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Use of Mastoid Periosteum Graft in Primary and Revision Rhinoplasty

Jong Sook Yi[1] · Hong Ryul Jin[1]

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Abstract

Background The authors initiated the use of a mastoid periosteum graft to augment or camouflage the dorsum and radix. This report describes the techniques and treatment outcomes of mastoid periosteum grafts in primary and revision rhinoplasty.

Materials and Methods Medical records of 62 patients who underwent rhinoplasty with mastoid periosteum were reviewed retrospectively. Of these, 21 patients who participated in follow-up for more than 6 months were analyzed through a comparison of pre- and postoperative photographs. Aesthetic results were scored on a scale of 0 to 4 (0 = poor, 1 = fair, 2 = moderate, 3 = good, 4 = excellent) with photographic evaluation by two independent surgeons.

Results A mastoid periosteum graft was used in 32 primary and 30 revision cases. The graft was used to augment the radix (28 cases), dorsum (15 cases), and both radix and dorsum (19 cases). Cartilage underlay was combined with mastoid periosteum grafts in 38 patients (61.3%, 17 in radix graft, 8 in dorsal graft, and 13 in both). The aesthetic outcome score assessed in 21 patients was 2.8 on average (3.2 in primary and 2.4 in revision cases). Cartilage combined cases showed better aesthetic outcome than free graft cases (3.1 vs. 2.5, respectively). Three cases of partial graft resorption were found, but there were no major complications.

Conclusions Mastoid periosteum grafting is a safe and effective method to augment the radix or dorsum in primary and revision rhinoplasty. Long-term partial resorption cannot be completely excluded, which necessitates further study.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Mastoid periosteum · Soft tissue graft · Alloplastic graft · Rhinoplasty

Introduction

Numerous autologous materials such as cartilage, fascia, perichondrium, dermis, and fat have been used as graft materials [1–4]. Cartilage is an ideal autologous graft material for dorsum and radix augmentation; however, the graft is visible even with careful carving in thin-skinned patients. Soft tissue materials such as fascia, perichondrium, dermis, and fat are good substitutes for cartilage grafts to avoid visibility, but they bring some disadvantages—harvesting done at an area remote from the operation field leaves a scar, the volume is often limited, and there is increased chance of infection and resorption [5].

Mastoid periosteum (MP) is relatively thick, covering the mastoid bone area reaching superiorly to the temporalis fascia and inferiorly to the sternocleidomastoid ligament. It is harvested from the post-auricular area, which is the same surgical field as that from which the ear cartilage is harvested. Thus, change of position during surgery is unnecessary, and scars are well hidden at the post-auricular sulcus. MP is thicker than perichondrium or temporalis fascia, and by attaching post-auricular soft tissue on top,

✉ Hong Ryul Jin
doctorjin@daum.net

[1] Dr. Jin'S Premium Nose Clinic, Seocho gu, Gangnamdaero 621, Seoul 06543, Korea

sufficient volume can be achieved for creating a smoother aesthetic dorsal contour without irregularity. This study reports our experience using MP grafts in primary and revision rhinoplasties.

Materials and Methods

The authors retrospectively reviewed 62 patients who had undergone rhinoplasty using MP to augment the dorsum or radix from July 2014 to December 2017 (male-to-female ratio, 27:35; mean age, 31.7 years). The study design was approved by the Institutional Review Board of Boramae Medical Center. Clinical records such as patient demography, main surgical maneuvers, graft materials used, graft sites, and complications were evaluated. Aesthetic outcome and complications were assessed in only 21 patients who participated in follow-up for more than 6 months and had both pre- and postoperative facial photographs.

Outcome Assessment

Aesthetic results were evaluated by two independent rhinoplasty specialists. They compared pre- and 6-month postoperative photographs in frontal, lateral, and oblique views. All photographs were taken in a standardized manner using a Canon camera (Canon Corp, Tokyo, Japan) with a 105-mm macrolens and the same film exposure, magnification, lighting, and angle. Aesthetic outcome was scored on a scale of 0 to 4 (0 = poor outcome, 1 = no improvement, 2 = moderate outcome, 3 = good outcome, 4 = excellent outcome). Graft-associated complications such as overcorrection, resorption, graft dislocation, graft visibility, infection, and donor site morbidity were reviewed.

