Computed Tomography for Constructing Custom Nasal Septal Buttons

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Objective: To determine the efficacy of computed tomography in creating custom nasal septal buttons.

Design: Retrospective chart review and telephone follow-up.

Setting: Tertiary care referral center.

Subjects: Ninety-five patients with symptomatic septal perforations repaired with custom Silastic septal buttons fashioned from reformatted computed tomographic images. Follow-up greater than 1 month was obtained in 74 patients (range, 1 month to 17 years; mean, 44.6 months).

Interventions: Custom septal buttons were placed intranasally under local or general anesthesia.

Main Outcome Measures: Patients were evaluated for resolution of preoperative symptoms related to the septal perforation, new symptoms related to the button, and duration of button retention.

Results: The average perforation was 2.6 cm in diameter (range, 6 mm to 6.0 cm). Nine buttons (12%) came out unexpectedly. Nine buttons were removed because of patient intolerance, and 14 buttons were lost or removed after 5 years, longer than the projected button life span. Excluding buttons that were removed because of patient intolerance, 56 (86%) of 65 buttons were in place for longer than 5 years or at the most recent follow-up. Most patients experienced improved breathing (60%) and a considerable reduction in epistaxis (77%) and nasal crusting (59%).

Conclusion: Custom septal buttons created using computed tomography are effective in relieving symptoms from large septal perforations.

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VARIOUS TECHNIQUES exist for closing septal perforations. These range from surgical closure with mucosal flaps to insertion of septal buttons. Surgical closure is often challenging and time-consuming. Septal buttons are a safe and effective way to close septal perforations. Septal buttons are available in standard sizes, and several methods have been described for creating custom septal buttons.1-3 Large and irregular perforations remain a challenge to close, as they are difficult to size and prefabricated buttons generally fit poorly. Using computed tomography (CT), images of a septal perforation can be generated from which a button can be fashioned. This method can be used for any size defect, and the buttons produced precisely obturate the defect, providing excellent symptom relief with a low failure rate.

METHODS

CLINICAL EVALUATION

Following institutional review board approval, all patients with septal perforations repaired using custom septal buttons fashioned from CT images were identified from a computerized database and then medical records were reviewed. Only patients with symptomatic perforations not responsive to medical treatment were fitted. Attempts were made to fit patients for buttons only after the perforation was stable. A complete circumferential ridge of tissue around the perforation to which the flanges could adhere was required to hold the button in place. Patients with perforations smaller than 1.5 cm in diameter were often fitted with standard buttons, or underwent surgical repair.

CT EVALUATION

Images were obtained on a General Electric CTI scanning system (GE Medical Systems, Milwauk ee, Wis). All images were taken without contrast. A lateral scout radiograph was taken from 130 mm above the external auditory meatus to 80 mm below the external auditory meatus. The patient was positioned supine with Velcro and foam head restraints to minimize head movement. The head was positioned with the chin slightly extended to produce images in the same plane as the hard palate. Technique factors were 120-kV, 340-mA, 1-second scan. The head calibration used had a 25-cm field of view.

A series of 1-mm axial scans were taken every 1 mm, starting at the hard palate, and moving vertically through the defect. There was
an 8-second delay in scanning termination to produce 8 scans superior to the defect. Scans were reformatted on a Cemax Workstation using the Arrange program (Imitron, San Francisco, Calif) to create 1:1 sagittal and coronal images of the perforation (Figure 1A). Coronal images of the defect were generated every 0.5 cm through the defect. Sagittal images were generated, one midline and one on either side of midline.

BUTTON CARVING

A 9-mm-thick block of medium-consistency medical grade silicone (Bentec Medical, Sacramento, Calif) was split into two 4-mm blocks. A piece of tracing paper was placed over the sagittal reformatted image of the perforation. The perforation was traced over a light box using a No. 2 pencil. The appropriate flanges to fit the remaining soft tissues were also traced at this time. The CT image was then removed, and the tracing was covered with protective transparency film. The 4-mm block of silicone was then placed over the transparency and the button was hand-carved at the outer edges of the flanges.

