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The "fascia taco" for nasal septum perforation closure—A retrospective Cohort study on success rates and patient reported outcomes

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Abstract

Objective: Nasal septum perforation (NSP) is a common condition affecting ~1.2% of the general population and is still considered challenging to treat. Therapeutic strategies range from conservative local treatments and septal button closures to over 40 different surgical approaches. This study aimed to present a novel secure approach.

Methods: We describe our novel and unique NSP closure approach using a "fascia taco," in which conchal cartilage is enveloped by temporalis fascia like a taco and splints are left in place for 6–8 weeks. A review of patient charts was conducted and questionnaires including the German-SNOT-22 and D-NOSE were sent by mail to all eligible patients who received a fascia taco between 2016 and 2021.

Results: Thirty-three patients were identified. The questionnaire response rate was 54.5%. The mean operative time (cut to sew) for all patients who only underwent NSP closure was 90.4 min. The overall success rate in terms of postoperative NSP closure was 81.8%. We found an apparent but nonsignificant association between closure failure and smoking (failure rate 66.6% in smokers vs. 15.4% in nonsmokers; $X^2 = 3.4188$, $p = .064$). Questionnaire analysis showed a significant postoperative reduction of mean values in D-NOSE from 60.8 to 33.1 ($p = .009$) and in German-SNOT-22 from 38.6 to 21.2 ($p = .005$).

Conclusion: The fascia taco technique is an easy-to-apply, safe procedure for NSP closure that is short in duration and associated with a low morbidity, resulting in excellent patient satisfaction.

Level of Evidence: 4.

KEYWORDS
cartilage, NSP, patient reported outcomes, SNOT-22, success rate, temporalis fascia

Preliminary results of this study have been presented by the first author at the first German Rhinoplasty Conference May 24–25, 2019 in Frankfurt/Main, Germany.

1 | INTRODUCTION

Nasal septum perforation (NSP) is a common condition affecting ~1.2% of the general population.[1] It is typically located in the anterior cartilaginous septal area (lamina quadrangularis), which accounts for over 80% of cases, but it can also reach posterior osseous parts (lamina perpendicularis ossis ethmoidalis and vomer) in 9% of cases.[2] Etiological investigations differentiate between traumatic/iatrogenic, nasal substance abuse, systemic drugs, occupational exposure, inflammation, infections, and neoplasms as pathogenetic factors in the development of NSP.[3] The most frequent causes of NSP are not easy to determine in retrospect but have been attributed to septoplasty, facial trauma, and habits such as nose picking and nasal substance abuse.[4] Patients with NSP may suffer from stuffed nose, breathing noises, nose bleeding, recalcitrant endonasal crust formations, and pain.[2]

There have been decades of effort spent trying to find safe and satisfactory closing techniques for NSP, ranging from conservative management, that is, medical (avoidance of digital manipulation, nasal irrigation, crust removal, ointments, etc.) and prosthetic (customized or assembled septal buttons) to different surgical approaches.[3]

The description of more than 40 different surgical techniques in the existing literature speaks to the need for one simple and safe management for NSP. These current techniques have been classified as "with osteocartilaginous support" (e.g., unilateral mucosal advancement flap, crossover flap, and anterior ethmoidal artery septal flap) and "without osteocartilaginous support" (e.g., nasal floor and inferior meatus flap, inferior turbinate flap, middle turbinate flap, lateral nasal wall flap, and pericranial flap).[3]

One specific technique with osteocartilaginous support that is surely missing from this list is the bipedicled, bilateral advancement, three-layer repair using autologous cartilage (Schultz-Coulon's bridge flap), which is the preferred approach for more than two-thirds of surgeons in the German-speaking otorhinolaryngology landscape and represents a kind of gold standard.[5–7] This technique combines Seiffert's approach for the bridge flap and Seeley's idea of expanded bilateral mucosal mobilization.[8–10]

All described techniques are accompanied by certain advantages and disadvantages, from donor site morbidity, long operative time, and challenging procedures to unsuccessful NSP closure, leading to revision surgery or new complaints. Success rates of the different approaches range from 25% to 92.5%.[5,6]

