Cutting and Suture Technique of the Caudal Septal Cartilage for the Management of Caudal Septal Deviation

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Objectives: To introduce the cutting and suture technique of the caudal L-strut for the management of caudal septal deviation and to evaluate its efficacy and surgical outcomes.

Design: Retrospective study.

Setting: Tertiary care rhinology clinic.

Patients: Forty-five patients who underwent endonasal septoplasty using the cutting and suture technique of the caudal L-strut.

Interventions: After elevation of the mucoperichondrial flap, deviated portions of cartilage and bone were excised, leaving at least a 1.5-cm strip of L-strut. If caudal septal deviation persisted, the caudal strut was cut at the convex-most part, and the cut ends were slightly overlapped and sutured together.

Main Outcome Measures: Improvement in the treatment of nasal obstruction using a visual analog scale and a questionnaire for subjective satisfaction were evaluated 2 to 6 months after septoplasty. To evaluate outcomes objectively, endoscopic photographs of the nasal cavity before and after surgery were evaluated by 2 independent surgeons.

Results: Significant improvement in the treatment of nasal obstruction was achieved, with mean visual analog scale scores of 7.93 preoperatively and 3.63 postoperatively (P<.001). Subjective satisfaction was rated as much improved in 68% of patients, improved in 15%, and no change in 17%. Endoscopic examinations showed that 51% of patients had near-complete correction of the septum and that 47% had improved but a little persisting caudal deviation. One patient had no change in caudal septal deviation on endoscopic examination.

Conclusion: The cutting and suture technique of the caudal L-strut seems to be a useful technique that can be performed with relative ease and simplicity.


Caudal Septal Deviation

Caudal Septal Deviation is a major cause of nasal obstruction. This perplexing problem greatly inhibits normal nasal breathing by narrowing of the external valve area and the nasal valve angle. Successful management of caudal septal deviation is challenging because it is difficult to overcome intrinsic cartilage memory. Septoplasty for the management of caudal septal deviation can involve multiple incisions on the concave aspect of the septal cartilage or wedge-shaped excision of convex-sided cartilage pieces, preserving intact contralateral cartilage alignment. However, the effect of these incisional or excisional techniques is not uniformly predictable because the eventual straightening of the septum is completed by a secondary healing process. Thus, surgeons frequently observe undercorrection or overcorrection of caudal cartilage deviation and weakening of the caudal septal support with subsequent nasal deformity.

In our experience, a severely deflected caudal septum with an associated external nasal deformity can be readily corrected using an external rhinoplasty approach. However, for caudal septal deviation with no associated deformity of the external nose, external rhinoplasty is best avoided. Difficulty in obtaining consistently satisfactory and predictable outcomes using previously published endonasal septoplasty techniques led us to seek a different approach for the correction of caudal septal deviation. This surgical approach preserves the naturally strong junction between the maxillary crest and the septal cartilage and involves cutting the convex-most part of the caudal septum and then reconnecting it with slight overlapping of the cut ends of the cau-
cudal cartilage strut. We call this approach the cutting and suture technique of the caudal L-strut. The present study investigates outcomes after the cutting and suture technique of the caudal L-strut for the management of caudal septal deviation.

**METHODS**

**PATIENTS**

This study was approved by the institutional review board of Asan Medical Center. We retrospectively reviewed the medical records of 45 patients (43 males and 2 females) who underwent septoplasty for caudal sepal deviation using the cutting and suture technique of the caudal L-strut between May 1, 2006, and October 31, 2008. Follow-up ranged from 3 to 31 months (mean, 15 months). Patients with C-shaped or angulated caudal septal deviation in an anteroposterior direction and without dislocation of the caudal septum from the anterior nasal spine were included. Patient ages ranged from 17 to 63 years (mean age, 32 years). All surgical procedures were performed by 1 of us (Y.J.J.). For surgical outcome assessment, patients were asked to quantify subjective nasal obstruction using a visual analog scale (VAS) from 0 (no obstruction) to 10 (complete obstruction) and to subjectively evaluate surgery outcomes as “much improved,” “improved,” or “no change.”

