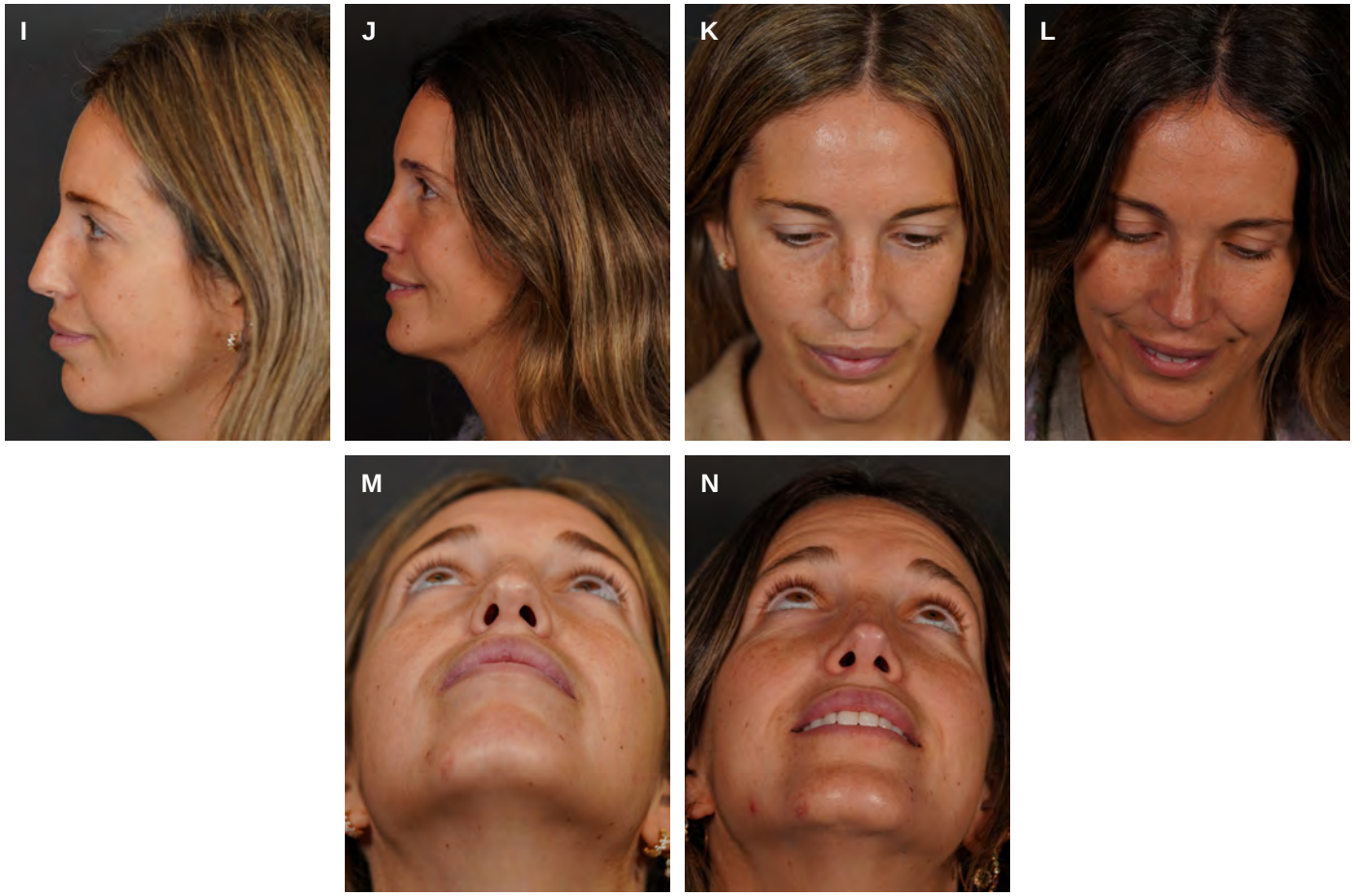


Figure 8. Continued

For the LD procedure, the low strip technique was employed, involving the removal of 5 mm of the cartilaginous part and 3 mm of the bony part of the septum. Subsequently, PEI-associated lateral osteotomies of the nasal pyramid were performed asymmetrically, resulting in the removal of 4 mm of bony strip.