This study aimed to present a novel NSP closure technique derived from Schultz-Coulon's autologous cartilage graft, Seeley's mucosal mobilization, and our own tympanoplasty experience using temporalis muscle fascia for tympanic membrane perforation closures, and to determine its safety, success rate, and degree of patient satisfaction.[5,9,11]

2 | MATERIALS AND METHODS

2.1 | Description of operating technique

The procedure is carried out under general anesthesia. After preoperative measurement of the perforation size, an anterior rhinoscopy is performed. Following application of local anesthetics combined with vasoconstrictors (e.g., articaine hydrochloride/epinephrine hydrochloride, Ultracaine® 1%-Suprarenin® 5 mL), a conventional transseptal approach is performed via a hemitransfixion incision. After scalpel circumcision along the edge of the NSP, a submucoperichondrial flap, either right- or left-sided, is elevated, covering an area extending ~0.5 cm circumferentially beyond the boney/cartilaginous perforation. Again, an exact measurement is mandatory. A retroauricular skin incision is then performed and used as an approach for harvesting both the temporalis fascia and the conchal cartilage. Alternatively, a second cavum conchae incision from the frontolateral direction is sometimes preferred to prevent protruding ear. First, the temporalis muscle fascia is harvested in a conventional manner after scalpel incision and mobilization using blunt rasparatory dissection, until the harvested fascia is wide enough to cover the cartilage on both sides and reach at least 0.5 cm beyond its margins (at least 4 × 5 cm is usually possible). Now, the fascia is spread over a turned around standard crucible, pressed down, and left to air dry during the next steps. Sufficient conchal cartilage is then harvested according to the perforation size, either retroauricularly or from the front. The cartilage is inserted into the folded fascia like a taco (a traditional Mexican dish) and sutured with two 5.0 PDS sutures through all tissue layers to hold it in place. The customized taco is inserted into the defect on one side, and it is essential to make sure the fascial frame is covered circumferentially by original and mobilized septal mucosa. Conventional silicone splints (e.g., rhino Doyle-Splint®, bess), sometimes with the air canal removed if preferred, are then sutured with 3.0 Prolene from both sides through all tissue layers and left in place for ~6 weeks (Figure 1). Standard wound closure is conducted without drains. Oral antibiotics (e.g., clindamycin 600 mg orally 3×/day) are recommended for 1 week after surgery and sesame oil (e.g., GeloSitin®, G. Pohl-Boskamp GmbH & Co. KG) should be used for nasal care up to five times a day for about 3 weeks to prevent crust formation. Postoperative follow-up includes revisits once a week for 8 weeks for nasal suction and application of local ointments if necessary. Retroauricular sutures, if nonabsorbable, should be removed on the seventh to tenth postoperative day.

2.2 | Data acquisition

Following ethics committee approval (process number 2022-100761-BO-ff) we performed a patient chart review using our local documentation systems, myMedis KIS (Getinge) and Soarian® Clinicals (Cerner), for all operated NSP where the "fascia taco" technique was used on a standard basis by surgeons J.B., C.S.B., and A.B. between 2016 and 2021. Cases were identified using the German modification of the International Classification of Disease (ICD-10-GM) code J34.8 and German Operation and Procedure Classification System (Operationen und Prozedurenschlüssel, OPS) code 5–214.4.

A letter including four questionnaires was sent by mail to each patient. These included two validated questionnaires, the German-SNOT-22 (Sino-Nasal-Outcome-Test 22)[12] and the D-NOSE (Nasal Obstruction Symptom Evaluation, German version),[13] as well as two

