Premiere Publications from The Triological Society

Read all three of our prestigious publications, each offering high-quality content to keep you informed with the latest developments in the field.

**Laryngoscope**

Founded in 1896

Editor-in-Chief: Samuel H. Selesnick, MD, FACS

The leading source for information in head and neck disorders.

[Laryngoscope.com](http://Laryngoscope.com)

**Investigative Otolaryngology**

Editor-in-Chief: D. Bradley Welling, MD, PhD, FACS

Rapid dissemination of the science and practice of otolaryngology-head and neck surgery.

[InvestigativeOto.com](http://InvestigativeOto.com)

**ENTtoday**

Editor-in-Chief: Alexander Chiu, MD

Must-have timely information that Otolaryngologist-head and neck surgeons can use in daily practice.

[Enttoday.org](http://Enttoday.org)

WILEY
Septal Cartilage Traction Suture Technique for Correction of Caudal Septal Deviation

Hyo-Seok Seo, MD; Han-Seul Na, MD; Sung-Dong Kim, MD; Keun-Ik Yi, MD; Sue-Jean Mun, MD; Kyu-Sup Cho, MD, PhD

Objective: Correction of the caudal septum deviation is the most difficult part of the septoplasty and a common cause of revision septoplasty. The purpose of this study was to present authors’ preliminary results in the treatment of patients with caudal septal deviation using the septal cartilage traction suture technique.

Study Design: Prospective, single center, observational study.

Materials and Methods: Sixty-seven patients with a caudal septal deviation underwent septal cartilage traction suture technique with endonasal septoplasty. After removal of excessive caudal cartilage, the caudal L-strut was sutured at two or more points using 5–0 Vicryl on the modified Killian incision site. Subjective outcomes using visual analog scales (VAS) and Nasal Obstruction Symptom Evaluation (NOSE) scale, objective endoscopic examination, and acoustic rhinometry data were assessed.

Results: There was significant symptomatic improvement in the VAS and NOSE scale at 1, 3, and 6 months postsurgery. Complete correction in the endoscopy was observed in the 91.0% of patients at 3 months postsurgery. The results of acoustic rhinometry increased from 0.3 and 4.3 preoperatively to 0.7 and 7.7 at 3 months postoperatively. Furthermore, no patient experienced septal hematoma, septic perforation, and loss of nasal tip support at 6 months follow-up.

Conclusions: The septal cartilage traction suture technique obtained significant improvement in subjective and objective outcomes in patients with caudal septal deviation. This technique is a simple, safe, and effective method to treat caudal septal deviation.

Key Words: Nasal septum, suture techniques, nasal obstruction, patient outcome assessment, postoperative complications.

Level of Evidence: 4

Laryngoscope, 130:E758–E763, 2020

INTRODUCTION

Patients with caudal septal deviation account for 5% to 8% of patients with nasal septal deviation.1,2 Caudal septal deviation may result in nasal obstruction, a crooked nose, columellar irregularities, and nostril asymmetry.3 Incomplete correction of the caudal septal deviation has been known as one of the main reasons for persistent septal deviation after primary septoplasty.4 It is difficult to correct caudal septal deviation using classical technique of septoplasty because small residual deviation can cause severe nasal obstruction, and weakening of the caudal septal support can may lead to subsequent deformity of external nose.

Many techniques, such as cross-hatching incision, horizontal mattress suture, septal batten graft, wedge resections, swing door, and cutting and suture, have been used in managing caudal septal deviation.2,5–8 Each technique was used alone or in combination and reported 82% to 96.5% postoperative symptomatic improvement.2,5–8 However, caudal septal deviation is difficult to correct because the intrinsic cartilage memory is hard to overcome. Furthermore, these techniques are also known to cause complications, including weakening of cartilages, overcorrection, and subsequent nasal deformity.6

We have developed a new operative technique called “septal cartilage traction suture,” which can be used successfully in patients with caudal septal deviation.

The purpose of this study was to evaluate the surgical outcomes of septal cartilage traction suture technique in the treatment of patients with severe caudal septal deviation.

MATERIALS AND METHODS

Subject

This prospective, nonrandomized study was approved by the institutional review board (IRB) of Pusan National University Hospital (1606-009-044) and was conducted from August 2017 to October 2018. Each patient signed an IRB-approved consent form to participate in the study before each operation.

A group of 67 consecutive patients who underwent septal cartilage traction suture technique with endonasal septoplasty were enrolled in this study. All patients had generalized C-shaped caudal septal deviation without dislocation of the caudal...
septum from the anterior nasal spine. Patients included in the study were 18 years or older and experienced unilateral nasal obstruction for longer than 3 months.