Surgical Technique

Preparation of MP Graft

To harvest MP, a 1- to 2-cm-long incision is made 2–3 mm posterior to the post-auricular sulcus. After incision, the post-auricular soft tissue including the mastoid fascia and post-auricular muscle are dissected to reach the MP. The thickness of the harvested periosteum graft can be modified by adjusting the volume of the attached soft tissue over the periosteum. Further dissection of adjacent connective tissue is performed to expose MP widely. The size of the MP harvested is determined by the amount required. An incision is made deep to the mastoid bone with a #15 scalpel, and then the periosteum is detached from the mastoid bone using a Joseph elevator. The adherent sternocleidomastoid muscle fiber is cut inferiorly, and the temporalis fascia can be included superiorly if necessary. After harvesting, the wound is closed layer by layer, and mild compression dressing is applied for a day to prevent hematoma.

Graft Preparation and Positioning

Harvested MP was used alone or with cartilage underlay as a graft. Most cartilages were used intact or after soft crushing, depending on the site of the graft or the necessary thickness. MP with or without cartilage was used to augment the radix and dorsum, to camouflage partial irregularities of the dorsum/sidewall, or to reinforce the thinned dorsal skin in revision cases. When the radix/dorsal pocket was too wide, MP was fixed via tagging suture through the glabellar skin and held by tape for a week. At the mid-dorsum, MP was fixed by percutaneous suture if necessary.

Statistical Analysis

Pre- and postoperative Aesthetic outcomes were compared using the Mann–Whitney U test. All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 20.0 (IBM Corp, Armonk, NY), with values of $P < 0.05$ regarded as statistically significant.

Results

Clinical applications of MP grafts are summarized in Table 1. MP grafts were used in 32 (51.6%) primary and 30 (48.4%) revision rhinoplasty cases. The largest graft

Table 1 Clinical application of mastoid periosteum graft ($N = 62$)

	N (%)
Operation type	
Primary	32 (51.6)
Revision	30 (48.4)
Grafting sites	
Radix	28 (45.2)
Dorsum	15 (24.2)
Radix + dorsum	19 (30.6)
Used methods	
Free graft	24 (38.7)
With Cartilage underlay	38 (61.3)
Radix	17
Dorsum	8
Radix + dorsum	13

obtained measured 2.3 × 3.8 cm^2, with an average size of 1.2 × 2.7 cm^2 (Fig. 1). The measured thickness of the graft varied from less than 1 mm at the margins to 4 mm centrally. MP grafts were used for radix augmentation in 28 patients (45.2%), for dorsal augmentation in 15 (24.2%), and simultaneous dorsum and radix augmentation in 19 (30.6%). Of the 62 patients in total, 38 (61.3%) had combined grafts with intact or soft crushing cartilage underlay, while 24 (38.7%) had periosteum grafts alone to augment the radix and/or dorsum.

Outcome assessment was possible in only 21 patients by comparing pre- and postoperative photographs. The characteristics of 21 patients are summarized in Table 2. The mean follow-up duration was 13.6 months (ranging from 6 to 35 months), and mean age was 28.1 years. The aesthetic outcome score was 2.8 on average (Table 3). Primary cases showed better aesthetic outcome scores than revision cases (3.2 vs. 2.4, respectively) but without statistical significance. Regarding the specific graft sites, aesthetic scores were better when the MP was grafted both on the radix and dorsum than when grafted on either site alone (3.3 vs. 2.6). Patients who had a cartilage–MP combination graft showed better aesthetic outcomes than those who had grafts with MP alone, and this was consistent in both primary and revision cases without statistical significance (Figs. 2, 3, 4).