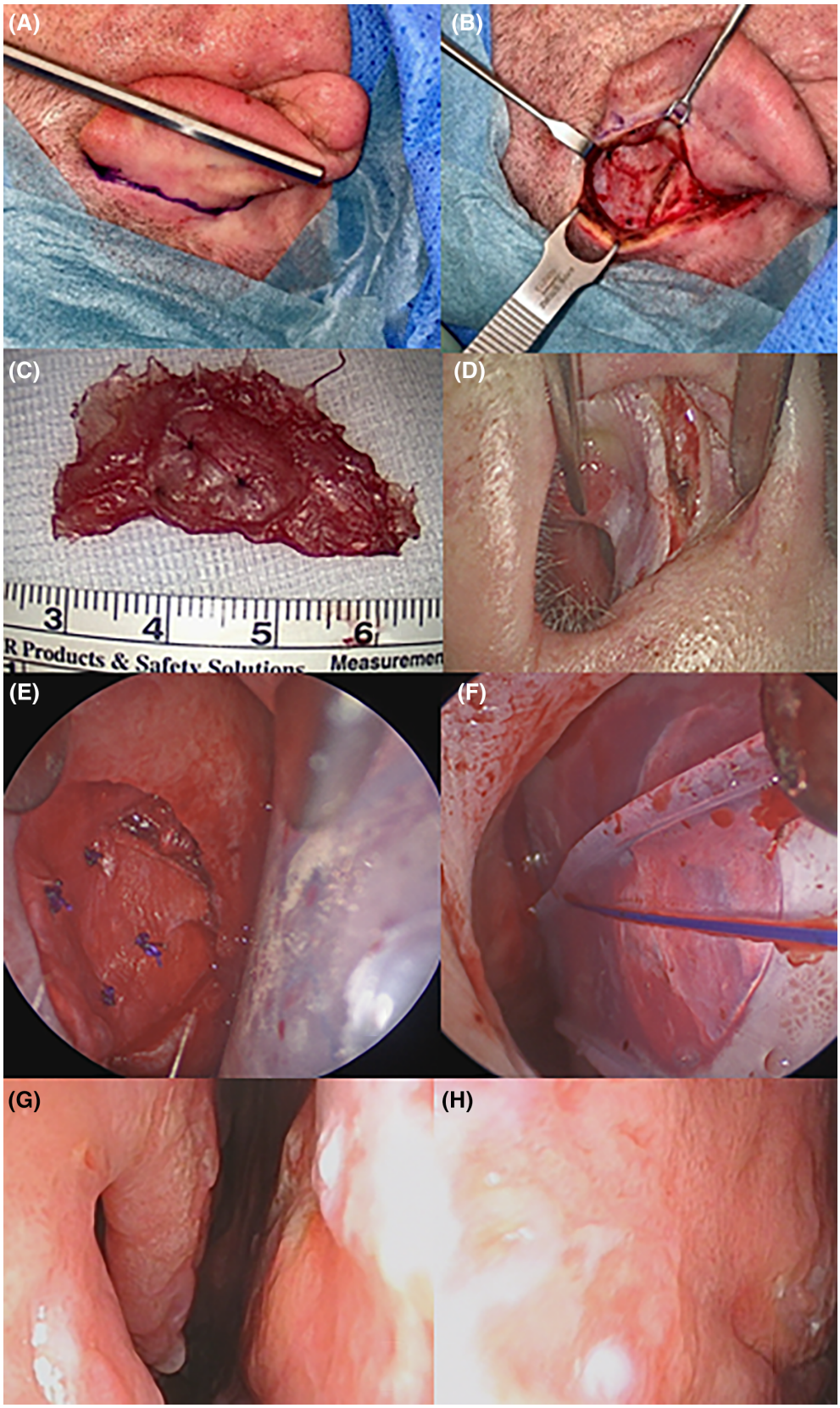

FIGURE 1 Intraoperative images of the "fascia taco" technique. (A) Retroauricular skin incision mark. (B) Skin mobilization and elevation for temporalis fascia harvest. (C) Customized fascia taco with fixed conchal cartilage graft inside. (D) Septal incision for submucoperichondrial access toward the perforation. (E) Fascia taco in place underneath mobilized septal mucosa. (F) Doyle-splint (air canal removed) and suture through all tissue layers covering the nasal septum perforation closure. (G, H) Endonasal site 8 weeks postoperatively, with splints removed, showing complete closure and mucosal covering on the right (G) and left (H).

customized forms to look for postoperative changes in complaints using visual analog scale scores ranging from 1 (very strong) to 10 (not at all) (Data S1).

This study followed the strengthening the reporting of observational studies in epidemiology (STROBE) statement: guideline for reporting observational studies.

2.3 | Statistics

Tests for normal distribution of results were performed using the chi-squared test. Differences between preoperative and postoperative outcome measures were analyzed with the Wilcoxon signed-rank test via Social Science Statistics (https://www.socscistatistics.com/). Graphs were created using Microsoft Excel. A survival curve was generated using the Kaplan–Meier method via KM Plotter (http://kmplot.com/analysis/index.php?p=service). Statistical significance was set at a level of $\alpha = .05$ ($p < .05$).

