Minimally invasive endoscopic septoplasty

Pierre-François Dolhen, Samuel Lipski, Antoine Noel

ABSTRACT

This paper analyzes a retrospective study of 131 consecutive cases of septoplasties performed using our endoscopic procedure. Clarification and new definitions of endoscopic septoplasty approaches are emphasized: Trans-Nasal Endoscopic Septoplasty (TNES) with an endoscope into the nasal fossa and Trans-Septal Endoscopic septoplasty (TSES) with an endoscope into the septal pocket. The patient's cohort is selected for treatment of persistent nasal obstruction and septal deviation needing surgery. The procedure is carried out on a well-defined homogenous population. Additional actions on inferior turbinate, rhinopharynx, or external procedures for columellar deformities are performed to obtain a free symmetric nasal pathway. Most of our surgeries (98%) is carried out endoscopically alone and only 2% of cases necessitated “hybrid” non-endoscopic adjuvant surgery to treat septo-columellar and other major caudal septal deformities as valve surgery. In the studied population, we observed 89% of significant posterior deformities, not only septal. Subjective evaluation of the nasal obstruction is achieved by using a simplified NOSE Scaling (sNOSE) giving an 87.8% satisfaction rate. Results showed a low level of complications such as perforation, hematoma or synechia, confirming the minimally invasive denomination of this procedure (MIES) with minimal operation time, in particular with TNES. Endoscopic Septoplasty (ES) had major advantages in Classical Headlight Septoplasty (HLS), such as enhancing the visualization of posterior nasal region and better final visual evaluation of the global nasal permeability. We recommend Minimal Invasive Endoscopic Septoplasty (MIES) to improve results, minimize complications, and to improve the pedagogic impact of the procedure. Video material illustrates the endoscopic procedures; moreover, ongoing developments in ultra-high, 4K, 4KHDR definition further emphasizes these advantages.

Keywords: Minimally invasive endoscopic septoplasty, Nasal obstruction, Septal deviation, Septoplasty, Trans-Nasal endoscopic septoplasty, Trans-Septal endoscopic septoplasty

INTRODUCTION

Septoplasty is one of the most common procedures used to correct nasal deflection when patients present persistent nasal airway obstruction [1]. Septoplasty is carried out alone or in some cases together with other procedures on external deformities or action on turbinate to free the nasal fossa [2]. Since the beginning of septoplasty, the goal was to insure the correction of deflection of the nasal septum with minimal traumatism and no residual deformities. Nevertheless, subjective
results on obstruction remained uncertain and the frequency of complication is quite high. Satisfaction rates based on various evaluation scales gave from 42 to 85% [3–4]. The complication rate varies from 4 to 36% [5–7].

Today, septoplasty is still commonly carried out using headlights or a cold light speculum. Minimal vision, poor illumination on the posterior part of the septum (vomer) and nasal fossa lack of magnification and weak identification of concomitant nasal abnormalities (turbinates or rhinopharyngeal pathologies) often dimish the efficiency of these techniques [8–9]. The use of a speculum introduces or mask deformities in spreading anatomical structures. Another negative point lies in the difficulty of sharing the operation field between senior surgeon and assistant.

Early, rhino-endoscopists discovered the advantage of using the same endoscope to perform septoplasty prior to the functional endoscopic sinus surgery (FESS), dacryocystorhinostomy or skull base surgery. So far, despite its numerous advantages, ES failed to replace classical headlights speculum, in contrast with other fields of rhinology, such as FESS or endoscopic skull base surgery [10–14], where it now clearly dominates. Nevertheless, several advantages of endoscopic septoplasty were recognized for revision septoplastics, for example [15].

At this point, it is difficult to compare different endoscopic septoplasty technical approaches because of the lack of clear definition of ES in the literature. Therefore, this paper categorises the different technical procedures and clarifies their specific applications in ES surgery. To do so, we suggest differentiating the Trans-Nasal Endoscopic Septoplasty (TNES) with an endoscope into the nasal fossa and the Trans-Septal Endoscopic Septoplasty (TSES) with an endoscope into the septal pocket (Video 1 and 2).

Videos

**Video 1:** Trans-Nasal Endoscopic Septoplasty (TNES) with an endoscope into the nasal fossa.

**Video 2:** Trans-Septal Endoscopic Septoplasty (TSES) with an endoscope into the septal pocket.

**Video 3:** Trans septal under water complex spur and crest cartilage palissade.

**Video URL at:** http://www.videojournalofclinicalresearch.com/archive/2018-2018100002VAMo8PD-dolhen/100002VAMo8PD-full-text.php

This study clarifies the concept of Endoscopic Septoplasty (ES) and evaluates if the newly developed technique can be categorized as minimally invasive. We used a well-defined homogenous group of patient presenting nasal obstruction. A optimal way to evaluate their obstruction is obtained by using simplified scaling methods. This articles assesses the advantages and possible consequences of the technique, compared to the more conventional approaches (HLS).

