



Irradiated Homologous Costal Cartilage Grafts in Complex Functional Septorhinoplasty

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Abstract

Optimal results in complex nasal reconstruction, particularly in the context of post-traumatic and revision septorhinoplasty, often require the use of cartilage grafts to provide additional structural support to the nose. While autologous costal cartilage (ACC) has been traditionally used, this can be limited by donor site morbidity, increased operative time, and in some cases, lack of suitable cartilage for grafting. There has been a trend towards using irradiated homologous costal cartilage (IHCC) as an alternative source of graft material. We review our departmental experience of using IHCC in functional septorhinoplasty surgery. We performed a retrospective review of electronic medical records of all patients who underwent septorhinoplasty using IHCC at a tertiary referral center between May 1, 2022, and April 30, 2024. Demographic data, surgical details, and postoperative outcomes, including rates of infection, resorption, warping, and revision were recorded and analyzed. Fifty-seven patients (34 males, 23 females) with a mean age of 41.0 years (range: 18–65 years) were included. Forty-one were revision septorhinoplasty operations, while 16 were primary cases. Almost all were performed via an open approach (98.2%). Three patients developed postoperative infection (5.3%) while one developed columellar dehiscence needing further revision surgery (1.8%). Functional and aesthetic results were otherwise satisfactory in all patients. We observed no cases of warping, resorption, or extrusion. The median length of follow-up was 279 days (interquartile range: 171–527 days). We present the largest United Kingdom series to date on the use of IHCC in septorhinoplasty surgery. Our findings support its use as a safe and effective graft material and a viable alternative to autologous sources, offering the benefits of a robust reconstructive material and shortened operative time, without the risk of donor site complications. A longer follow-up period is ideally required to evaluate its long-term structural stability.

Keywords

- ▶ rhinoplasty
- ▶ costal cartilage
- ▶ homologous grafts

Complex nasal airway reconstruction, particularly in cases of post-traumatic and revision septorhinoplasty, often requires the use of cartilage grafts to provide structural support to the nasal framework and augment both the internal and external nasal valve areas.^{1–3} Autologous costal cartilage (ACC) has traditionally been the preferred graft material due to its

robustness and versatility.^{4,5} However, the process of harvesting ACC carries a significant risk of donor site morbidity, including postoperative pain, scarring, chest wall deformity, and critically, pleural cavity puncture and pneumothorax. Additionally, a secondary surgical site prolongs operative time and may increase overall procedural complexity.⁶

In response to these challenges, irradiated homologous costal cartilage (IHCC), sourced from cadaveric donors, has gained attention as an alternative graft material. IHCC offers several advantages, including eliminating donor site complications, reducing operative time, and ensuring easier availability.⁷ Nevertheless, concerns persist regarding previously reported graft-related complications associated with IHCC compared with ACC, including resorption and infection.⁸ This study aims to review our early institutional experience with IHCC in complex septorhinoplasty, focusing on postoperative outcomes while evaluating its potential as a safer and more efficient alternative to ACC.

Methods

We performed a retrospective review of electronic medical records of consecutive adult patients (≥ 18 years old) undergoing septorhinoplasty at our institution between May 1, 2022, and April 30, 2024. There were no specific exclusion criteria.

Demographic data collected included age, gender, past medical history, and smoking status. Surgical history, including the number of prior nasal operations, was obtained. Operative details reviewed included indication for surgery, primary or revision status, surgical approach, and types of graft used. Postoperative outcomes of interest included rates of infection, resorption, warping, extrusion, need for revision surgery, and any other complications.

IHCC, preserved in saline, was sourced from a commercial tissue bank (Hospital Innovations, Pontyclun, United Kingdom) and prepared according to the manufacturer's guidelines. Our practice involves washing the cartilage in normal saline and soaking it in a solution containing 80 mg/2 ml of gentamicin diluted in 100 ml of 0.9% sodium chloride prior to grafting to ensure sterility and minimize the risk of infection. The grafts were fashioned intraoperatively and placed as needed to achieve the desired functional and aesthetic results (►Fig. 1).

All patients received antibiotic prophylaxis at the time of surgery. A single dose of 1.2 g co-amoxiclav was administered intravenously at induction of anesthesia. Patients with penicillin allergy received 600 mg of clindamycin instead. Additionally, all patients were discharged with a 1-week course of oral antibiotics (co-amoxiclav 625 mg three times daily or clindamycin 300 mg four times daily for penicillin-allergic patients).

Functional outcomes were assessed postoperatively based on patient-reported symptoms, clinical examination including endoscopic nasal evaluation, and objective measures of nasal airflow using nasal inspiratory peak flow measurements. Aesthetic outcomes were evaluated using pre- and postoperative standardized clinical photography. Patients were followed up at 1 week, 3 months, and 12 months postoperatively. Complications such as infection, graft resorption, warping, or extrusion, where applicable, were noted and documented at each visit. Postoperative clinical photography was typically undertaken at 12 months following surgery.

