Objective: To demonstrate histologic correlates and describe refinements in cosmetic rhinoplasty using the ultrasonic bone aspirator.

Methods: This retrospective review of 103 consecutive patients undergoing cosmetic rhinoplasty at a tertiary care academic facial plastic surgery practice extends the applications for the ultrasonic bone aspirator to include reducing the nasal spine, glabellar deepening, sculpting of mobile bone fragments after osteotomy, smoothing of bony edges after medial osteotomy, and reducing the convexity of nasal bones. We performed histologic analysis of cartilage samples, and the patient and surgeon subjectively evaluated the aesthetic outcome of the procedure.

Results: All patients obtained satisfactory outcomes. Seven patients experienced minor complications. One patient had a visible dorsal irregularity, 2 had palpable but not visible dorsal irregularities, 2 had asymmetry of the dorsum, and 2 had underresection of the dorsum. No patients experienced skin or soft-tissue injury.

Conclusions: The ultrasonic bone aspirator can be a useful adjunct for the cosmetic rhinoplasty surgeon. The ultrasonic bone aspirator permits precise, graded removal of bone without damage to surrounding soft tissue or mucosa. With multiple applications in nasal surgery, the ultrasonic bone aspirator permits refinement of subtle irregularities and asymmetry of the nasal bones. Complications associated with the device are rare.


The ultrasonic bone aspirator (SONOPET; Stryker Corporation, Kalamazoo, Michigan) is a device developed for applications in neurosurgery and orthopedic surgery requiring precise bone removal without attendant soft-tissue injury. Currently approved by the US Food and Drug Administration for use in the head and neck, the device has been used for bony dorsal hump and nasal spine removal, turbinate reduction (unpublished data, J.D.G. and E.A.P., April 2009), endoscopic transorbital decompression (unpublished data, E.A.P., April 2009), and dacryocystorhinostomy. The aspirator's longitudinal torsional motion with concurrent irrigation and suction allows for precise graded removal of bone in a clean surgical field. Minimal heat is generated, and direct visualization of bone removal is possible. This retrospective review extends the applications for the ultrasonic bone aspirator to include reducing the nasal spine, glabellar deepening, sculpting of mobile bone fragments after osteotomy, smoothing of bony edges after medial osteotomy, and reducing the convexity of nasal bones. Also, this review demonstrates the preservation of histologic correlates and technical refinements using the ultrasonic bone aspirator.
tologic architecture in the surrounding cartilage after application of the ultrasonic bone aspirator. The device is easy to master and to use, it allows for subtle refinements without damaging surrounding structures, and it affords excellent visualization for achieving a satisfactory aesthetic result.

**METHODS**

The ultrasonic bone aspirator (Figure 1) was used in 103 consecutive patients undergoing cosmetic rhinoplasty by the senior author (E.A.P). All procedures were performed via an open approach using transcolumnellar and marginal incisions. A subsuperficial musculoaponeurotic system dissection was performed to elevate the soft-tissue envelope overlying the upper and lower lateral cartilage. The periosteum overlying the nasal bones was dissected completely free using a Cottle elevator. The cartilaginous component of the dorsal hump was addressed using a scalpel.

To address the bony dorsum, we inserted an Aufricht retractor under the soft-tissue envelope to allow full visualization of the nasal bones. Next, the ultrasonic bone aspirator was used to sequentially remove the bony portion of the dorsal hump. The soft-tissue envelope was periodically redraped and the profile view was inspected to assess the amount of dorsal hump reduction. Once the desired height and contour of the dorsum was achieved, any necessary tip refinement and middle vault reconstruction was performed. For open sky deformities, medial and/or lateral osteotomies and infracturing were performed using curved guarded osteotomes.

The ultrasonic bone aspirator was used in novel ways to achieve further aesthetic refinement. Nasal spine reduction was performed in patients with a severe nasal deflection (ie, tension) nose deformity. Precise, graded deepening of the prominent glabella was performed via direct visualization. After medial or lateral osteotomies, sculpting of mobile bone fragments and smoothing of medial bony edges was accomplished if necessary (Figure 2). Lastly, in cases in which the brow-tip aesthetic line was interrupted by convex nasal bones, the ultrasonic bone aspirator was used to reshape those bones. Histologic analysis was performed on cartilage treated with the ultrasonic bone aspirator and on untreated cartilage to evaluate for injury to the tissue architecture.

Complications were defined as skin or mucosal injury; undesired fracture or comminuted nasal bones; a persistent open sky deformity; an inverted V deformity; visible irregularities; palpable nonvisible irregularities; or asymmetry, overresection, or underresection of the dorsum. Patient follow-up occurred at 1 week, 1 month, 3 months, 6 months, and 12 months postoperatively; however, not all patients in the series achieved 6-month follow-up at the time of manuscript preparation. The cosmetic result was graded as satisfactory if the patient and surgeon agreed that the aesthetic goals were achieved. Any result with a persistent deformity was observed. Data collection and analysis were performed with approval from the Institutional Review Board of Thomas Jefferson University Hospital.