Subjective evaluation of patient nasal obstruction is done by a 5 step simplified Scaling Score derived from NOSE score (sNOSE).

**MATERIALS AND METHODS**

**Eligibility criteria**

Retrospective analysis of 460 consecutive cases of endoscopic septoplasties between October 2013 and October 2015 is carried out. All the patients selected for this endoscopic septoplasty study complained of persistent intractable nasal obstruction and presented a significant degree of septal deviation, confirmed by endoscopic evaluation and or CT scan. In this the study, all procedures are performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent is obtained from all individual participants included in the study.

Patients with access septoplasty before FESS, dacryocystorhinostomy or septorhinoplasty are excluded (n= 253) to avoid inserting bias confusion in evaluating this poly symptomatic population (epiphora, esthetic consideration, and smelling problems). Also, sixty-seven patients, which as principal complaints snoring and one patient with concomitant indication of amygdalectomy are also excluded. Initially, surgery was only performed on patients with severe or strong obstruction however the study also includes seven cases of mild obstruction, at the demand of the patient. In the course of the study, we lost contact with eight patients.

The group of patients includes septal deviation in combination with other various etiologies like vasomotor rhinitis, vasconstrictor addicts, trauma, allergic rhinitis with no result under nasal steroids and antihistamines, complex congenital septoturbinal deformities and persistent or residual rhinopharyngeal adenoids. We have also included patients, who needed complementary procedures to the endoscopic septoplasty to gain optimal result in nasal obstruction. The complementary procedures are a columellar plasty, resection of concha bullosa, adenoids reduction or reductional turbinoplasties. In summary, 131 patients fulfilled our eligibility criteria.

**Endoscopic septoplasty operative technique**

**Devices/instrument:** A 4 mm endoscope 0° Olympus® HD mounted with a Visera camera connected to a 22-inch full HD screen (1920 x 1080 pixel resolution) and a 19-inch HD screen for the assistant was used. Endoscrub (Medtronic®) is used to clean the lens or to produce
continuous irrigation. The main surgical instrument was the Freer Storz® suction elevator allowing smooth undermining and soft suction to avoid collapse and trauma to the mucosa (Figure 1).

**Surgical technique:** Two distinct endoscopic approaches are utilized: Trans-Nasal Endoscopic Septoplasty (TNES) with an endoscope into the nasal fossa and the Trans-Septal Endoscopic Septoplasty (TSES) with the endoscope into the septal pocket.

### a) The trans-nasal endoscopic septoplasty (TNES)

In Trans-Nasal approach, the endoscope stays in the nasal fossa, anterior unilateral spur or posterior crest is directly reached on the convex side, or if bilateral on both sides. It is the optimal procedure to isolate the deformed area: an anterior spur can just be transected (mucosa and cartilage). If a bony protrusion occurs, the powered burr is used, or simply an osteotome to remove the premaxilla.

In case of an isolated vomerian posterior crest, a mini super-inferior tunnel is realized 3 mm anterior to the deformity and the osteoteocartilaginous crest is pulled out on the same side.

### b) The trans-septal endoscopic septoplasty (TSES)

The Trans-Septal approach is used for more extended deformities, like the classical anterior-posterior spur-crest complex and for more severe deformities. The mucosa and the perichondrium are transected just before the convex side and superior (subperichondrally) and inferior (subperiosteally) tunnelisation is carried out on both sides exactly like a Cottel technique; the endoscope being placed into the new-created nasal pocket. The cartilage and the bony deformed portion of the septum are removed by chondrotomy or osteotomy or are reshaped to achieve correction in respecting the septal framework. The palisade technique is used for antero-superior cartilage deformation of the quadrangular cartilage (vertical strips of the cartilage, luxation or limited resection are realized if necessary). If extended portion of the septum have to be resected because of global deformities, the crushed or modeled cartilage is reinserted to reconstruct the septum.