Results

Fifty-seven patients with a mean age of 41.0 years (range: 18–65 years) and a male-to-female ratio of 1:0.68 (34 males, 23 females) underwent septorhinoplasty with IHCC during the study period and were included. Of these, 16 were primary procedures (28.1%) and 41 were revision cases (71.9%). The vast majority were performed via an open approach (98.2%).

The most common indication for using IHCC in primary procedures was post-traumatic nasal deformity (81.4%), while in those requiring revision, the most common reason was persistent nasal obstruction following previous septoplasty or septorhinoplasty (75.6%). Simultaneous septal perforation repair was performed in two cases (3.5%). Detailed characteristics of the study population are summarized in ►Table 1.

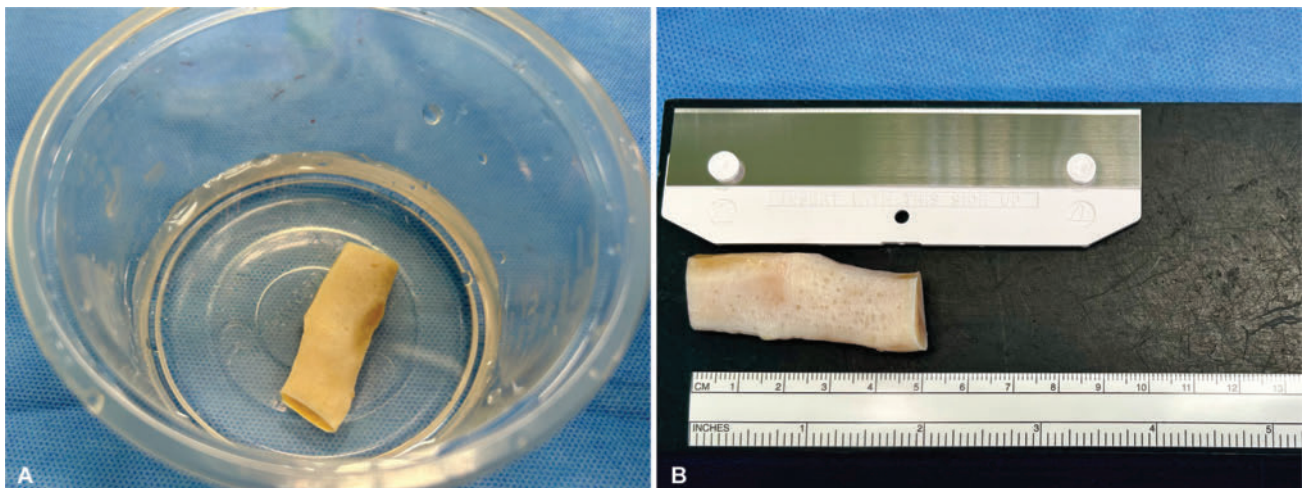


Fig. 1 (A) Preparation of the cartilage by soaking in a solution containing gentamicin and sodium chloride. (B) Typical dimensions of costal cartilage ready for fashioning.

Table 1 Demographic and operative characteristics of the study population

	Subjects (n = 57)
Gender	
Male	34 (59.6%)
Female	23 (40.4%)
Age, years	
Mean ± SD	41.0 ± 12.0
Range	18–65
Surgical status	
Primary	16 (28.1%)
Revision	41 (71.9%)
Surgical approach	
Open	56 (98.2%)
Closed	1 (1.8%)
Indications for surgery, primary	
Post-traumatic nasal deformity	13 (81.4%)
Button battery-induced nasal deformity	1 (6.2%)
Cocaine-induced nasal deformity	1 (6.2%)
Syndromic craniosynostosis	1 (6.2%)
Indications for surgery, revision	
Persistent nasal obstruction	31 (75.6%)
Postoperative nasal deformity	6 (14.6%)
Post-traumatic nasal deformity	3 (7.4%)
Vasculitis-induced nasal deformity	1 (2.4%)
Simultaneous perforation repair	
Yes	2 (3.5%)
No	55 (96.5%)
Smoking status	
Smoker	25 (43.9%)
Non-smoker	32 (56.1%)
Cocaine use	
Yes	4 (7.0%)
No	53 (93.0%)
Past medical history	
Allergic rhinitis	8 (14.0%)
Diabetes	5 (8.8%)
Chronic rhinosinusitis	3 (5.3%)
Vasculitis	1 (1.8%)

Abbreviation: SD, standard deviation.

Among revision cases, 29 patients had undergone one previous nasal surgery (70.7%), 9 had undergone two (22.0%), and 3 patients had undergone three previous septoplasties or septorhinoplasties (7.3%). A description of the types of reconstructive cartilage grafts is outlined in ► **Table 2**.