DISCUSSION

Modern rhinoplasty, particularly preservation rhinoplasty, demands exceptional precision. Submillimeter accuracy is essential, especially when resecting the PPE. Consequently, the ability to perform 100% of osteotomies in preservation rhinoplasty with an ultrasonic piezotome represents a significant advance.

Beyond precision, it is crucial to highlight the substantial benefits in terms of potential intraoperative and postoperative complications. The ability to cut bone rather than fracture it offers an unparalleled advantage in preventing intraoperative surprises.

Traditionally, many surgeons have utilized piezotomes for lateral osteotomies but have relied on osteotomes or saws for transverse fractures, and on punches or osteotomes for resection of the pyramidal process of the maxilla.[19] This article effectively demonstrates that the ultrasonic piezotome, when equipped with specialized inserts, can also be used for these procedures.

The success of piezo-assisted rhinoplasty hinges on the maneuverability and precision of the hand devices utilized within the restricted nasal space.[20] In our study, we encountered challenges associated with the limited visibility and space for manipulating the piezotome inside the nose, emphasizing the need for smaller hand devices to achieve reproducible surgery.

The introduction of smaller hand devices is essential to navigate the intricate nasal anatomy effectively, particularly in closed-approach rhinoplasty where visibility is inherently limited. A narrower profile and ergonomic design of hand devices enable surgeons to access challenging areas with greater ease, enhancing maneuverability and precision during the procedure. Furthermore, smaller hand devices minimize tissue trauma and improve patient comfort by reducing the invasiveness of the surgical approach.

Our findings underscore the importance of innovation in instrument design to address the specific requirements of piezo-assisted rhinoplasty. Manufacturers should prioritize the development of compact and versatile hand devices tailored to the unique demands of closed-approach preservation rhinoplasty. These advances in instrument technology have the potential to enhance surgical outcomes and optimize patient satisfaction in aesthetic rhinoplasty procedures.

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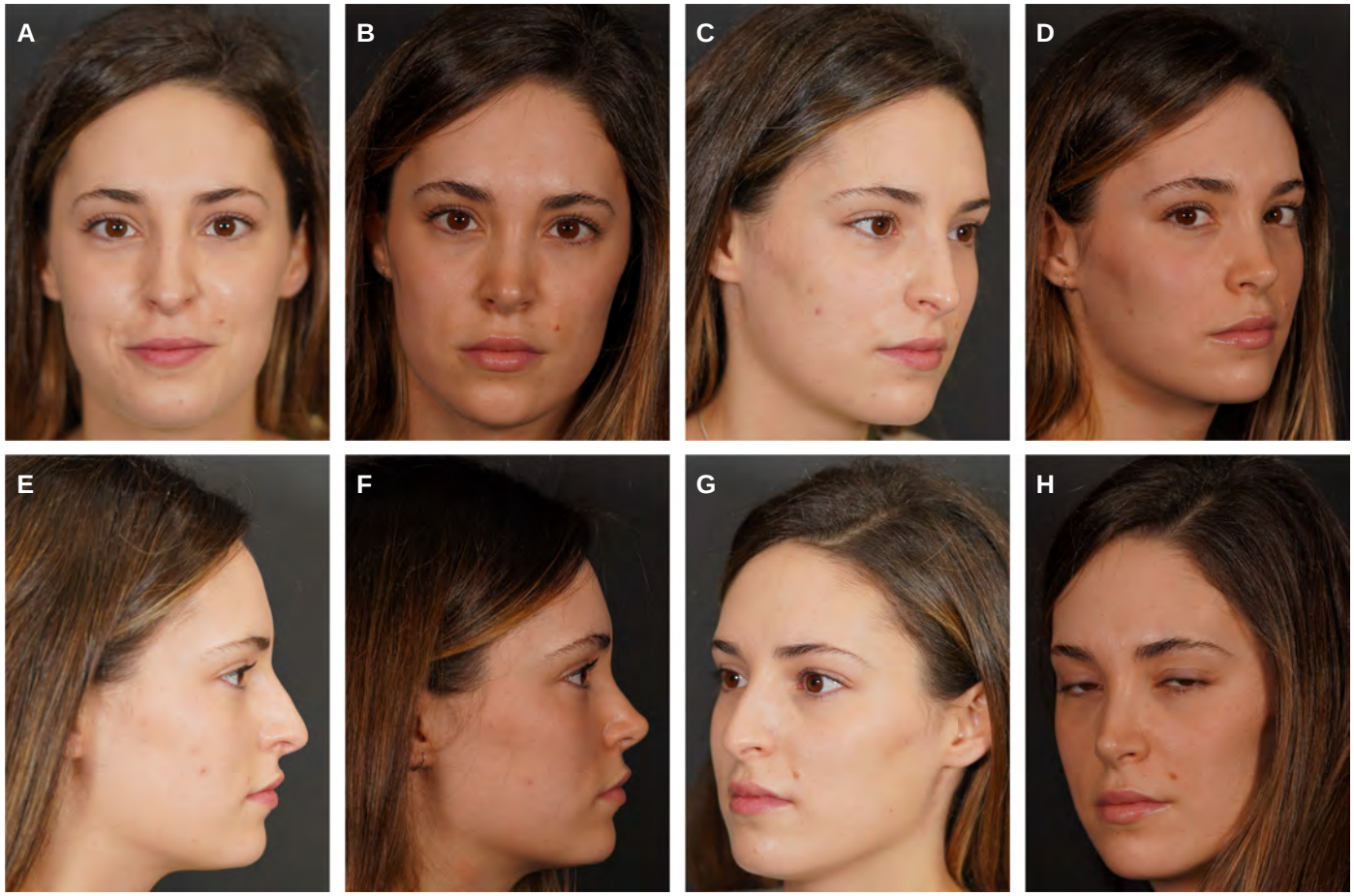