3 | RESULTS

We identified 33 cases of NSP closure within the 5-year interval, in 15 male and 18 female patients. The mean age at time of surgery was 42.7 years (range 17–82) (Table 1). The perforation sizes ranged from 0.09 to 4.32 cm^2 (Figure 2). The mean operative time (cut to sew) for all cases that underwent solely NSP closure (excluding further interventions such as septorhinoplasty, paranasal sinus surgery, or adenoidectomy) was 90.4 min (range 51–145 min) (Table 1).

TABLE 1 Patient characteristics.

Parameter	Value, *n* (%)
Total procedures evaluated	33 (100%)
Sex	
Female	18 (54.5%)
Male	15 (45.5%)
Age	42.7 (range: 17–82)
Operative time (mean)	90.4 min (range: 51–145)
Questionnaire responders	18 (54.5%)
Sex	
Female	11 (61.1%)
Male	7 (38.9%)
Age	45.1 years (range: 25–82)

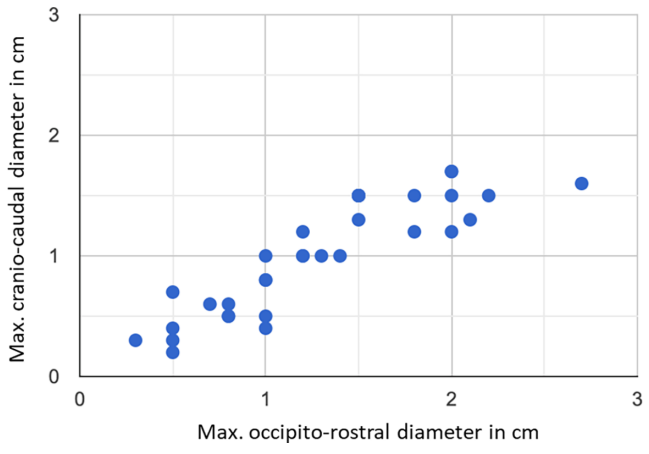

FIGURE 2 Distribution of perforation sizes. These ranged from 0.09 to 4.32 cm^2.

The overall success rate in terms of postoperative NSP closure in these 33 patients was 81.8% ($n = 27$) at a follow-up interval of up to 53 months (Figure 3).

In order to determine whether there was a correlation between initial perforation size and postoperative failure of closure, we divided all closing attempts into three different groups according to perforation size: small (<1 cm^2), medium (≥1 to <2 cm^2), and large (≥2 cm^2). Failure rates were 12.5% for small, 11.8% for medium, and 14.3% for large sized perforations, showing no significant association between perforation size and outcome ($X^2 = 0.0288$, $p = .986$).

We found an apparent but statistically nonsignificant association between closure failure and smoking (failure rate 66.6% in smokers vs. 15.4% in nonsmokers; $X^2 = 3.4188$, $p = .064$) (Figure 4).

Eighteen patients responded to the questionnaires (54.5%), of whom 7 (38.9%) were men and 11 (61.1%) were women (Table 1).

According to the responders, the main complaints for which perforation closure was actually indicated were nasal obstruction (44.4%), breathing noises (27.8%), and recurrent epistaxis (11.1%). Subjective causative declarations for NSP were iatrogenic/postoperative in eight cases (44.4%), unclear in three cases (16.7%), and digital manipulation in another three cases (16.7%). Two cases (11.1%) were referred for status after nasal bone fracture, and one case (5.6%) each for nasal substance abuse and cleft lip and palate.

Questionnaire analysis showed a significant postoperative reduction in complaints: mean values in D-NOSE were reduced from 60.8 to 33.1 ($p = .009$) (Figure 5A) and in German-SNOT-22 from 38.6 to 21.2 ($p = .005$) (Figure 5B).

Work-up of the customized questionnaire items revealed subjective postoperative improvement (decreased complaints) in nine out of ten queried items, with significant improvement in sense of smell, physical efficiency, decongestion (ab)use, general condition, and nasal breathing noise. Only allergic complaints remained unchanged (Table 2).