Hematoma or depression of donor sites was not found in any cases. The donor site incision scar dimmed with time, and in most cases, the scar was highly acceptable. Recipient site complications, such as overcorrection, extrusion, graft visibility or infection were not found during postoperative follow-up except in four cases of partial resorption and one case of graft dislocation. Partial resorption was noticed in three males and one female when MP was used for radix grafting without underlying cartilage. One case of graft dislocation was found in the case of a female with an MP graft alone on the radix without tagging suture. Further correction was recommended, but patients refused revision surgery.

Discussion

Common autologous yet soft tissue graft materials used so far in rhinoplasty include perichondrium, fascia, dermis, and mature scar tissue [1–5]. As each of these materials has its merits and demerits, surgeons have long sought an ideal material for soft tissue graft. In this article, we introduced the MP graft as an effective and safe novel material for dorsum and radix in both primary and revision rhinoplasties.

Because Asian rhinoplasty requires considerable amounts of material for dorsal augmentation and tip surgery, lack of graft sources has always posed a problem in efforts to achieve better nasal shape [6, 7]. Historically, cartilages have been chosen as the main autologous graft material. Unlike rib cartilage, however, septum and ear cartilages have limitations in providing sufficient length and volume in augmentation [7, 8]. Furthermore, the use of cartilage grafts for augmentation also runs the risk of the graft showing or irregularity, particularly in thin-skinned patients, even after careful carving or bruising [7–9]. The radix requires special attention in augmentation because the graft shows up easily, especially in Asians who have relatively flat faces compared to Caucasians [6, 8]. Crushing grafting cartilage helps to prevent graft visibility but also has the disadvantage of unpredictable absorption rate with a maximum of 90% cartilage loss, depending on the degree of crushing [8]. To prevent irregularity of the dorsum/radix in long-term follow-up, dorsal grafts using cartilage are generally best accompanied by additional soft tissue coverage if possible.

The temporal fascia graft, since it was introduced in 1984, has been the most commonly used material for soft

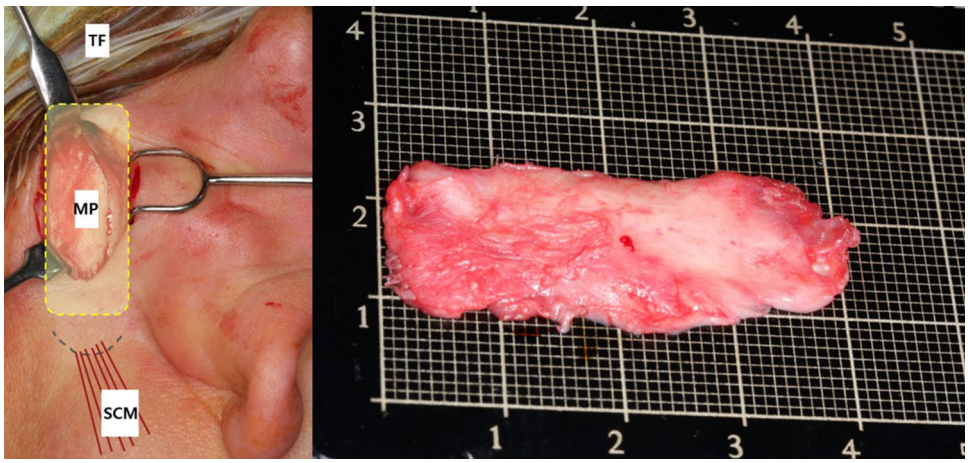


Fig. 1 Virtual incision line (yellow dotted line) of mastoid periosteum graft (left). Typical harvested mastoid periosteum. Thickness, width and length of mastoid periosteum can be adjusted as necessary (right). (*TF* temporalis fascia, *MP* mastoid periosteum, *SCM* sternocleidomastoid muscle)