**RESULTS**

One hundred three patients underwent cosmetic rhinoplasty using the ultrasonic bone aspirator. Ninety-six patients had no history of nasal surgery, and 7 patients required revision surgery. Included were 71 female patients and 32 male patients with a mean age of 29 years (range, 15-64 years). Follow-up ranged from 0 to 14.2 months (mean, 3.2 months). The breakdown of procedures and complications are listed in the Table. The most common application was smoothing of the bony edges, which was performed in all patients.

No serious complications occurred, although 7 patients (6.8%) experienced some minor complications. One patient had a visible dorsal irregularity, 2 patients had palpable but not visible dorsal irregularities, 2 patients had asymmetry of the dorsum, and 2 patients had underresection of the dorsum. No skin injuries, open sky deformities, or inverted V deformities were observed. On histologic analysis, no loss of chondrocytes was observed on the surface of cartilage treated with the ultrasonic bone aspirator.
CASE 1: SMOOTHING BONY EDGES

A 51-year-old woman with a previous nasal fracture sought treatment for correction of a dorsal hump deformity, septal deviation, and turbinate hypertrophy. She underwent open reduction of the nasal and septal fracture. First, the bony dorsum was lowered with the ultrasonic bone aspirator. Bilateral low-to-high lateral osteotomies and medial osteotomies of the nasal bones were performed with curved guarded osteotomes. After pressing in the nasal bones to give them their final shape, redraping of the skin and soft-tissue envelope demonstrated palpable irregularity of the bone along the medial osteotomy margin. The ultrasonic bone aspirator was used to smooth these irregularities, and final checks were made of the final dorsal height. Postoperatively, the patient had a straightened profile with a smooth dorsum.

CASE 2: REDUCING THE CONVEXITY OF THE NASAL BONES

A 49-year-old man sought treatment for right-sided nasal obstruction and because he believed his nose to be wide. Evaluation of the external nasal framework demonstrated a moderate dorsal hump, curved nasal bones, and a wide nasal tip. Intranasal examination revealed enlarged turbinates, a mild cartilaginous septal deviation, and a moderate-sized right-sided bony spur. Treatment included septoplasty, turbinate reduction, and tip refinement with a cephalic trim and dome-binding sutures. After dorsal hump reduction, bilateral low-to-high lateral osteotomies and medial osteotomies of the nasal bones were performed with curved guarded osteotomes. Inspection after redraping the skin and soft-tissue envelope did not reveal a smooth brow-tip aesthetic line secondary to the convex shape of the nasal bones. The ultrasonic bone aspirator was used to sculpt the nasal bones to achieve a satisfactory brow-tip aesthetic line (Figure 4).

CASE 3: NASAL SPINE REDUCTION

A 32-year-old woman with a dorsal hump deformity, deviated nasal septum, and turbinate hypertrophy unresponsive to nasal corticosteroids sought surgical intervention. Examination revealed evidence of a previous nasal fracture, right septal deviation, and turbinate hypertrophy. Treatment included submucous turbinate resection, lowering of the bony dorsum with the ultrasonic bone aspirator, medial and lateral osteotomies, a medial crural fixation stitch, turbinate resection, and septoplasty. After initial reduction of the bony dorsum, the prominence of the glabella was identified, and the ultrasonic bone aspirator was used to reduce the nasal spine. Three months postoperatively, the patient had improved nasal breathing and symmetry of the base view (Figure 5B).

CASE 4: DEEPENING OF THE GLABELLA

A 32-year-old woman with a history of previous nasal trauma, resulting in a nasal septal deformity and difficulty breathing through her nose, sought surgical intervention after failed medical management. The results of physical examination were notable for a ptotic tip and dorsal hump deformity, and anterior rhinoscopy revealed enlarged turbinates and a deviated septum. Treatment included lowering of the bony dorsal hump with the ultrasonic bone aspirator, medial and lateral osteotomies, a medial crural fixation stitch, turbinate resection, and septoplasty. After initial reduction of the bony dorsum, the prominence of the glabella was observed relative to nasal projection and tip rotation. The bone overlying the glabellar region was contoured using the ultrasonic bone aspirator to achieve a more aesthetically pleasing result (Figure 6). Postoperatively, the patient had an improved nasal profile with appropriate tip rotation, nasal projection, and glabellar deepening.

CASE 5: SCULPTING OF MOBILE BONE FRAGMENTS

A 32-year-old woman with a dorsal hump deformity, deviated nasal septum, and turbinate hypertrophy underwent treatment with submucous turbinate resection, lowering of the bony dorsum with the ultrasonic bone aspirator, bilateral cephalic trims, domal sutures, and lateral osteotomies with nasal bone infracture. After infracture, the ultrasonic bone aspirator was used to sculpt the irregularities on the mobile bone fragments (Figure 2A). Postoperatively, the patient had an improved nasal profile and a straightened dorsum.
Figure 3. On histologic analysis, no loss of chondrocytes was observed on the surface of cartilage (hematoxylin-eosin, original magnification ×10). Normal cartilage (A) and cartilage surface treated with the ultrasonic bone aspirator (SONOPET) (B). Arrows indicate normal chondrocytes.