Figure 9. A 28-year-old female presented with a long nose characterized by a high radix and a large hump on the bridge, as well as an alar divergency deformity (A, C, E, G, I, K, and M). The patient underwent preservation rhinoplasty procedures, including LD and ST, utilizing a closed approach with full subperichondrial and subperiosteal dissection of the nose. No surface of the bony vault and dorsum was needed. Postoperative photographs depict the patient's results 1 year after surgery (B, D, F, H, J, L, and N). LD, let down; ST, surface technique.

In addition to smaller hand devices, the selection of specific inserts plays a crucial role in achieving precise preservation rhinoplasty in a closed approach. Our study highlights the significance of utilizing specialized inserts tailored to the anatomical nuances of the nasal dorsum and pyramid.

For lateral osteotomies, we have identified the Woodpecker SS18 insert as highly effective, featuring optimal dimensions and a toothed design for efficient bone cutting. This insert's unique characteristics facilitate precise osteotomies, enabling surgeons to achieve the desired dorsal modifications with minimal disruption to the surrounding tissues. When using a piezo device to remove the PPE, the risk of causing a skull base fracture and subsequent cerebrospinal fluid leak is extremely low.

Similarly, for transverse osteotomies, the Woodpecker SS4 insert has proven invaluable, particularly in addressing radix bone thickness and achieving precise osteotomies. The inclusion of additional teeth on this insert enhances cutting speed and efficiency, ensuring optimal outcomes in nasion augmentation and camouflaging of transverse osteotomy lines.

Our study underscores the importance of selecting inserts tailored to the specific anatomical challenges encountered in preservation rhinoplasty. By utilizing specialized inserts optimized for precision and efficiency, surgeons can achieve superior aesthetic results while minimizing intraoperative trauma and postoperative complications.

Proficiency in rhinoplasty has undergone a significant surge in recent years, both intraoperatively and postoperatively. Notably, the increasing popularity of intraoperative pictures and videos in rhinoplasty has not only contributed to surgeons' marketing efforts but has also underscored the importance of minimizing swelling and bruising during and after surgery. Reduced postoperative inflammation not only enhances the surgeon's ability to control, assess, and validate the final result at the surgical table but also elevates the overall quality of the outcome.

The integration of ultrasound technology has played a pivotal role in achieving these goals. It not only aids in minimizing postoperative swelling and bruising but also provides superior control over fracture lines during the procedure.