The outer edges were then sanded on the high-speed setting using a fixed round sanding wheel (Dremel), first with a 0.3-inch No. 408 (coarse) sanding band, then with a No. 432 (fine) sanding band until the outer edge was smooth and relatively flat. Any debris was cleaned using pressurized air.

Using a felt-tipped pen, dots were placed every 4 to 5 mm around the perimeter of the button to mark the midline where the groove would be carved to create the flanges. A groove was carved with the Dremel sanding wheel approximately 1-mm deep using two stacked 1-mm sanding disks, No. 420 at high speed. This created an initial groove 1-mm deep and 2-mm wide, leaving 1-mm flanges on either side of the groove.

The button was reoriented on the original tracing of the septal defect. By pressing the button down on the tracing, an imprint of the No. 2 pencil lead was transferred to the button. Using the same two 1-mm sanding disks, the groove was carved to the edge of the defect outline. The orientation of the button to the Dremel sanding wheel was reversed occasionally to create a more consistent groove. The button was cleaned and the imprint retransferred as needed, until the hub matched the defect on the sagittal CT scan (Figure 1B). A small notch was carved in the anterior-superior aspect of the right flange to orient the surgeon when inserting the button (Figure 2A).

BUTTON INSERTION

Most buttons were inserted in the operating room, as many of the buttons are quite large, and occasionally an anatomy was required to facilitate insertion. Prior to insertion, the button was autoclaved. The patient was sedated, intubated, and placed under general anesthesia. The nose was topically anesthetized using 5% cocaine. The anterior and posterior aspects of one flange were sewn together with a mattress stitch, and the button coated with antibiotic ointment (Figure 2B). The button was then inserted with a bayonet forceps, while the folded flanges were passed through the perforation opposite to the nasal cavity. A Freer elevator was used to get the folded flanges through the perforation. The stitch was cut to allow the flange to open against the remaining septum. The button may be hand-trimmed in situ and an elevator used to position the flanges with respect to the middle turbinates (Figure 3).

RESULTS

Between August 1980 and December 2000, 95 patients were fitted with custom septal buttons. Preoperative symptoms related to septal perforations are listed in Table 1. The most common symptoms experienced were crusting, epistaxis, and difficulty breathing. Other common symptoms included pain, rhinorrhea, postnasal discharge, and hyposmia. A cause for the perforation was sought in every case, though undetermined in 19 patients. More than 40% of perforations were caused by nasal surgery (Table 1). External nasal trauma was responsible for 11% of perforations, and both cocaine use and nonsurgical intranasal trauma was the source of 8% of the perforations. In 19 patients (20%), there was no identifiable cause.
Perforations ranged in size from 6 mm to 6.0 cm in diameter, with an average diameter of 2.6 cm. Of 85 patients with documented perforation measurements, 67 (79%) had defects 2.0 cm in diameter or larger. Follow-up was obtained by direct examination and questioning or via a telephone questionnaire. Seventy-four patients received follow-up of longer than 4 weeks (Table 2). Follow-up ranged from 4 weeks to 17 years (mean, 44.6 months). In 58% of these patients, the septal button was in place at their last follow-up. Button loss was highest in the first year (32%) and after 5 years (39%). Button loss in the first year was most commonly due to patient intolerance and surgical removal of the button (Table 3). Nine buttons were removed because of infection, 9 buttons came out unexpectedly. Four were removed because of enlarging defects. One button came dislodged due to trauma, another with a sneeze, and 1 patient experienced nasal obstruction secondary to the button. Button loss after 5 years was more commonly due to button breakdown or enlarging defects. Five buttons broke down after more than 5 years of use, exceeding the normal wearout period for Silastic. Two of these patients had new buttons inserted at their last follow-up. The other 3 patients had not since their button loss. Buttons were removed because of infection in 8 patients. Of these patients, 4 had new buttons replaced after the resolution of infection, 3 were awaiting new button placement at last follow-up, and 1 had recurrent Pseudomonas aeruginosa infections and was not planning on button replacement when last seen. None of the buttons were sniffed into the nasopharynx. Excluding buttons that were removed due to patient intolerance, 57 (88%) of 65 buttons were in place for longer than 5 years or at the most recent follow-up.

