

Combined use of scoring incisions and 2-octylcyanoacrylate adhesive during endonasal septoplasty to correct cartilaginous deviations

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ABSTRACT

Background: Applying 2-octylcyanoacrylate (2-OCA) tissue adhesive onto scoring incisions may increase efficacy and prevent concavity recurrence after septal deviation treatment. The present study evaluates the utility of 2-OCA adhesive application during endonasal septoplasty.

Methods: The postoperative outcomes were compared between two consecutive periods in a single surgical department. Between March 2011 and March 2012, 23 consecutive patients underwent septoplasty using scoring incisions without 2-OCA application (scoring alone group), and between April 2012 and April 2013, the scoring incision gaps were filled with 2-OCA in 27 patients (scoring + CA group). The patients were followed up for more than six months.

Results: A straight septum was achieved in 37.0% of patients in the scoring alone group versus 58.3% in the scoring + CA group. The postoperative symptom score for nasal obstruction was significantly improved in both groups. Persistent septal swelling developed in three (12.5%) patients in the scoring + CA group. Neither group experienced major complications such as septal hematoma, abscess, or septal perforation.

Conclusions: Application of 2-OCA adhesive onto scoring incisions appears to be a reliable and effective technique to correct deviated cartilage during endonasal septoplasty. However, the volume of 2-OCA applied onto the septum should be minimized to avoid potential foreign body reaction. A long-term follow-up study is warranted.

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Nasal septal deviation is a common nasal disorder and is one of the most common causes of nasal obstruction. Several surgical techniques have been introduced to correct septal deviations, including submucosal resection,^{1,2} wedge resection,³ suture techniques,^{4,5} morselization,⁶ swinging door technique,⁷ septal batten grafting,^{8,9} and cartilaginous septum scoring using cross-hatching incision,^{10–12} but none of these techniques has emerged as superior. Although surgical methods yield good immediate postoperative results, they show limited success in achieving consistent outcomes. Several long-term complications may result, including recurrence, saddle deformities due to L-strut weakness, and caudal septum displacement.^{3,4,9,11}

Scoring incision is a well-known method that gives shape to the septal cartilage.^{12,13} A partial-thickness incision is made on the concave cartilage surface, which affects the interlocked cartilaginous stresses and bends the tissue contralaterally.¹³ However, the long-term outcomes can vary.¹² The cartilage frequently reverts to its original deviation once healing occurs (Fig. 1A). If the tissue is incised too deeply or the cartilage is too thin, the septal cartilage may weaken, potentially decreasing septal cartilage support or leading to overcorrection (Fig. 1B).^{14,15}

Recently, Ozyazgan and Idaci¹⁴ introduced the application of cyanoacrylate (CA)-based tissue adhesive to increase the efficacy of scoring incisions and prevent concavity recurrence after open rhinoplasty. They demonstrated that filling the scoring incision gaps with CA adhesive is an effective, safe, fast, and easy method to treat septal cartilage deviation (Fig. 1C). Ozyazgan's method may be effective during open rhinoplasty, but its effectiveness for endonasal septoplasty is questionable. The extrinsic force on septal cartilage can be

simply and effectively relieved using open rhinoplasty or extracorporeal septoplasty. However, eliminating this force during endonasal septoplasty may be difficult, because the contralateral mucoperichondrium is still attached to the septal cartilage. Furthermore, the open approach is preferably avoided in patients with a septal deviation without an external nose deformity due to potential incisional morbidity and the increased surgical duration.⁹

Potentially, a combination of scoring incisions and CA tissue adhesives may also be an effective and safe method to treat septal cartilage deviation in endonasal septoplasty. In the present study, the utility of 2-octylcyanoacrylate (2-OCA) application in increasing the efficacy of scoring incisions and preventing concavity recurrence in endonasal septoplasty is evaluated.

MATERIALS AND METHODS

Study Design

The medical records of 79 consecutive patients who underwent septoplasty using a septal cartilage scoring incision between March 2011 and April 2013 at the Konkuk University Chungju Hospital were reviewed. Between March 2011 and March 2012, 43 consecutive patients underwent septoplasty using a scoring incision without 2-OCA application (scoring alone group). Between April 2012 and April 2013, the scoring incision gaps in 36 consecutive patients were filled with 2-OCA (scoring + CA group).