**SURGICAL PROCEDURE**

The mucoperichondrial flap of the septum was elevated using a Freer or Cottle elevator via an endonasal approach after making a hemitransfixion incision on the concave nasal cavity. The central portion of the septal cartilage and bone was excised, leaving an L-strut of dorsal and caudal cartilaginous septum at least 1.5 cm long. If the caudal septal deviation was not sufficiently corrected using that procedure, a contralateral flap was raised from the caudal aspect of the cartilage without making an incision on the contralateral side (Figure 1A). Flap elevation was facilitated by retracting the nasal mucosa just caudal to the cartilaginous septum. The mucoperichondrial flap of the septum was elevated using a small double-pronged retractor. After bilateral flap elevation, the caudal strut was cut using a hemitransfixion incision on the contralateral side (Figure 1B and Figure 2A). The excess portions of the upper and lower caudal strut were then overlapped, and the overlapping cartilages were sutured together using 3 to 4 stitches (5-0 polydioxanone sutures; Ethicon, Somerville, New Jersey) (Figure 1C). Straightening of the cartilage could be verified immediately after this cutting and overlapping suture maneuver. The degree of overlapping cartilage was adjusted such that the vertical height of the original caudal septum was not shortened as a result of overlapping (Figure 2B). If the stability of the newly created caudal septum was questionable, a septal batten graft made from cartilage removed from the central part was placed for further support, usually on the concave side (Figure 1D and Figure 2C). Closure of the hemitransfixion incision was performed using 5-0 chromic gut, and 2 or 3 through-and-through transmucosal sutures (4-0 polydioxanone sutures) were used to hold both mucosa tightly to the newly created caudal septum. Surgery was concluded once straightening of the deviated caudal septum was confirmed (Figure 3).

**RESULTS**

Thirty patients (67%) presented for primary septoplasty and the remaining 15 (33%) presented for revision surgery. Placement of a septal batten graft using the septal cartilage from the central part was performed in 24 patients (53%) and always in a unilateral manner. Comitant procedures for improvement of nasal patency, such as inferior turbinoplasty (14 patients) and radiofrequency inferior turbinate volume reduction (15 patients), were performed.

Forty-one patients (91%) completed the postoperative questionnaire. Mean VAS scores improved from 7.93 to 3.63, indicating that improvement in nasal obstruction was achieved ($P < .001$). To clarify the effect of inferior turbinate reduction on symptom improvement, we compared VAS score changes between the groups with and without concomitant inferior turbinate reduction (Table). Both groups showed significant improvements in VAS scores for nasal obstruction. However, no significant difference was noted in the amount of VAS score improvement between the 2 groups (with vs without concomitant inferior turbinate reduction: 4.36 vs 4.15, $P = .97$). To assess the effect of the batten graft, we also compared the VAS score change in patients treated with only the cutting and suture technique and in patients who underwent concomitant batten placement. Both groups showed significant improvements in the treatment of nasal obstruction. When we compared the changes in VAS scores according to batten graft placement, the batten graft showed an additionally beneficial effect on symptom improvement (with vs without batten graft placement: 5.22 vs 3.11, $P = .01$ (Table)). Evaluations of the postoperative subjective outcomes in the 41 patients with questionnaire data were much improved in 28 (68%), improved in 6 (15%), and no change in 7 (17%). Endoscopic examination of the nasal cavity showed that 23 patients (51%) had near-complete straightening of the septum and that 21 patients (47%) had improved but some persisting caudal septal deviation. Only 1 patient (2%) showed virtually no change in caudal septal deviation on endoscopic examination. All of the patients with near-complete straightening on endoscopic examination belonged to the much improved group. However, patients with improved but persisting caudal septal deviation diversely presented as much improved (n = 5), improved (n = 6), or no change (n = 6) in postoperative satisfaction. One patient with no change in the caudal septum on endoscopic examination showed no change in subjective satisfaction.