Exclusion criteria included a simultaneously performed endoscopic sinus surgery, other nasal surgery such as polypectomy, and the additional use of a different technique. Additional exclusion criteria were patients with septal perforations, bleeding disorders or anticoagulant therapy, pregnancy, and the presence of a severe medical or neuropsychiatric disorder.

**Surgical Procedure**

All procedures were performed under general anesthesia. The septal cartilage traction suture technique was combined with conventional endonasal septoplasty. Modified Killian incision was performed using the no. 15 blade at the concave site of the nasal cavity. After elevation of the mucoperichondrial flap, the deviated septal bone and cartilage were selectively removed, preserving 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, the vertical caudal cartilage excess was resected at the bottom, without disarticulation from the anterior nasal spine, to make a flexible relationship between caudal septum and nasal spine. After removal of surplus caudal cartilage, the caudal septum was sutured on the modified Killian incision site at two or more points using 5-0 Vicryl (Ethicon, Somerville, NJ). The needle penetrating through the ipsilateral mucosa of incision site was passed through the most convex part of the caudal cartilage and then sutured through the opposite mucosa of incision site to pull into the concave side of the nasal cavity (Fig. 1). The concept of this technique is illustrated in Figure 2. Should the needle not penetrate the septal mucosa fully but not the opposite septal mucosa. Straightening of the caudal cartilage can be verified immediately after the septal cartilage traction suture technique.

All patients underwent out-fracture and volume reduction of inferior turbinate on both sides using microdebrider. Silicone nasal splints were inserted into both nasal cavities and fixed by suturing to the nasal septum. After completion of the surgery, both nasal cavities were packed with polyvinyl acetate with carboxymethyl cellulose sheet (Rhinocel) (HUIZHOU FORYOU MEDICAL DEVICES CO., LTD., Dongjiang Huizhou, China). All patients were treated postoperatively with antibiotics (third-generation cephalosporin) for 10 days and analgesics as required. All nasal packs were removed in the morning following surgery.

![Surgical procedures of the septal cartilage traction suture technique.](image-url)
and all patients were discharged 2 days after surgery without acute complications. These splints were removed 7 days later in the outpatient clinic.

**Outcome Assessment**

Each patient was evaluated preoperatively and at 1-, 3-, and 6-month follow-up visits. Visual analog scale (VAS) and Nasal Obstruction Symptom Evaluation (NOSE) scale were used to assess subjective symptom improvement. VAS was recorded in the range of 0 through 10, with 0 being no obstruction and 10 being complete obstruction. The NOSE scale was recorded in the range of 0 to 100, and higher NOSE scores indicated worse nasal obstruction.

Objective outcomes were evaluated by endoscopic examination and acoustic rhinometry. In the endoscopic examination, the degree of correction of the caudal septal deviation was evaluated by measuring the longest vertical length of the caudal septal deviation from the midline of the maxillary crest. Endoscopic evaluation was classified as complete or incomplete. Complete correction was

<p>| TABLE I. Pre- and Postoperative VAS and NOSE Scale. |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Preop</th>
<th>1 Mo</th>
<th>3 Mo</th>
<th>6 Mo</th>
<th>Pre-1 Mo</th>
<th>Pre-3 Mo</th>
<th>Pre-6 Mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS</td>
<td>7.3 ± 1.6</td>
<td>1.8 ± 1.4</td>
<td>1.3 ± 1.0</td>
<td>1.4 ± 1.0</td>
<td>-5.6 ± 1.9*</td>
<td>-6.1 ± 1.9*</td>
<td>-6.0 ± 1.7*</td>
</tr>
<tr>
<td>NOSE</td>
<td>52.9 ± 26.5</td>
<td>8.6 ± 13.0</td>
<td>5.2 ± 6.9</td>
<td>5.8 ± 7.2</td>
<td>-46.4 ± 22.6*</td>
<td>-50.0 ± 22.9*</td>
<td>-49.6 ± 23.0*</td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD.

*P < .001.

Mo = month, NOSE = Nasal Obstruction Symptom Evaluation; SD = standard deviation; VAS = visual analog scale.

<p>| TABLE II. Pre- and Postoperative Acoustic Rhinometry. |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Preop</th>
<th>1 Mo</th>
<th>3 Mo</th>
<th>Pre-1 Mo</th>
<th>Pre-3 Mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCA (cm²)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convex</td>
<td>0.3 ± 0.2</td>
<td>0.8 ± 0.4</td>
<td>0.7 ± 0.3</td>
<td>0.5 ± 0.3*</td>
<td>0.4 ± 0.3*</td>
</tr>
<tr>
<td>Concave</td>
<td>0.8 ± 0.4</td>
<td>1.2 ± 1.7</td>
<td>0.7 ± 0.2</td>
<td>0.4 ± 1.3</td>
<td>-0.1 ± 0.3</td>
</tr>
<tr>
<td>NCV (cm³)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convex</td>
<td>4.3 ± 1.9</td>
<td>8.8 ± 2.1</td>
<td>7.7 ± 2.2</td>
<td>4.4 ± 2.5*</td>
<td>3.3 ± 2.8**</td>
</tr>
<tr>
<td>Concave</td>
<td>6.0 ± 1.8</td>
<td>9.3 ± 2.5</td>
<td>8.5 ± 2.0</td>
<td>3.3 ± 2.3*</td>
<td>2.5 ± 1.5*</td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD.