With regard to donor site morbidity, the questionnaires revealed no deterioration, and even a postoperative decrease in mean levels of retroauricular sensation disorder ($p < .05$) (Table 2).

Patients reported postoperative satisfaction in 72.2% of cases ($n = 13/18$). In 83.3% of cases ($n = 15/18$), patients would choose the same intervention again.

According to patient charts, no adverse events as defined by CTCAE v5.0[14] occurred in any of the cases.

4 | DISCUSSION

With this study, we were able to show that the newly described "fascia taco" technique is an easy-to-apply, quick, and safe procedure for NSP closure, which allows for more than satisfactory results in terms of reperforation rate and patient-reported outcome. By using a relatively large sample cohort, we have shown that the results presented here are likely to have widespread applicability, which fully meets the initial aim of the study.

Conservative approaches to NSP closure include the use of customized or assembled septal buttons. This approach particularly suits

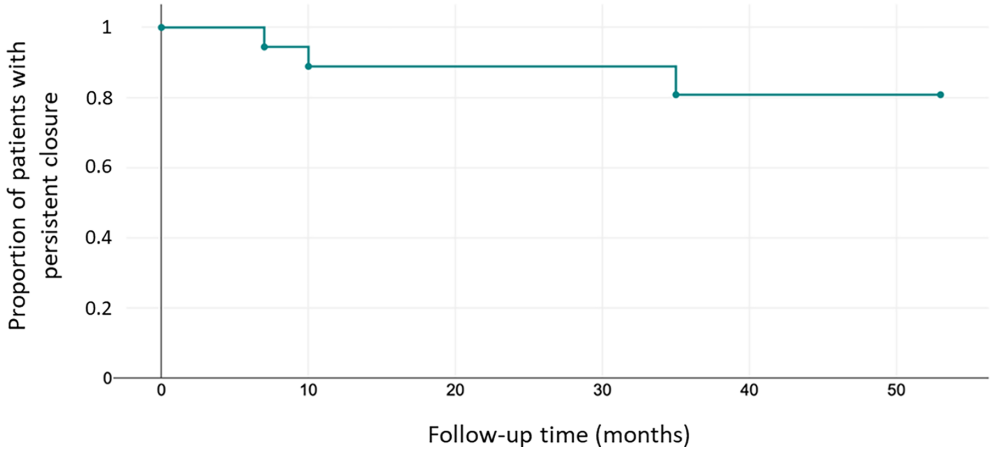

FIGURE 3 Probability of long-term NSP closure. The success rate was 81.8% at 53 months.

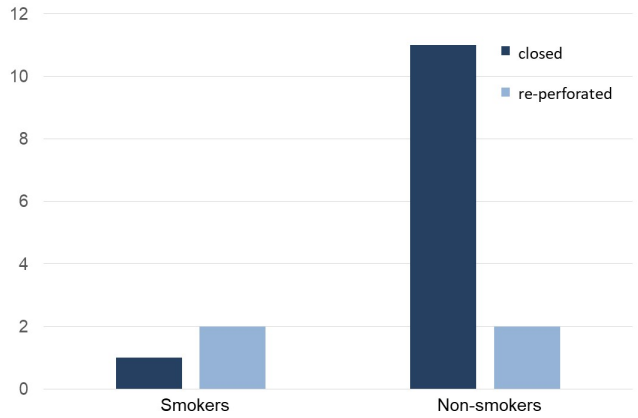

FIGURE 4 Successful closure stratified by smoking habits. A statistically nonsignificant association between smoking and failure of closure (failure rate 66.6% in smokers vs. 15.4% in nonsmokers) was detected ($X^2 = 3.4188$, $p = .064$).