Three patients (5.3%) developed postoperative infections which were successfully treated with antibiotics. One patient developed a postoperative dehiscence of the columellar scar and wound breakdown, needing to return to the operating theater and further revision surgery. One patient developed a small septal perforation which was managed expectantly. Functional and aesthetic results were otherwise satisfactory in all patients (► **Fig. 2**). There were no cases of graft warping,

Table 2 Patterns of homologous costal cartilage graft usage

	Subjects (n = 57)
(Extended) spreader	48
Septal extension/replacement	43
Columellar strut	15
Lateral crural strut	4
Alar batten	4
Alar rim	4
Shield	2
Cap	1
Plumping	1

resorption, or extrusion during the follow-up period. The median length of follow-up in the current series was 279 days (interquartile range: 171–527 days) with a current discharge from clinic rate of 42.1% to date.

Discussion

The evolution of IHCC as a graft material in septorhinoplasty has been characterized by significant advances and increased acceptance over the years. Initially described by Dingman and Grabb in 1961, early reports faced skepticism due to graft-related complications, including resorption and graft migration.^{9,10} However, subsequent studies have demonstrated its efficacy and safety leading to a resurgence in its use.^{11,12} More recent meta-analyses and international series have further validated the low complication rates associated with IHCC, supporting its use as a reliable graft material in complex septorhinoplasty.^{13,14}

The overall complication rate in our series was 8.8% (5/57), comparable to published figures in the literature.¹⁵ Our complications included three cases of postoperative infection, one case of septocolumellar dehiscence, and one case of septal perforation. The three cases of infections occurred in patients who were smokers undergoing revision septorhinoplasty. Two of these patients required treatment with intravenous antibiotics—one for 6 days and the other for 14 days. The third patient responded effectively to a 2-week course of oral antibiotics. The case of septocolumellar dehiscence occurred in a patient with vasculitis-induced nasal deformity. Notably, we observed no cases of warping, resorption, or extrusion in our series—complications historically associated with IHCC.

The mean age of our study cohort was 41.0 years (range: 18–65 years). There are potential limitations to harvesting ACC in older patients. Ossification of costal cartilage increases with age, making it more challenging to harvest and less suitable as a graft material.¹⁶ In such cases, IHCC lends itself as a particularly useful alternative for patients who may otherwise not be ideal candidates for autologous cartilage harvesting.

The relatively high proportion of revision cases in our series (41/57, 71.9%) reflects the role of our unit as the national referral center for complex nasal reconstruction, including patients requiring revision septorhinoplasty. These cases often need additional graft material as native septal



Fig. 2 (A) Preoperative views of a 35-year-old lady with saddle nose deformity after previous septoplasty. (B) Postoperative appearances at 11 months following reconstruction with septal replacement, extended spreader, and diced cartilage dorsal onlay grafts.

cartilage is frequently depleted due to previous surgical interventions. Here again, IHCC provides ample graft material while minimizing the risks associated with harvesting ACC.¹⁷

One of the primary advantages of IHCC is its “off-the-shelf” availability, which eliminates the need for ACC harvesting. This not only helps significantly reduce operative time, but also avoids donor site morbidity associated with harvesting, including pain, infection, and in some cases even chest wall deformities.¹⁸ Avoiding a secondary surgical site also prevents a potentially unaesthetic scar which can be particularly problematic for some patients.¹⁹

Our departmental practice of using IHCC has allowed us to transform our service and perform more complex reconstructions as day-case procedures, avoiding the need for overnight hospital stays typically required after autologous rib harvest. This not only improves patient comfort and satisfaction but also reduces health care costs and optimizes resource utilization, including operating theater capacity—an important consideration within publicly funded health care settings such, as the National Health Service (NHS), where waiting lists for elective procedures are currently at an all-time high as an ongoing sequela of the recent pandemic.

We acknowledge several potential limitations to our study. The retrospective nature and lack of a control group limit our ability to directly compare IHCC to ACC grafts in a prospectively designed study. Furthermore, the median follow-up period of 279 days, while sufficient to capture relatively early complications, may not be long enough to detect potential long-term issues such as structural instability of the graft material. However, to our knowledge, the current study represents the largest series to date from within the United Kingdom and Europe on the use of IHCC in septorhinoplasty surgery. Our findings contribute to the existing evidence base on its safety and efficacy, with low incidences of major complications, supporting the broader adoption of IHCC in complex nasal reconstruction.

Conclusion

Our experience of using IHCC in septorhinoplasty demonstrates its safety and efficacy as a graft material for both primary and revision surgery. The low complication rate observed in our series, with no instances of warping, resorption, or extrusion, supports its viability as an alternative to autologous sources. IHCC offers robust reconstructive properties and reduces operative time by eliminating the need for autologous cartilage harvesting. This approach also avoids donor site complications and allows more complex nasal reconstructions to be performed as day-case procedures, optimizing resource utilization. Our study represents the largest United Kingdom and European series to date and further contributes to the evidence supporting the broader adoption of IHCC as a valuable tool in the armamentarium of the rhinoplasty surgeon.

Conflict of Interest

None declared.

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