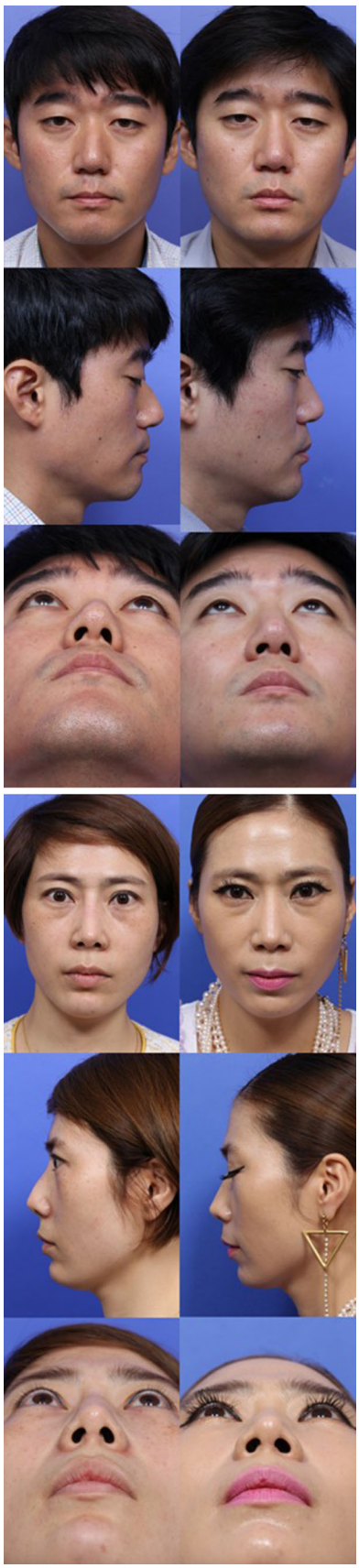
Table 2 Characteristics of 21 cases with outcome analysis

No.	Sex	Age	Revision	Graft sites	Cartilage underlay	Follow-up months	Aesthetic outcome scoring	Complications
1	M	23	N	Radix	None	14	Fair	Partial resorption
2	M	26	N	Radix	Crushed	12	Excellent	–
3	M	31	N	Radix	Crushed	24	Excellent	–
4	M	20	N	Radix	None	6	Excellent	–
5	M	23	N	Dorsum	Intact	8	Excellent	–
6	M	22	N	Radix, Dorsum	Crushed	16	Moderate	–
7	M	20	N	Radix	Crushed	12	Fair	Partial resorption
8	M	27	Y	Radix	None	15	Fair	Partial resorption
9	M	48	Y	Dorsum	Intact	22	Fair	–
10	M	48	Y	Dorsum	None	24	Fair	–
11	F	20	N	Radix	None	12	Excellent	–
12	F	45	N	Radix, Dorsum	Crushed	15	Excellent	–
13	F	27	N	Radix, Dorsum	Crushed	12	Excellent	–
14	F	37	Y	Dorsum	None	7	Excellent	–
15	F	24	Y	Radix	Intact	9	Excellent	–
16	F	18	Y	Radix	None	6	Fair	Graft dislocation
17	F	28	Y	Radix	None	7	Excellent	–
18	F	25	Y	Radix	None	14	Moderate	–
19	F	22	N	Radix	Intact	8	Moderate	Partial resorption
20	F	29	Y	Radix	Intact	13	Excellent	–
21	F	39	Y	Radix	Crushed	12	Moderate	–

Table 3 Aesthetic outcome score of 21 patients

	Score	*P* value
Mean	2.8	0.08
Primary (n = 11)	3.2	
Revision (n = 10)	2.4	
Grafting sites		0.41
Radix (n = 14)	2.7	
Dorsum (n = 4)	2.5	
Radix + dorsum (n = 3)	3.3	
Used methods		0.33
Free	2.5	
Primary (n = 3)	3	
Revision (n = 6)	2.2	
Cartilage underlay	3.1	
Primary (n = 8)	3.3	
Revision (n = 4)	2.6	