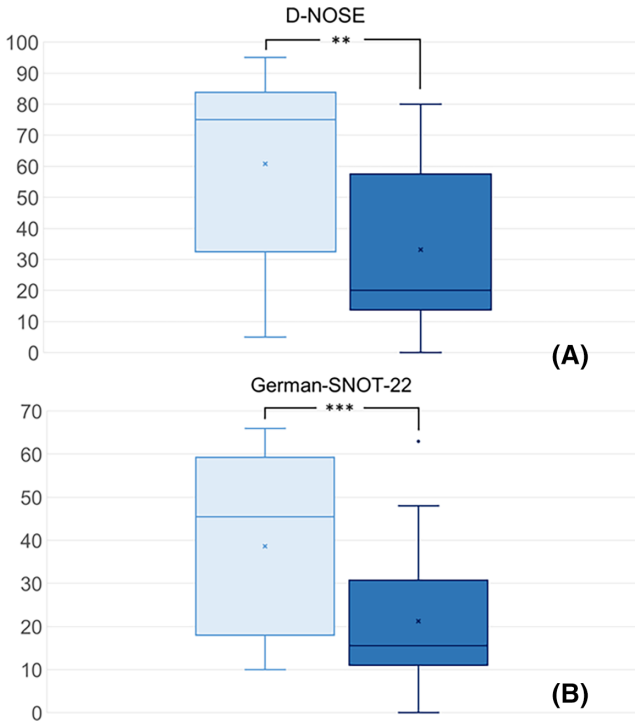

FIGURE 5 Change in patient reported outcomes. The boxplots show a significant reduction in mean symptom scores from 60.8 preoperative (light blue) to 33.1 postoperative (dark blue) (**$p = .009$) in D-NOSE (A) and significant reduction in mean symptom scores from 38.6 preoperative (light blue) to 21.2 postoperative (dark blue) (***$p = .005$) in German-SNOT-22 (B).

those patients who, for a variety of reasons, are unable to undergo general anesthesia, refuse surgical intervention, or are unable to quit smoking. These buttons are quite helpful for reducing nasal breathing noises and stuffed nose. However, patients frequently report suffering from crust formation on button edges, dislocations, foreign body sensations and pain, and recurrent bacterial and fungal infection. These complications, in return, are counterproductive as they may lead to non-compliance or even NSP enlargement.[15–17] From our perspective, the aims of NSP closure approaches should include permanent closure without irrigation, no further need for specific nasal care (e.g., suction, crust removal, button exchange, use of ointment, antibiotics, or other drugs), and first and foremost a relief of symptomatology.

Using temporalis fascia is a well-known and widely utilized standard procedure in tympanoplasty or skull base defect closures and leads to excellent closure results.[18,19] This approach to NSP has already been published by others using polydioxanone as an inner graft enveloped by the fascia.[20,21] Fascia provides an ideal scaffold of mesenchymal origin to revascularize and promote mucosal regrowth.[21] It has proven to be an excellent wound healing and re-epithelialization graft as it promotes mature scar formation by its fibroblasts.[22–24]

Wounds usually heal faster in a wet, uncontaminated environment than under dry or moist conditions.[25,26] A wet, incubator-like microenvironment is paramount for the survival and proliferation of transplanted tissues.[27] We believe this type of microenvironment, provided by the splints left in place over 6–8 weeks (depending on clinical course), is one important factor in the improved healing and successful closure seen with this technique.

This sandwich-like, non-composite graft (using single germ layer, mesoderm derived tissue) with osteocartilaginous support, formed by enveloping conchal cartilage with fascia like a taco, is unique. It was developed in 2015 and first presented in May 2019 at the first

TABLE 2 Results from customized questionnaires.

Item	Mean preoperative value[a]	Mean postoperative value[a]	Significance (*p*-value)[b]
Stuffed nose/impaired nasal breathing	5.17	6.72	.06876
Sense of smell	6.11	8.06	**<.05**
Nasal secretion	4.94	5.83	.20766
Snoring	5.44	6.11	>.05
Physical efficiency	5.56	7.00	**<.05**
Headache	6.83	7.50	>.05
Allergic complaints	8.61	8.61	n.c.
Decongestion (ab)use	5.44	7.50	**.0278**
General condition	5.39	7.39	**.00222**
Nasal breathing noise	3.39	7.11	**.00148**
Donor site morbidity			
Sensation disorder (retroauricular)	9.17	7.67	>.05
Cosmetic evaluation (retroauricular)	9.44	9.06	n.a.
Change in shape (retroauricular)	9.94	9.17	n.a.

[a]Higher values represent subjective improvement, that is, decreased complaints, according to visual analog scale values ranging from 1 (very strong) to 10 (not at all).
[b]Significant changes are marked in bold.