The 6 most common symptoms from septal perforations and the percentage of patients (n=74) experiencing symptom improvement or complete symptom resolution were crusting, 59%; epistaxis, 77%; difficulty breathing, 60%; pain, 71%; rhinorrhea, 39%; and postnasal drainage, 44%. Most patients experienced improved nasal airflow and a considerable decrease in crusting and epistaxis.

**COMMENT**

Nasal septal perforations occur in many scenarios. In a previous series of 171 patients, nasal surgery was the most common cause, followed by intranasal trauma. Other causes include external trauma, cautery, cocaine abuse,
infection, and systemic diseases, such as systemic lupus erythematosus, Wegener granulomatosis, sarcoidosis, and, very rarely, Crohn disease. Nasal perforations vary in symptomatology depending on both the size and location. The most common symptoms associated with septal perforations are crusting, epistaxis, breathing difficulty, and pain. Patients also may complain of whistling, rhinorrhea, postnasal drainage, and hyposmia, among other symptoms.

There are many reports in the literature on surgical or mechanical closure of septal perforations. Septal buttons are often used because of the relative ease of button placement and the high failure rate of surgical closure. Techniques for creating nasal septal buttons are as varied as the causes of perforation. Prefabricated septal buttons are available in 1- or 2-piece units. They offer the advantage of being cost-effective and efficient relative to custom-made buttons. The single-piece button has the disadvantage of having a fixed distance between the flanges, which does not allow for various septal thicknesses. Yet both 1- and 2-piece prefabricated septal buttons are limited by imprecise fit. This can cause increased crusting, nasal obstruction, foreign body sensation, button movement, and button loss. Custom septal buttons provide a more comfortable fit, better symptomatic relief, and less button loss.

Several techniques have been described for making custom septal buttons. Kern et al describe placing a piece of paper in one nasal chamber, while outlining the perforation via a cotton carrier dipped in thimerosal. A button was then carved out of Silastic using the paper as a template. Zaki used mold material on a cotton swab or tongue blade to make an impression of the perforation, from which a polished, heat-cured acrylic button was made. Redleaf and associates injected septal perforations with vinyl polysiloxane to make an impression.

These methods have proven to be effective, but have limited utility in obturating large perforations. Larger perforations require a tight-fitting button due to limited adjacent soft tissue for the flanges to secure the button in place. It is difficult to size these perforations with molds or paper tracing. Computed tomographic evaluation of septal defects provides images of the defect for accurate sizing of the defect and evaluation of the surrounding soft tissues. This facilitates the construction of a button that precisely fits the defect. Visualization of the surrounding soft tissues also allows the medical artist and surgeon to create flanges that more closely match the patient’s individual intranasal anatomy.

Of the 95 patients in this series, 30 had perforations greater than 3 cm in diameter. Perforations greater than 3 cm in diameter have been considered the upper limit for accurate sizing in previously described methods of creating custom buttons. Despite this, septal button placement was successful in 74% of the patients with perforations greater than 3 cm in diameter, and in 86% of all patients in this study. In addition, most of the patients experienced improved breathing, and decreased crusting and epistaxis. This indicates that CT provides a suitable alternative for creating custom septal buttons in patients with symptomatic perforations. Finally, custom septal buttons do not preclude future surgical repair. If patients cannot tolerate the button, it can be easily removed and surgical repair undertaken.

CONCLUSIONS

Computed tomography is a noninvasive method for sizing septal perforations and creating custom septal buttons. This technique provides a solution to some of the limitations of other methods of creating custom septal buttons. Septal button placement was successful in 86% (56/65) of the patients in this study. Most patients experienced improved breathing, reduced crusting, and decreased epistaxis. This indicates that CT is a valuable asset when creating custom septal buttons for patients with symptomatic nasal septal perforations.

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REFERENCES