In case of sharp deformities, especially on the top of the spur and crest complex, it is almost impossible to preserve the mucosal layer. In such cases, horizontal section of the mucosa, parallel to the floor of the nasal fossa is preferred rather than risking resections and loss of mucosa. The inferior and superior flap must then be re-approximated at the end of the surgery. In some cases, we experimented our newly developed technique called Trans-Septal Underwater endoscopic septoplasty (TSUES) with a continuous irrigation into the septal pocket. Water injection and pocket inflation without any suction, giving a kind of hydrotomy and providing easy access to hidden area posterior to sharp deflection into the septum.

When another cause of obstruction is identified, adequate endoscopic action is combined with the endoscopic septoplasty to suppress the concomitant cause of obstruction: adenoid shaving, concha bullosa excision reduction turbinooplasty, Torwald cyst marsupialization or valve plasties is used in this series. The procedure stops when endoscopic visual permeability and the symmetry on both sides is optimal. Without action on inferior turbinate, there is no need for packing or splinting the nasal fossa, contributing to dimishing the discomfort of the procedure. Turbinoplasty or radio frequency of the inferior turbinate implies nasal packing on the first day and splinting with silicone for 8 days respectively. No septal incision suture is needed.

**Study outcomes**

Type of major deformation and associate anatomical abnormalities are counted. We considered vomerian crest, adenoid hypertrophy, Torwald cysts or concha bullosa as posterior deformities. We checked the total number of posterior deformities encountered. The endoscopic follow-up was done for one week and one month after the surgery. Subjective results were obtained pre-operatively directly from the patient and 10 to 30 months after the surgery by phone. For the evaluation of nasal obstruction, we used a 0 to 4 grade scale, with zero meaning no obstruction and 4 complete obstruction. A score of 0 or 1 post-operatively is considered as a good result.

**Statistical analysis**

We used a Wilcoxon t test for qualitative ordinal data. It is performed to compare the preoperative and postoperative sNOSE scale. Quantitative data are analyzed on Chi-square test or Student t test. A p value <0.05 was considered statistically significant. Analysis
was performed using the XLSTAT software version 2016 (Addinsoft. 2016. XLSTAT 2016: Data Analysis and Statistical Solution for Microsoft Excel. Paris, France 2016).

RESULTS

A total of 131 consecutive patients received endoscopic treatment by the senior surgeon and two young resident surgeons. The majority of patients were male (64.1%), ages range from 10 to 71 years, with a mean of 31. Most patients achieved 3 and 4 scores (94.7% of cases) in sNOSE scale preoperatively except 7 (5.3%) who presented a score of 2 (Table 1).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number of cases</th>
<th>Percentage (%)</th>
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<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>84</td>
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<tr>
<td></td>
<td>Female</td>
<td>47</td>
</tr>
<tr>
<td>Age</td>
<td>Mean ±SD</td>
<td>31 ± 15.2</td>
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<tr>
<td></td>
<td>Range</td>
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<tr>
<td>Preoperative sNOSE scale</td>
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<td></td>
</tr>
<tr>
<td>0–1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>5.3</td>
</tr>
<tr>
<td>3–4</td>
<td>124</td>
<td>94.7</td>
</tr>
</tbody>
</table>

SD: Standard deviation

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Operative procedure

Endoscopic Septoplasty alone is possible in all but 2.3% of cases. Additional external approach is made in three cases when the caudal end or the columnar septum is deformed or too anterior for endoscopic approach (2%). Even in these cases, the other septal job is done by endoscopic septoplastic in the beginning of the operation. Different situations of septal deflections occured: we described 16% isolated anterior spurs; 9.2% isolated posterior vomerian crest and 74.8% complex anterior-posterior spurs and crests. TNES were well adapted to the isolated deflections (Figure 3). The TSES approach is the most frequently used for anterior-posterior in continuity deviation. If needed, other endoscopic actions on turbinates and adenoids can be carried out at the same time, including turbinal outfracture (100%), radiofrequency (29.8%); turbinoplasty reduction (61.8%). In case of reduction turbinoplasty maximum reduction reached 50% and on average 30%. Concha bullosa is treated by lateral and external endoscopic resection.

Mean operative time (except additional procedures and based on 6 consecutive cases realized by senior surgeon each) for the TSES was 21 ± 2 min. Mean operative time was significantly shorter for the TNES: 7 ± 2 min.

Functional assessment

The sNOSE scale (4 to 0) improves post surgery from 3.4 ± 0.5 on average pre-surgery to 0.9 ± 0.6 (p <0.05) post-surgery. The gain is 2.5 on average in all the population. 87.8% of patients presented good results with a score less than one (less than a minimal/light obstruction or no obstruction at all) and 11.8% as unsatisfactory results (at least score of 2, n = 16). In 33% of cases, 0 obstruction was noted (Figure 4).