During follow-up, 6 patients experienced irritation due to the suture material used for mucosal approximation sutures. Two of these patients had chondritis related to the suture material. They experienced mild tenderness on the nasal tip that persisted for more than 2 weeks postoperatively and granulation tissue formation on the caudal septal mucosa. Both issues completely resolved after antibiotic drug treatment for 3 weeks and meticulous
Figure 1. Surgical procedure of the cutting and suture technique of the caudal L-strut. A, The bilateral mucoperichondrial flap of the septum was raised from the caudal aspect of the cartilage without making an incision on the contralateral side. B, The caudal strut was cut using scissors at the convex-most region in the caudocephalic direction. C, The excess portions of the upper and lower caudal strut were then overlapped, and the overlapping cartilages were sutured together using 3 to 4 stitches. D, A septal batten graft made from cartilage removed from the central part was placed for further support, usually on the concave side.

Figure 2. Illustration of the cutting and suture technique of the caudal L-strut. A, The deviated caudal L-strut was cut at the most curved portion in the caudocephalic direction. B, The excess portions of the upper and lower caudal strut were then laid over each other, and the overlapping cartilages were secured in place with 3 to 4 stitches using 5-0 polydioxanone sutures. The degree of cartilage overlap was adjusted such that the vertical height of the original caudal septum was not shortened as a result, which is illustrated as septal height. C, If the stability of the newly created caudal septum was questionable, a septal batten graft made from cartilage removed from the central part was placed for further support.
dressing. One case of saddle nose was found to be due to loosening of the connection between the upper and lower cut ends, and this was corrected in revision surgery.

**COMMENT**

Caudal septal deviation can manifest as a form of cephalocaudal deviation and anteroposterior deviation. Cephalocaudal deviation can be corrected using vertical sleeve resection or the swinging door technique. When there is displacement of the caudal septum off the anterior nasal spine, it can be corrected by restoring a proper relationship between the anterior nasal spine and the posterior-most end of the caudal septum. In cases of deviation in the anteroposterior direction, the caudal septum represents a C-shaped convexity, or acute angulation, less frequently. The underlying abnormality of anteroposterior caudal deviation is usually excess septal cartilage length encased between the maxillary crest and the nasal roof. To straighten the cartilage, a small segment of the posterior end of the caudal septum can be resected, which can bring the caudal septum in straight midline positioning. However, the resected end needs to be reconnected with the anterior nasal spine and maxillary crest, which is difficult to reconstruct with its original strong attachment. The difficulty of reconstruction in this area is due to the 3-dimensional relationship between the cartilage and the bony shelf; the nasal spine and the maxillary crest are tilted toward the nasal cavity. The conventional septrhoplasty technique using cartilage incisions for correction of the caudal septum also has significant limitations because the healing process should be able to push up the nasal tip and dorsum to create sufficient room for straightening. However, if the incision is not properly augmented by an additional straight batten graft, it may never be able to overcome the strong downward pressure exerted by the nasal tip and dorsum, thus thwarting any attempts at straightening.

Techniques such as suture, swinging door, septal batten, ethmoid bone sandwich graft, tongue-in-groove, and extracorporeal septrhoplasty have been used in managing caudal septal deviation. Ellis used a suture technique as an adjunct for correcting caudal septal deviation. Kridel et al used a tongue-in-groove technique for correcting excess columellar show and caudal septal deviation. Metzinger et al reported the use of ethmoid bone sandwich grafting for the correction of caudal septal deviation via an external rhinoplasty approach. André and Vuyk described septal battens and septal replacement for the correction of dorsal and caudal septal deviations. Gubisch recommended removal of the whole septum and then extracorporeal reconstruction of the septum followed by reinsertion. This broad range of approaches illustrates the difficulty of treating caudal septal deviation.

**Figure 3.** Preoperative (A) and postoperative (B) endoscopic views of a patient with caudal septal deviation corrected using the cutting and suture technique of the caudal L-strut.

**Table. Symptom Improvement According to Additional Procedures**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Patients, No.</th>
<th>VAS Score</th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>P Value</th>
<th>Change in VAS Score</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inferior turbinate reduction, turbinoplasty, or radiofrequency volume reduction</td>
<td></td>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performed</td>
<td>28</td>
<td>8.04</td>
<td>3.68</td>
<td>&lt;.001</td>
<td>4.36</td>
<td>.97</td>
<td></td>
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<tr>
<td>Not performed</td>
<td>13</td>
<td>7.82</td>
<td>3.67</td>
<td>&lt;.001</td>
<td>4.15</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Septal batten graft</td>
<td></td>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performed</td>
<td>23</td>
<td>8.36</td>
<td>3.14</td>
<td>&lt;.001</td>
<td>5.22</td>
<td>.01</td>
<td></td>
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<tr>
<td>Not performed</td>
<td>18</td>
<td>7.50</td>
<td>4.39</td>
<td>&lt;.001</td>
<td>3.11</td>
<td>.98</td>
<td></td>
</tr>
</tbody>
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Abbreviation: VAS, visual analog scale.