German Rhinoplasty Conference in Frankfurt/Main, Germany. Our approach was adopted by others who later published case series.[28] Indeed, there have been Turkish and Chinese case reviews of similar techniques, using costal cartilage and anterior rectus abdominis fascia,[29] additional free mucosal flaps,[30] or a sandwich-like fascia separation.[31] Here, we are excited to present the first results from the original and largest cohort to date.

Outcome comparisons with other surgical NSP closure studies are somewhat difficult to carry out as there are many different approaches and outcome measures. With regard to success rate in terms of one-stage successful closure, we found our results (82.1%) slightly inferior compared with the reported 93.7% of Schlutz-Coulon's bridge flap.[32] This may be due to limited sample size in our study, including a learning curve for three different surgeons in executing this novel approach, which may mean that higher success rates will be achieved in further intervention cohorts. A recent meta-analysis showed an overall success rate of 91% regardless of surgical approach (open vs. endonasal) or use of flaps, grafts, or nasal bolstering materials.[33] In addition, we found smoking tobacco limited success and was a feature in 17% of our cohort, which makes it difficult to compare results with other cohorts. This circumstance is known to be a limiting factor in wound healing as described in detail in a systematic review.[34] We also had one patient (5.6%) who was undergoing surgery for a cleft palate, which is considered very challenging and extends this cohort beyond the usual NSP clientele.

Reports on operative time are sparse. We believe that our fascia taco technique, which takes about 1.5 h on average, is one of the most time-effective procedures compared with other published surgical approaches.

Reports on patient-reported outcomes (PROs) include outcome measures such as the Glasgow Benefit Inventory (GBI), SNOT-20 (i.e., SNOT-20 GAV SDT), SNOT-22, or NOSE.[10,16,35,36] To the best of our knowledge, this study is the first to investigate PROs of NSP closure using both German-SNOT-22 and D-NOSE to compare preoperative and postoperative values. This enabled us to clearly see the subjective benefits of surgical intervention in addition to straightforward closure success rates. Furthermore, patients' reported satisfaction levels and willingness to undergo the same procedure again are encouraging in the promotion of our fascia taco approach.

Donor site morbidity is reported to be excellent in comparison with harvesting costal cartilage, where severe adverse events such as pneumothorax can occur.[37–39] This makes our approach more favorable than other techniques.

The limitations of this study include its retrospective, nonrandomized, and nonblinded design as well as its sample size, which although larger than previous studies, was still limited. At the time this study was conducted, data validated questionnaires such as the NOSE-Perf scale had not yet been published,[40] and as a consequence NOSE-Perf was not used in this study. This might be a very helpful tool not only to assess an individual patient's symptomatology, but also to compare different strategies for closure techniques. Another limiting factor might be the use of visual analog scales ranging from 1 to 10 but in an unintuitive manner, as increasing values represented a decrease in symptoms, resulting in questionable results as seen under donor site morbidity.

Future trials on NSP closure should focus on improving wound healing using internal and external supplements. The impact of the compensation for malnutrition provided by supplements such as vitamin C, zinc, high protein nutrition support, essential fatty acids, and glutamine should be investigated.[41,42] Monitoring/compensating for hemoglobin and albumin deficits, applying pantothenic acid ointments or sesame oil, and smoking cessation are key factors in

achieving the best healing outcomes in patients and should therefore be in scope of future investigations. Additionally, the role of hyperbaric oxygen therapy still remains uncertain but might occupy a legitimate place in wound care.[43,44] Novel image-based techniques using 3D-endoscopy for NSP measurements may improve accuracy in preoperative or intraoperative planning.[45]

Cartilaginous tissue engineering and surveillance of wound healing using optical coherence tomography is part of our own lab's remit, and will shed more light on the underlying wound healing processes.

The results of this study could have a huge impact for every ENT surgeon dealing with NSP, as its closure is still considered challenging. Postoperative complaints, relapsing perforations, crust formations, and long operating times can be diminished by implementing our fascia taco approach as a standard procedure, leading to a more efficient daily practice.

5 | CONCLUSION

The fascia taco technique described here is an easy-to-apply, safe procedure that is short in duration and associated with low morbidity, leading to high levels of patient satisfaction, for NSP as large as 4.3 cm^2. Smoking cessation appears to be mandatory for a successful outcome.

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CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

Data are available upon reasonable request to the corresponding author. Survey forms are included as supplementary material.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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