Septal cartilage deviation was identified on nasal endoscopy. All patients were at least 16 years old and suffered from nasal obstruction lasting more than three months. Patients were excluded using the next criteria: bony septal deviation alone, septal fracture, revision septoplasty, open septoplasty, chronic sinusitis or polyps, and a less than six-month follow-up period. A total 51 patients who underwent septoplasty using a septal cartilage scoring incision and were followed up for more than six months were enrolled. This study was approved by the Konkuk University Chungju Hospital Institutional Review Board.

Surgical Techniques

Endonasal septoplasty was performed under general anesthesia. Local anesthesia was administered submucosally, and a hemitrans-

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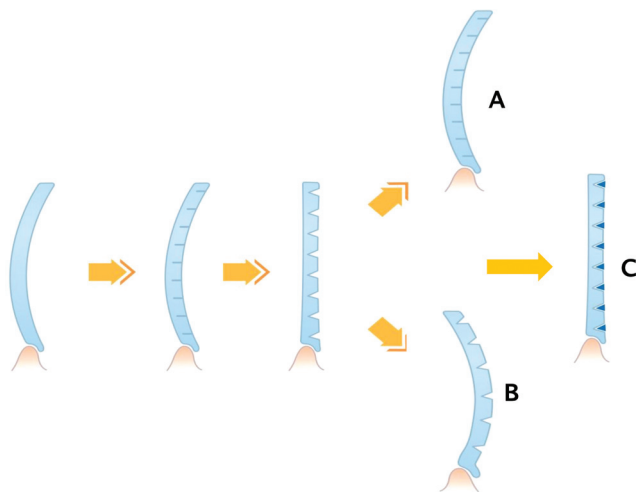


Figure 1. Schematic illustrating CA adhesive applied to scoring incisions to straighten the deviated septal cartilage. The scoring incision may cause the deviated septum to bend at midline, and the cartilage frequently reverts to its deviated position (A) or overcorrects (B) over time. Filling the scoring incision gaps with CA tissue adhesive may prevent concavity recurrence (C).

fixion incision was performed on the nasal septum concave side. The cartilaginous and bony septum was exposed using subperichondral and subperiosteal dissections. The deviated septal cartilage was separated from the ethmoid and vomer perpendicular plate through a boomerang-shaped cartilage excision. The deviated bony septum and crest was excised or fractured and displaced contralaterally.

When the remaining cartilaginous septum was not considered completely corrected using the aforementioned technique, a scoring incision was then performed. Scoring incisions were made with a sickle knife on the septal cartilage concave surface at 2- to 4-mm intervals to approximately half of the cartilage thickness. The 2-OCA (Dermabond, Ethicon, Inc., Somerville, NJ) was applied to the scoring incision gaps while holding the cartilage in a slightly overcorrected position. The procedure was complete once the deviated septum was confirmed as straightened (Fig. 2), and the hemitransfixion incision was closed using 5-0 chromic gut suture. Patients with compensatory inferior turbinate hypertrophy additionally underwent turbinate surgery, such as submucosal turbinoplasty or radio frequency volume reduction.

Silastic stents were then sutured on both sides to the mucosa, and nasal packing was placed. The nasal packs were removed one to two days postoperatively, and the silastic stents were removed after five to seven days.

Surgical Outcome Assessment

The efficacy of 2-OCA tissue adhesive on the corrected cartilage stability was evaluated using postoperative nasal endoscopy and compared between the two groups. A clinician uninvolved with the surgery evaluated the postoperative septum based on anterior rhinoscopic photography at the final follow-up visit. The deviation severity was categorized as mild, moderate, or severe based on the distance between the most deviated portion relative to midline or the ipsilateral nasal wall.⁸ The postoperative outcomes were classified into four categories: straight, improved with residual deviation, no change or worsened deviation, and overcorrection. Postoperative complications, such as hemorrhage, septal hematoma, synechia, and infection, were also evaluated. Changes in the visual analog scale (VAS) scores, ranging from 0 (no problem) to 10 (severe), of the nasal obstruction were compared between pre- and three months postoperatively.