Statistically significant p value (p <0.05) was obtained when comparing satisfaction scores obtained in sNOSE by senior surgeon (10 years experience of endoscopic septoplasty) and the youngest surgeons (2 years maximum of endoscopic septoplasty).

Figure 2: Posterior anatomical abnormalities.

Figure 3: Operative procedures.
When TNES and TSES were tested separately: the gain was 2.5 each and identical. The sNOSE score improved from 3.4 ± 0.6 on average preoperatively to 0.9 ± 0.8 (p <0.05) postoperatively. We did not find a statistically significant difference between TNES and TSES (Figure 5). Three groups are defined depending on the time the telephone interview took place. The call group 1 from 6 to 10 months; call group 2 from 10 to 20 months and call group 3 from 20 to 30 months after the surgery. Group 3 was the first operated cases.

Complications

There were six cases with complications in the TSES group. The most frequent complication is persistent septal deviation and septal hematoma. No complication was noted in TNES.

We had three cases of minimal crusting; one case of persistent nasal obstruction was associated with micro septal perforation. The cause of unsatisfactory result was not clearly identified and no empty nose syndrome was identified (Table 2).

DISCUSSION

The novelty of our study is to consider a relatively large number of patient (131) with together septal deformities and nasal obstruction. Previous studies encompassed an even larger number of patients but did not focus exclusively on nasal obstruction and did not discriminate the motivation for carrying out the surgery (rhinoplasty, snoring, access to lacrymal duct [16, 17]). Consequently, their endoscopy technique and results could not be assessed.

Subjective evaluation of patients is sometimes based on scores like NOSE or SNOT-22 but without a clear consensus on the pertinence of these scores in patients with isolated nasal obstruction [18–19]. Some of them are validated (NOSE) but patient questioning and clear interpretation of these scales are often considered too abundant or even confusing for this specific mono symptomatic population. We suggest replacing the relative complexity of classical NOSE score by using a simplified NOSE scale (sNOSE 5 steps 0 to 4) to carry out an investigation subjectively and with as less bias as possible.

An alternative would be to link simple subjective scaling scores given by patient and objective measurements such as rhynomanometry. However, no clear correlation is established between subjective evaluations and measured results [20-21].

A pre-septoplasty score ranging from 3.4 (average population) to 0.9 post-operation gives a good idea of the global improvement (2.5 gains on average) of a residual nasal obstruction. Globally, 89% of satisfactory results of our method compares well to the 42–85% success rate of headlight speculum, even if the way to evaluate the results differs [3-4].

There was no significant difference in scores obtained in the groups ranging 6 to 10; 10 to 20 and 20 to 30 months after the surgery. This supports the long-term stability of the procedure.

When TNES and TSES were tested separately, no difference occurred in gain score for the patient. The type of approach (TNES or TSES) applied does not matter but well the final endoscopic permeability is evaluation by the surgeon.

Direct endoscopic evaluation of a difficult area, especially for posterior deformities, identifies the residual cause(s) of nasal obstruction. Adenoids, posterior turbinate hypertrophy, Torwald cysts or synechia must be taken into account to obtain the best flow in both nasal fossa. In our study, we report a high incidence and nasal obstruction.
of posterior significant septal deformations: 84% are described in opposition to the 28% noted by Becker [22]. If we consider the other posterior deformations producing nasal obstruction like adenoids (22%) and cysts (0.15%) posterior abnormalities reached 89%. We interpret this, as one of the principal explanations for the good results obtained with endoscopic septoplasty, compared to classical techniques. Because there is no need for speculum, MIES leaves the anatomy undistorted. The endoscope makes it possible to check the permeability of the nasal fossa without deformation, enhancing the final result.

With the endoscope, it becomes possible to perform all kinds of septoplasty, from the Trans-Nasal approach for limited deviation and/or revision surgery to total septoplasty by a trans-septal approach in more complex situations or even extremely deformed septum. Only the very caudal-columellar deformity needs to be completed by additional external approach (<2% of cases).

In the majority of studies, the type of ES use is not mentioned. It seems that most commonly endoscopic septoplasty concern Trans-Nasal endoscopic septoplasty or sometimes a mix of Trans-Nasal and Trans-Septal endoscopic septoplasty [23-25]. Therefore, we insist on the existence of 2 types of ES depending on the position of the endoscope: the endoscope into the nasal fossa (TNES) and endoscope into the new created septal pocket (TSES). We confirm the interest to use the Underwater Trans Septal technique (TSES) allowing a very clear visualization of anatomical details (like in orthopedic arthroscopy). The clear endoscopic vision overcomes the difficult and sharp deformities of the septum and avoid rupturing the subperichondrial layer.