tissue grafting [10]. It has been used for dorsum or radix camouflage as a free graft or with cartilage [10, 11]. When used for wrapping diced cartilage, it has been known to maintain cartilage viability with less inflammatory responses [7, 12]. However, harvesting temporalis fascia has some drawbacks, including pain, hematomas, and transient or permanent alopecia along the temporal incision. Moreover, a separate temporal incision requires separate skin preparation, prolongs operation time, and increases the risk of infection [5, 10–12]. A dermo-fat graft is harvested from the sacral or inguinal areas. The donor site scar is hidden easily, but intra-operative postural changes may cause inconvenience and increase the risk of contamination. Unpredictable absorption is another drawback of dermo-fat compared to other soft tissue grafts [13–15]. Superficial mastoid fascia has been introduced recently to provide an appropriate amount of soft tissue for regional augmentation, especially when unplanned soft tissue is required [5]. The graft has been used for focal coverage in secondary rhinoplasties under thin skin, as a filling material, or as an interpositional graft on the supratip area. Recently, Campiglio et al. reported that diced conchal cartilage wrapped in retroauricular fascia was very effective to augment dorsum in primary and secondary rhinoplasty [16]. However, the harvestable volume is limited and the thickness of the fibrous layer is irregular, which may lead to unpredictable absorption. In addition, the quality of tissue is loose and thus there's differences in thickness. Furthermore, wide soft tissue dissection of underlying skin can increase donor site complications like hematoma, depression or sensory changes. Unlike other



◀**Fig. 2** Case 1. (Above) Mastoid periosteum graft with bruised cartilage underlay on radix. Deep radix was augmented smoothly and effectively with mastoid periosteum–cartilage combination (left before, right postoperative 24 months). Case 2. (Below) Mastoid periosteum graft in revision case. After removal of silicone from the dorsum, mastoid periosteum was applied to cover irregular surface and thinned skin (left before, right postoperative 13 months)

soft tissue grafts, the periosteum of the mastoid area has a dense layer of connective tissue covering the outer surface of the bone, consisting of an outer fibrous membrane and an inner cellular layer. The outer layer is composed mostly of collagen, while the inner contains osteoblasts, a potential source of mesenchymal stem cells [17, 18]. Due to its regular thickness, it curls much less, which makes it easier to place on the exact region where it is needed, unlike fascia grafts. Harvesting periosteum is straightforward. An incision is made just above post-auricular sulcus, which saves post-auricular nerve endings, and goes down directly to periosteum without adjacent soft tissue dissection. With this approach, surgeons typically do not encounter major blood vessels or nerve branches. We experienced that a sizeable graft—3 cm^2 on average—can be easily obtained and the thickness can be adjusted from 1 to 4 mm by attaching soft tissues on top. The donor site morbidity of MP is minimal with a hidden incision line behind the ear, and no drain is required after the procedure. To summarize, the advantages of MP include (1) autologous material, (2) dense soft tissue with less resorption, (3) adjustable volume, (4) ease of harvest and manipulation, and (5) lower donor site morbidity.

In our study, MP grafts in rhinoplasty showed overall good aesthetic outcomes with more than 6 months of follow-up, especially when used in combination with cartilage. When a considerable volume is required for augmentation, adding cartilage underlay is recommended instead of attaching abundant soft tissue with the MP to prevent long-term resorption. Areas of deficient volume are mainly filled with a combination of cartilage and MP just for smoothing. In cartilage-depleted revision cases, MP with soft tissue attachment can be an option; however, slight long-term resorption is expected, as our study showed. Thus, in this case, slight overcorrection may facilitate a better outcome.

In most cases, MP can be easily grafted onto the recipient site without tagging or fixation. Meticulous external taping and splinting ensure correct placement of the MP graft, even with cartilage combination. However, the MP can slip downward when the pocket is too tight, or can be displaced when the pocket is too large. In such cases, a tagging suture or percutaneous suture fixation is recommended to prevent graft dislocation.

The limitation of this study is its small number of long-term follow-up patients. Patients who were satisfied with the aesthetic results tend not to visit the clinic again, despite strong recommendations. Since we only assessed treatment outcomes by postoperative photographs, further subjective assessment of aesthetic outcome would be helpful.

Conclusion

Mastoid periosteum is a safe and effective graft material for augmenting the radix and dorsum without major complications. Resorption of the grafted site can be minimized with cartilage underlay while maintaining the camouflaging effect. The true longer-term effects of this material require further study.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest to disclose.

Human and Animal Rights This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent For this type of study informed consent is not required.

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