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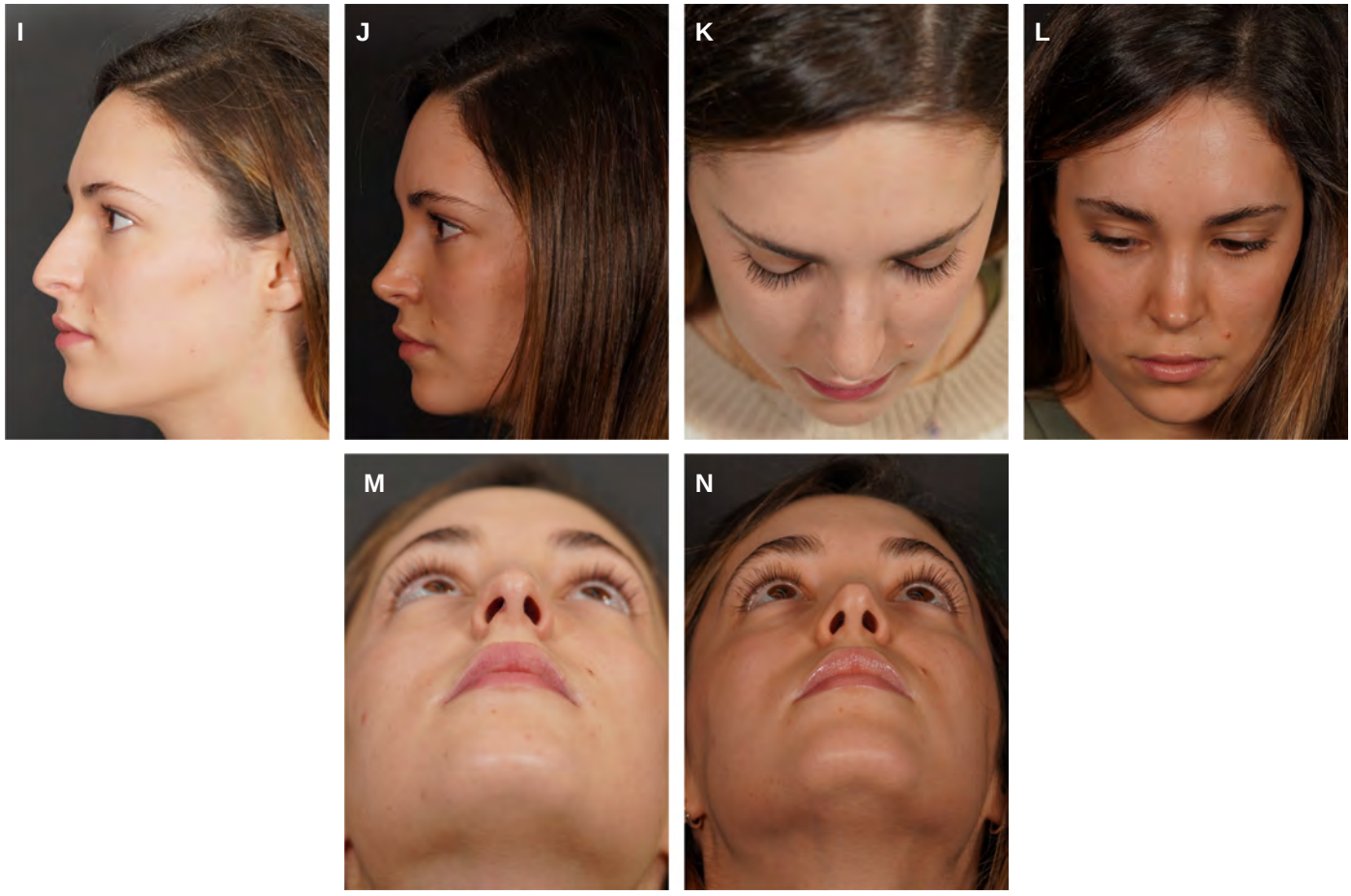


Figure 9. Continued

CONCLUSIONS

Although contemporary rhinoplasty procedures benefit from well-designed inserts for infracartilaginous closed approaches, it is undeniable that rhinoplasty surgeons should actively contribute to the design of piezo inserts, particularly those tailored for closed approaches. Innovations in instrument design, particularly in hand devices and inserts, are essential to address the unique challenges posed by closed-approach preservation rhinoplasty. By prioritizing the development of compact and versatile instruments tailored to the demands of preservation rhinoplasty, manufacturers can support surgeons in achieving superior aesthetic results and improving patient satisfaction. Although it is nowadays possible to accomplish every nose osteotomy using a piezotome, the involvement of surgeons is crucial for advancing the field, ensuring that the tools employed align seamlessly with the nuanced techniques and requirements of modern rhinoplasty, ultimately contributing to improved outcomes and patient satisfaction.

Disclosures

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