*P < .001.

**P = .001.

MCA = minimal cross sectional area; Mo = month; NCV = nasal cavity volume.

and all patients were discharged 2 days after surgery without acute complications. These splints were removed 7 days later in the outpatient clinic.

**Outcome Assessment**

Each patient was evaluated preoperatively and at 1-, 3-, and 6-month follow-up visits. Visual analog scale (VAS) and Nasal Obstruction Symptom Evaluation (NOSE) scale were used to assess subjective symptom improvement. VAS was recorded in the range of 0 through 10, with 0 being no obstruction and 10 being complete obstruction. The NOSE scale was recorded in the range of 0 to 100, and higher NOSE scores indicated worse nasal obstruction.

Objective outcomes were evaluated by endoscopic examination and acoustic rhinometry. In the endoscopic examination, the degree of correction of the caudal septal deviation was evaluated by measuring the longest vertical length of the caudal septal deviation from the midline of the maxillary crest. Endoscopic evaluation was classified as complete or incomplete. Complete correction was
defined as the reduction of the longest vertical length by more than 50%. Acoustic rhinometry was used to measure the minimal cross-sectional area (MCA) and the nasal volume of both nasal cavities.

**Statistical Analysis**
Data were presented as means ± standard deviation. Mean differences in the subjective symptoms and acoustic rhinometry pre- and postsurgery were analyzed by a paired t test. The degree of correction in the endoscopic examination was assessed by the McNemar's chi-squared test. All statistical analyses were performed using R version 3.5.1 (R Foundation for Statistical Computing, Vienna, Austria) and RStudio version 1.1.456 (RStudio, Inc., Boston, MA). A P value <.05 was considered to indicate statistical significance.

**RESULTS**
A total of 67 patients were enrolled in the study, including 53 males and 14 females from 18 to 68 years of age, with

![Fig. 3. Preoperative and postoperative endoscopic findings. Preoperative A, B, endoscopy shows that the septum is severely deviated to the left side. Postoperative endoscopic views show a straightened caudal septum at 1 month C, D, and 3 months E, F.](image-url)
mean age of 26.0 years. The right-side nasal obstruction was 39 (58.2%), and the left side was 28 (41.8%).

The mean preoperative VAS scores were 7.3 ± 1.6. After surgery, VAS scores decreased to 1.8 ± 1.4, 1.3 ± 1.0, and 1.4 ± 1.0 at 1, 3, and 6 months postsurgery, respectively (all P < .001). Compared to a mean preoperative NOSE scale score of 52.9 ± 26.5, postoperative NOSE scale scores were significantly decreased to 8.6 ± 13.0, 5.2 ± 6.9, and 5.8 ± 7.2 at 1, 3, and 6 months, respectively (all P < .001) (Table I).

The mean MCA of the convex side changed from 0.3 ± 0.2 cm² to 0.8 ± 0.4 cm² at 1 month postsurgery and 0.7 ± 0.3 cm² at 3 months postsurgery with statistical significance, respectively (P < .001 and P < .001, respectively). However, the mean MCA of the concave side was not statistical different between the preoperative and postoperative scores (Table II).

The mean postoperative nasal volume of the convex and concave side were significantly increased to 8.8 ± 2.1 cm³ and 9.3 ± 2.5 cm³ at 1 month postsurgery (all P < .001) and to 7.7 ± 2.2 cm³ and 8.5 ± 2.0 cm³ at 3 months postsurgery (P = .001 and P < .001, respectively) from 4.3 ± 1.9 cm³ and 6.0 ± 1.8 cm³ (Table II).

Of the 67 patients, 59 patients (88.1%) at 1 month postsurgery and 61 patients (91.0%) at 3 month postsurgery were considered to have a complete correction in the nasal endoscopy after septal cartilage traction suture technique (Table III) (Fig. 3). However, there was no statistically significant difference in the subjective and objective outcomes between the 1 and 3 months postsurgery. None of the patients showed postoperative complications, such as septal hematoma, infection, septal perforation, and loss of nasal tip support, during 6 months follow-up.