Figure 4. Photographs of a male patient before and after use of the ultrasonic bone aspirator to sculpt the nasal bones to achieve a satisfactory brow-tip aesthetic line (the dashed line outlines the nasal bones). A, Preoperative photograph of a male patient with curved nasal bones. B, Six-month postoperative photograph of the same patient with straighter nasal bones.

Figure 5. Photographs of a male patient before and after nasal spine reduction using the ultrasonic bone aspirator (the dashed line outlines the nasal bones). A, Preoperative photograph of a male patient with a severely deviated nasal spine. B, Postoperative photograph of the same patient with improved base view.
The ultrasonic bone aspirator can be used in a variety of settings to address challenging nasal deformities more easily. For example, nasal spine reduction can be achieved under direct visualization with greater facility and potentially greater precision than that achieved through osteotomy. Overresection of the nasal spine or the caudal septum can be avoided to prevent attendant tip ptosis and columellar retraction. In this series, nasal spine reduction was successfully achieved in 10 patients.

In some patients, despite adequate bony and cartilage hump reduction, a prominent glabella disrupts the nasofrontal angle and contributes to an unattractive nasal profile. Traditionally, glabella reduction can be achieved with specialized carbide or power-assisted rasps, but these methods are technically difficult to perform and offer poor visualization. Other methods include the use of diamond burrs; however, the rotating tip can cause soft-tissue injury to the forehead or nasal skin. The ultrasonic bone aspirator can access the glabella for precisely graded bone removal with direct visualization before or after nasal bone osteotomy and infracture. Glabellar deepening without soft-tissue injury was accomplished successfully in 3 patients.

The ultrasonic bone aspirator also enables sculpting of mobile bone fragments, smoothing of bony edges, and reducing the convexity of curved nasal bones. Irregularities or asymmetries in the mobile nasal bones after osteotomies are difficult to address with traditional methods such as rasps or drills, which may avulse the bone fragments. The vibratory motion of the ultrasonic bone aspirator removes bone through a light application with no torque applied to the mobile bones and minimal heat generation. No risk of fragment avulsion or spooling of surrounding tissues is incurred. The capability to smooth rough edges and to prevent palpable and/or visible irregularities after osteotomies permits improvements in nasal contour irregularities, especially in thin-skinned individuals. Now, the ultrasonic bone aspirator is used to refine nasal contours and smooth bony irregularities in nearly every case involving nasal bone osteotomies. Moreover, the device can be used to flatten convex nasal bones that disrupt a smooth brow-tip aesthetic line. Lateral osteotomies will narrow the dorsum but will not be sufficient to straighten the dorsum if the nasal bones are curved. Sculpting of the nasal bones avoids complications associated with intermediate osteotomies, which may become visible or palpable and may lead to nasal bone collapse.

The main drawbacks of the ultrasonic bone aspirator for cosmetic rhinoplasty include cost, time, and limited usefulness via an endonasal approach. The multiple applications of this device make it an attractive tool for rhinoplasty; however, its cost may be prohibitive to some physicians or institutions. The handpiece can be sterilized, but each tip is the single-use type, which adds expense. We have not performed any rigorous time trials, but removal of large amounts of bone with the ultrasonic bone aspirator can be slower than with rasps. With respect to bone removal, the bone aspirator’s concurrent irrigation and suction produce a clean surgical field. Moreover, there is no need to continually sharpen or clean the instruments, as is sometimes necessary with rasps.

It can be difficult to use the ultrasonic bone aspirator via an endonasal approach. We strongly suggest using the device with only a light touch; care must be taken to avoid excessive pressure at a single point, resulting in excessive bone removal. The size of the device and the ability to control the amount of pressure is limited by the access available in endonasal rhinoplasty.

Ultrasonic bone aspiration permits precise graded removal of bone without damage to surrounding nasal soft tissue and mucosa. Histologic correlates demonstrate preservation of cartilage architecture compared with traditional techniques. The technique affords excellent visualization for refinement of subtle irregularities and asymmetry. Multiple applications in nasal surgery can be found, and although long-term results are lacking, the device’s positive safety profile and early results warrant further use and investigation.

Figure 6. Photographs of a female patient before and after dorsal hump reduction and deepening of the glabella. A, Preoperative photograph showing dorsal hump and relatively prominent glabella. The dashed line denotes the Frankfort horizontal plane; the glabellar region is outlined between the solid lines. B, Four-month postoperative photograph.
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Correspondence: Jewel D. Greywoode, MD, Department of Otolaryngology—Head and Neck Surgery, Thomas Jefferson University Hospital, 925 Chestnut St, Sixth Floor, Philadelphia, PA 19107 (jewel.greywoode@gmail.com).
Author Contributions: Both authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Pribitkin. Acquisition of data: Greywoode and Pribitkin. Analysis and interpretation of data: Greywoode and Pribitkin. Drafting of the manuscript: Greywoode and Pribitkin. Critical revision of the manuscript for important intellectual content: Greywoode and Pribitkin. Statistical analysis: Greywoode. Obtained funding: Pribitkin. Administrative, technical, and material support: Greywoode and Pribitkin. Study supervision: Pribitkin.

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REFERENCES


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