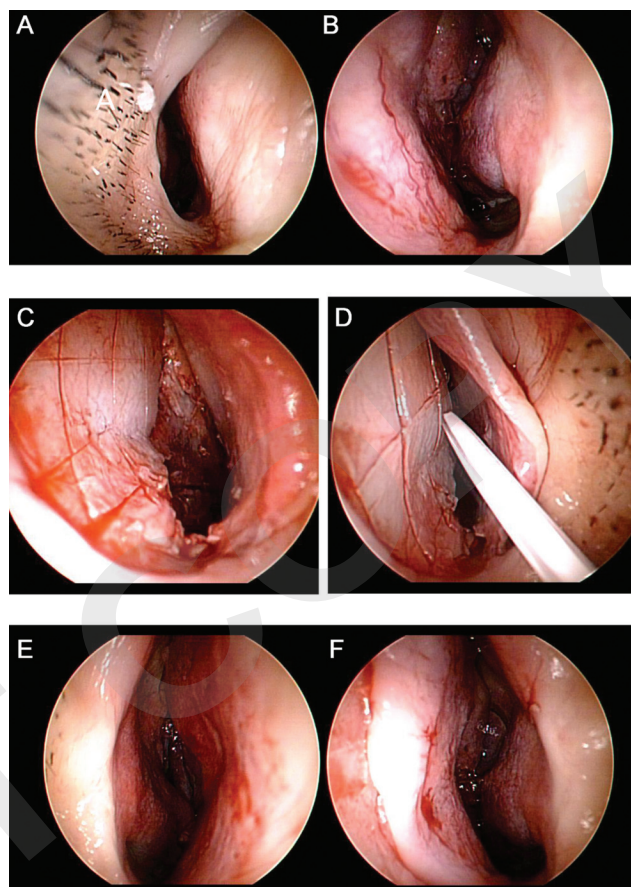


Figure 2. The combined scoring incision and 2-OCA adhesive technique viewed endoscopically. Preoperative septal endoscopy (A and B). The septum is approached from the concave side after performing a hemitransfixion incision. Horizontal and vertical cartilaginous strips were removed, and half-thickness scoring incisions were made along the concave cartilage surface using a sickle knife at 2- to 4-mm intervals (C). The 2-OCA was applied to the scoring incision gaps while holding the septum in a slightly overcorrected position (D). Immediate postoperative endoscopy shows a straightened cartilaginous septum (E and F).

In the scoring + CA group, the minimal cross-sectional area (MCA) and the nasal volume were measured pre- and two to three months postoperatively using acoustic rhinometry. The saccharin transit time (STT) was also measured in the scoring + CA group pre- and four to six weeks postoperatively to evaluate the effect of 2-OCA on nasal mucociliary clearance. During STT, a commercially available saccharine tablet measuring 1.0 mm was positioned approximately 1 cm behind the inferior turbinate anterior border. The time elapsed until the patient experiences a sweet taste at the posterior nasopharynx was recorded in minutes.¹⁶ The mean pre- and postoperative STTs were compared.

Statistical Analysis

Analyses were performed using the Statistical Package for the Social Sciences version 15.0 for Windows (SPSS, Inc., Chicago, IL). The two groups were compared using the Fisher's exact test and Student's *t*-test. The mean MCA scores, nasal volume, and subjective symptoms were compared using the Wilcoxon signed-rank test. A *p*-value of less than 0.05 indicated a significant difference.

RESULTS

A total 30 male and 21 female patients with a mean age of 27.1 years (range, 16–58 years) were included. The scoring alone group (*n* = 27)

Table 1. Clinical characteristics compared between the scoring alone and the scoring + CA groups

Parameters	Scoring alone (n = 27)	Scoring + CA (n = 24)	p-value
Age (year), mean $\pm$ SD	26.3 $\pm$ 7.3	28.0 $\pm$ 8.1	NS
Sex (M:F)	16:11	14:10	NS
Allergic rhinitis, n (%)	8 (29.6)	6 (25.0)	NS
Degree of deviation, n (%)			NS
Mild	4 (14.8)	2 (8.3)	
Moderate	15 (55.6)	12 (50.0)	
Severe	8 (29.6)	10 (41.7)	
Postoperative septal status, n (%)			0.032
Straight	10 (37.0)	14 (58.3)	
Residual deviation	13 (48.1)	10 (41.7)	
Unchanged	3 (11.1)	0 (0.0)	
Overcorrected	1 (3.7)	0 (0.0)	
Combined procedure, n (%)			NS
Submucosal turbinoplasty	7 (25.9)	5 (20.8)	
RFTVR	8 (29.6)	5 (20.8)	
Inferior turbinate lateralization	5 (18.5)	3 (12.5)	
VAS score, mean $\pm$ SD			
Preoperative	6.92 $\pm$ 2.0	7.25 $\pm$ 1.9	NS
Postoperative	3.95 $\pm$ 1.5	3.10 $\pm$ 1.4	0.043
Follow-up (month), mean $\pm$ SD	11.8 $\pm$ 3.5	9.1 $\pm$ 2.8	NS

RFTVR = radiofrequency turbinate volume reduction; NS = not significant; SD = standard deviation; CA = cyanoacrylate; M = male; F = female.

comprised 16 male and 11 female patients aged 26.3 ± 7.3 years and was followed-up a mean 11.8 months (range, 6–24 months). The scoring + CA group (n = 24) comprised 14 male and 10 female patients aged 28.0 ± 8.1 years and was followed-up a mean 9.1 months (range, 6–15 months). There was no significant difference in age and sex distributions between the two groups (Table 1).