**DISCUSSION**

Caudal septal deviation is a major cause of nasal obstruction and causes an aesthetic distortion of the nasal base. Deviated caudal septum may change the lobular–and columellar relationship and has a significant effect on tip position and symmetry. The complete correction of caudal septal deviation can be a challenging problem because it is difficult to overcome intrinsic cartilage-bending memory. Furthermore, weakening of the caudal septum and separation from the anterior nasal spine commonly result in saddle nose deformity or tip ptosis. Although various techniques have been reported to correct caudal septal deviation, this defect is one of the most difficult to surgically correct with high septal deviation.

The cross-hatching incision involves multiple incisions on the concave side of the septal cartilage, preserving intact contralateral cartilage alignment. However, it is difficult to predict the effect of this technique because the eventual straightening of the septum is completed by a secondary healing process. The horizontal mattress suture technique corrects the curvature of the cartilaginous septum with a vertical force generated by the suture. If the cartilage is too thin or too weak, it is better to apply a reinforcement implant such as a batten graft. However, these techniques may weaken the caudal septal support, with subsequent nasal deformity, and may be associated with a high failure rate.

Batten graft and wedge techniques correct the septal deviation by cartilage reinforcement. Caudal septal batten grafting using septal cartilage or bone has been reported to straighten and strengthen the deviated caudal septum. However, use of the cartilage or bone on the caudal septum can make the caudal septum and nose too thick and stiff, which can be anatomically unnatural. Although the created wedge made of septal cartilage or bone act as a lever and modify the curvature without jeopardizing the keystone area, it cannot be applied to caudal septal deviation and angulations of the cartilage.

The swing door method and the cutting and suture technique call for caudal septal repositioning. The swing door technique consists of a wedge resection of the vertical cartilage excess along the maxillary crest, with the release of the caudal septal attachments to swing the septum to the midline. The midline position may be secured with an absorbable suture attached to the periosteum adjacent to the opposite side of the nasal spine. However, the septum can slip from the midline of the maxillary crest when the suture loosens or when the soft tissue stretches out, which can lead to undercorrection of the caudal septum.

The cutting and suture technique involves cutting the convex-most part of the caudal septum and then reconnecting it with slight overlapping of the cut ends of the caudal L-strut. However, preserving about 2 mm of the caudal end is what distinguishes the cutting and suture technique from the partial cutting and suture technique. Although these techniques completely breaks the cartilage memory for bending, too much overlap or loosening of the suture may shorten the caudal septal height. Additional techniques such as batten graft are needed to strengthen the support. Furthermore, the cutting and suture technique may cause tip-lowering or saddle nose deformity because the caudal L-strut was cut and overlapped.

The main abnormality of the caudal deviation after removal of deviated septal bone and cartilage is not only the excessive length of the septal cartilage but also the bending elastic memory of the cartilage itself. Our surgical technique preserves the naturally strong strong junction between the caudal septum and anterior nasal spine and involves resecting the vertical caudal cartilage excess and then tightly suturing the caudal L-strut on the incision site for eliminating the cartilage bending memory. We named this procedure the **septal cartilage traction suture technique** of the caudal L-strut. Our novel technique was significantly improved subjective symptoms measured by VAS and NOSE scale score. Furthermore, objective measurement of improvement in nasal obstruction was done with acoustic rhinometry and nasal endoscopy. MCA and nasal volume in the convex side were significantly increased after surgery. Endoscopic examinations of the nasal cavity showed that this technique resulted in complete correction in 91.0% of patients at 3 months postsurgery. However, the nasal volume in the concave side was also increased, which is thought to be due to volume reduction of the inferior turbinate. There were no residual nasal obstruction and postoperative complications, including infection related to the use of a braided suture, in all patients at 6 months follow-up. Other benefits of
this technique is that it is anatomically sounder because it preserves the L-strut, avoiding the separation of the caudal septum from the anterior nasal spine; can be performed easily; and can be verified immediately after this septal cartilage traction suture technique. However, the traction suture must be done at the most curved portion of caudal septum in the caudocephaleric direction and must hold the caudal septum tightly to the incision site mucosa to effectively overcome the bending force of the cartilage. Furthermore, tightly suturing the caudal septum on the incision mucosa incites fibrosis and creates scar tissue, resulting in more pulling of the caudal septum into the concave side of the nasal cavity. Although the traction suture is not fixed at a more stable and rigid structure, such as the soft tissue around the anterior nasal spine, traction suturing of caudal septum on the incision site mucosa may result in sufficient traction.

Limitation of our study is that patients were not classified according to the degree of deviation, despite the extension of caudal septal deviation, which could have influenced on the results. It is obvious that additional rhinomanometry for nasal airway resistance would be valuable for interpreting the results. Further study may be needed to evaluate the long-term results of this technique.

CONCLUSION

An ideal caudal septoplasty should be minimally invasive and improve nasal obstruction. The septal cartilage traction suture technique is relatively easy and is very effective in correcting caudal septal deviation without severe postoperative complications.

REFERENCES