*The postoperative questionnaires of 4 patients were lost.

Statistical difference between preoperative and postoperative VAS score in each group.

Statistical difference of changes in VAS score between the 2 groups.
Despite using previously published techniques, we often could not optimally correct deviated caudal septums. Such failures led us to explore a different surgical approach. For some years, we have used the cutting and suture technique of the caudal L-strut for the correction of caudal septal deviation. A previous study documented our experience using the dorsal L-strut cutting and suture technique to correct severe cartilaginous deviation in severely deviated noses. The success of that approach led us to adopt the same technical concept for managing caudal septal deviation. The logic was that the excess length of caudal septal cartilage is the main abnormality for this type of deviation. Thus, cutting and overlapping of the convex-most part of the caudal septal L-strut could reduce the excess length, thereby creating a straight caudal septal segment yet not affecting the original tip height. The present study found that this approach resulted in significant improvement in nasal obstruction in 83% of patients with caudal septal deviation. The beneficial effect of this technique on improvement of the treatment of nasal obstruction was observed regardless of concomitant inferior turbinate reduction or septal batten grafting. However, placement of the batten graft enhanced the effect of the cutting and suture technique significantly. On the other hand, the inferior turbinate reduction had no additional effect on improving nasal obstruction.

Endoscopic examinations of the nasal cavity showed that the technique resulted in near-complete straightening of the septum in 51% of patients and improved caudal septal deviation in 47%. Patients with near-complete straightening and with no change in endoscopic examination findings showed the same degree of improvement in postoperative subjective satisfaction. However, patients with improved but persisting caudal septal deviation presented diverse postoperative improvements. Some patients presented much improved or improved nasal obstruction, and others presented no change in their symptoms. The various degrees of improvement in nasal obstruction in this partially corrected group clearly illustrate the subjective nature of the nasal obstruction symptom.

For better correction of caudal septal deviation, not only the batten graft but also modified suture techniques, which were not used in the present series, eliminating the cartilage bending memory, can also be used together to achieve near-complete straightening of the septum.

The cutting and suture technique has several advantages over other corrective techniques for caudal septal deviation. The technique is relatively easy to perform. It is very useful for revision cases involving depleted septal cartilage due to previous surgery. In addition, it is useful for the simultaneous correction of caudal deviation of the external nose and nasal obstruction. In particular, this technique completely breaks the cartilage memory for bending. Therefore, an immediate intraoperative verification of straightening of the caudal septum is possible, and there is low risk of deviation recurrence, which is a major issue because the cartilage has a strong tendency to return to its original shape (Figure 2).

The cutting and suture technique has several potential drawbacks. First, formation of the L-strut by removing the central part of the cartilage is required in every case. Second, suture material–related problems such as stitch granuloma can occur. Third, it is not applicable for linear-type caudal septal deviations with displacement from the anterior nasal spine. Fourth, as demonstrated in one case, too much overlap or loosening of the suture may shorten the caudal septal length, resulting in a saddle nose deformity. Fifth, one other concern is long-term stability in terms of nasal tip weight; however, this can be addressed using additional supporting cartilage grafts (eg, septal batten or caudal septal extension grafts).

In conclusion, the present study found that the cutting and suture technique of the caudal L-strut may be a valuable approach in the management of caudal septal deviation owing to its relative ease and simplicity of use and its acceptable complication rate.

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Author Contributions: All 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: Jang. Acquisition of data: Jang, Yeo, and Wang. Analysis and interpretation of data: Yeo. Drafting of the manuscript: Jang, Yeo, and Wang. Critical revision of the manuscript for important intellectual content: Jang and Yeo. Statistical analysis: Jang and Wang. Study supervision: Jang.

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