The advantage of the TNES was already recognized in tricky situations like redo with “forgotten” isolated residual anterior spurs or posterior crest and no remnant of the quadrangular cartilage. In this situation, it is classically difficult to save the mucosa because of frequent absence of the cartilage, hypertrophy of the residual mucosa or scary tissue. Our procedure saves time for these challenging situations with a very simple and efficient approach avoiding dangerous tentative to undermine these fragile mucosa.

Headlight surgeons often minimize the endoscopic advantage of the best visualization of posterior region by the common opinion that spurs and posterior crests in the inferior aspect of the nasal cavity rarely contributing to nasal obstruction. They are just ignoring the posterior and inferior aspect of the nasal fossa and justify by this way a “voluntary” incomplete surgery. We cannot validate this attitude. Indeed, we identified in our study 86% of case with significant posterior pathology including posterior septal deviation but 60% posterior hypertrophy of the inferior turbinate, 20% of adenoid hypertrophy. This is probably one of the reasons for our good results (88%) compared to traditional septoplasty.

General complication rates (4.5%) are low and have to be compared to the 4 to 25% described with HLS [5–7]. Additional complications due to the use of the endoscope or irrigation are not identified.

Small perforation is regularly encountered during mucosal elevation especially at the sharpest point of the septum but can be early recognized and limited. If a larger trauma occurs on the mucosa, endoscopic adjustment of the flap with or without fixation can be achieved eventually by the use of glue.

We noticed two cases of early septal asymptomatic micro perforation in our MIES (1.5%) but without complaining of the patient at the time of clinical evaluation. We could not be completely sure that later, these perforations would not enlarge without symptomatology manifestations. These results are less or equal to the best published rate of perforation.

MIES could also benefit of powered instrumentation developed for FESS to refine the result: A residual bony spur may be burred. Mucosal, cartilaginous or adenoid excess can be reduced by shaving under visual control with precision, unlike with HLS.

The TSES approach make it possible to stay under the subperichondral vascular layer, sparing the vessel webs, which are really endoscopically visible under the elevated perichondrium. Endoscopic evaluation easily identifies and controls excessive bleeding by monopolar or bipolar cauterization, for example, on the premaxillary. It renders endoscopic septoplasty less bloody than with conventional technique and packing are not necessary.

Septal hematoma is very uncommon. We noted three hematoma in the follow-up. (2.3%). A low rate of hematoma is linked to bloodless procedure and to the lack of a need to suture, allowing natural flow of blood through the incision.

An operation time, ranging from on average 7 min for the TNES and 21 min for the TSES, is clearly shorter than headlight speculum. Additional surgical option is not included in this calculation. We have to underline that our TNES operation time is a lot shorter than the other ES mentioned and that TSES time is comparable to those published already [26].

Unsatisfactory results are not considered as a complication and represent 11.8% of cases. We do not recognize precisely the cause of these poor results collected by phone. We suspected perhaps the lack of experience in endoscopic approach as suggested by difference between results obtained by senior and young surgeons. Another hypothesis, could be a lack of septal correction, unrecognized valve narrowing, ignoring another cause of nasal obstruction like turbinate hypertrophy or residual adenoids.

The study limitations are the involvement of other causes of nasal obstruction. Indeed some patients have turbinal hypertrophy, adenoids hypertrophy, ... besides their septal deviation.

It is generally impossible to design a perfect study taking into account only the type of septal approach without considering the other factor of nasal obstruction. We adopt the most global endoscopic approach of the
CONCLUSION

Our experience with endoscopic septoplasty and analysis of data complete the minimal invasive concept MIS. Endoscopic septoplasty presented advantages compared to classical approach in many situations. The principal benefit is the best illumination and magnification of the field of view.

We made a distinction between the trans nasal and trans septal approach. We also described a completely new underwater septoplasty by trans-septal approach. We recognized 89% of significant posterior obstructive abnormalities justifying for us the endoscopic approach, which is largely superior to visualize and correct the posterior portion of the septum or the nasal fossa than conventional surgical procedures. The results of endoscopic septoplasty were assessed by the clear improvement of nasal obstruction.

We confirm that the minimally invasive label of this technique with very low incidence of complications. We recommend using it especially in pediatric population where surgery is needed.

REFERENCES


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Author Contributions
Pierre-François Dolhen – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published
Samuel Lipski – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published
Antoine Noel – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

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