In scoring alone group, 10 patients (37.0%) demonstrated a straight septum postoperatively, 13 patients (48.1%) showed mild residual septal deviation, three patients (11.1%) showed unchanged or worsened deviation, and one patient (3.7%) demonstrated overcorrection. In the scoring + CA group, the postoperative anterior rhinoscopy showed a straight septum in 14 patients (58.3%) and mild residual septal deviation in 10 patients (41.7%), although the septum was notably improved compared with the preoperative status. None of the patients had an unchanged or overcorrected septal deviation postoperatively (Table 1).

The mean VAS score of nasal obstruction improved postoperatively from 6.92 ± 2.0 to 3.95 ± 1.5 in the scoring alone group ($p < 0.001$), and from 7.25 ± 1.9 to 3.10 ± 1.4 in the scoring + CA group ($p < 0.001$). There was significant difference in postoperative VAS score between the two groups ($p < 0.05$) (Table 1).

Pre- and postoperative acoustic rhinometry was performed in 15 patients (62.5%) in the scoring + CA group. The MCA significantly improved from 0.29 to 0.38 cm² at the convex side of the nasal cavity ($p = 0.02$). The MCA at the concave side increased from 0.34 to 0.36 cm², but this was not statistically significant ($p > 0.05$) (Fig. 3). The nasal volume significantly increased ($p = 0.01$) in the convex side of the nasal cavity (5.18 versus 6.43 mL). The concave side nasal volume decreased postoperatively (6.81 versus 6.29 mL), but this difference was not statistically significant ($p > 0.05$) (Fig. 3).

STT was performed in 13 patients (54.2%) in the scoring + CA group. The mean STT pre- and postoperatively were 9.1 ± 2.2 and

9.3 ± 1.4 minutes, respectively, and there was no significant difference noted ($p > 0.05$).

Postoperative septal swelling lasting greater than one month occurred in three patients (12.5%) in the scoring + CA group, but it eventually subsided. No complications, such as septal hematoma, septal perforation, or saddle nose, were observed postoperatively in either group. None of the patients in either group requested a revision septoplasty.

DISCUSSION

The present study evaluated the use of 2-OCA tissue adhesive to increase the efficacy of scoring incisions in preventing concavity recurrences after endonasal septoplasty. In this novel surgical technique, filling the scoring incision gaps with 2-OCA tissue adhesive modifies the curvature and maintains the septal framework along midline. The 2-OCA tissue adhesive acts as a wedge to achieve structural stability and immediate correction of the septal cartilage.

Endonasal septoplasty combined with 2-OCA filled scoring incisions offers several advantages. The technique is quite simple to perform. In the present study, the 2-OCA adhesive was applied into the wedge-shaped space generated by the scoring incision; no specific securing procedure was required. In addition, the technique is indicated in both anterior-posterior curvature as well as cephalo-caudal curvature of the septal cartilage. In most patients, the septum is curved in both directions. As stated by Ozyazgan and Idaci,¹⁴ filling the wedge-shaped scoring incision with 2-OCA creates both perpendicular and parallel opening forces to the incision. Therefore, both anterior-posterior and cephalo-caudal septal cartilage curvature can be addressed using this technique by changing the scoring incision direction and interval. Finally, 2-OCA maintains the correction even when the incision depth is unsatisfactory. The therapeutic effectiveness depends the scoring incision.¹² Excessively deep incisions can damage the cartilage integrity and weaken it, but insufficiently deep incisions will not yield the preferred correction.¹⁵ Hardened 2-OCA prevents incision closure and prevents the incised cartilage from returning to its previous shape. Furthermore, in a septum incised too deeply, filling the scoring incisions with 2-OCA maintains the cartilage integrity.¹⁴

CA tissue adhesive is easily applied, biocompatible, and biodegradable and has many uses in otolaryngology, including cartilage grafting in rhinoplasty,^{17–20} ossicular reconstruction,^{21,22} and laryngeal repair.²³ CA includes methylcyanoacrylate, ethylcyanoacrylate, isobutylcyanoacrylate, and butylcyanoacrylate. OCA was developed to address toxicity concerns and reduce skin irritation and allergic responses.²⁴ Numerous experimental and clinical studies have assessed the effects of CA on cartilage. In experimental studies, most report that CA has a minimal histotoxic effect on the cartilage, generates few foreign body reactions, and safely stabilizes the cartilage fragments.^{17,25–29} Many clinical studies have demonstrated that CA adhesive is effective and safe in various surgeries.^{14,17–19,30–32} However, a few studies reported negative effects on the cartilage. Toriumi *et al.*³³ reported that butyl-2CA increased inflammation and caused a foreign body giant cell response when CA was applied to the subdermal plane in rabbit ears. Among the clinical studies, Min and Jang³⁴ recently reported that CA tissue adhesive was associated with a relatively high complication rate (24.2%) when used in tip surgery, but it also simplified the surgical graft fixation.

Although the clinical use of 2-OCA has been expanding, few reports have investigate the efficacy of bioadhesives in septoplasty. Ozyazgan and Idaci¹⁴ first described the feasibility of CA-based tissue adhesive application to correct deviated septal cartilage and prevent recurrence. In their study, open rhinoplasty was performed. Filling the scoring incision gaps with CA tissue adhesive was an effective, safe, fast, and easy method to treat septal cartilage deviation, and no

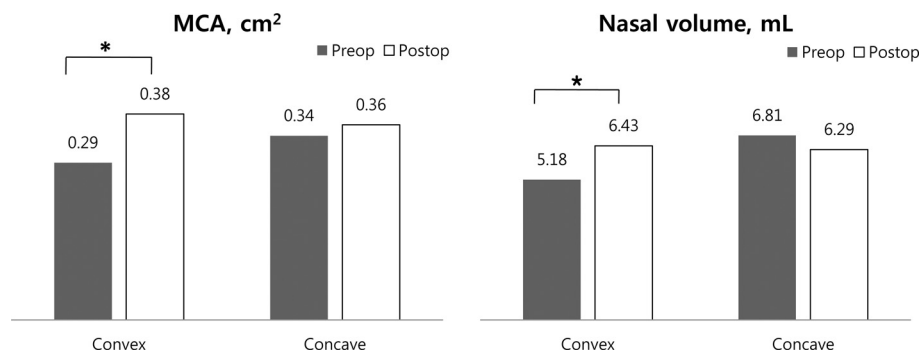


Figure 3. MCA and nasal volume (NV) pre- and postoperatively determined by acoustic rhinometry in 15 cases in the scoring + CA group. The MCA and NV are significantly increased on the convex side. *, $p < 0.05$.

complications such as infection or foreign body reactions were observed in the 23 patients. In the present study, this technique was similarly effective in correcting the deviated cartilage using endonasal septoplasty. However, the complication rate in the present study was higher than that reported by Ozyazgan and Idacı,¹⁴ a study using open rhinoplasty (12.5% versus 0.0%). Potentially, the chosen surgical approach and CA adhesive volume may be risk factors for complications. Although 2-OCA is a longer chain bioadhesive that more gradually releases toxic byproducts into surrounding tissues, the potential for a local inflammatory response exists.³⁴ Contact between the 2-OCA and surrounding soft tissues may be increased in the endonasal approach compared with the open or extracorporeal approach used in Ozyazgan's method. In addition, most of the observed complications occurred when a relatively high 2-OCA volume was applied. Therefore, 2-OCA adhesive should be applied only to the scoring incision gaps using the minimum volume, and surgeons should ensure that 2-OCA adhesive does not contact the surrounding tissue.

The current study is limited by its relatively small sample size, nonrandomized design, and relatively short follow-up period. Ideally, a randomized study using a larger sample size and longer follow-up would more accurately determine the 2-OCA efficacy and safety in septoplasty. In addition, to analyze the association between the 2-OCA volume and the complication rate, an experimental study is warranted characterizing the histomorphologic changes within the septal cartilage in patients undergoing septoplasty with 2-OCA.

CONCLUSIONS

Application of 2-OCA adhesive to scoring incisions appears to be an effective technique to correct deviated cartilage during endonasal septoplasty. However, the applied 2-OCA volume must be carefully minimized to prevent foreign body reaction. A long-term follow-up study is warranted to determine the recurrence and complication rates.

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