Transumbilical Endoscopic Costal Cartilage Harvesting

A New Technique

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Background: The quality and quantity of costal cartilage allow for versatile and stable cartilage supply for various nasal deformities, but the apparent scar on the chest wall can be a major concern in cosmetic surgery of Asians. The authors describe a new method for harvesting costal cartilage by transumbilical endoscopic approach to avoid any scar on the chest wall and to fulfill the requirements of cosmetic procedures.

Methods: An endoscopic retractor paired with a 10-mm and 30-degree down-viewing rigid endoscope is used to harvest the seventh, eighth, and ninth rib cartilage on the right. Elevators and eletrocautery units designed for conventional endoscopic procedures are used for cartilage dissection. Adequate amount of cartilage graft can be obtained through umbilical incision.

Results: Eight patients underwent rhinoplasty with costal cartilage harvested using this method. The length of the harvested blocks from the seventh and eighth ribs ranged from 4.5 to 7 cm. The cartilage blocks harvested from the ninth ribs were 2.5 and 3.5 cm in length. The operative time of cartilage harvesting ranged from 2 to 2.5 hours. There were no associated intraoperative complications. In all cases, no signs of pneumothorax were detected after operation. The umbilical wounds healed without significant scarring within 2 weeks.

Conclusions: This technique provides an effective alternative for costal cartilage harvesting with an inconspicuous scar hidden by the umbilicus that can be applied to selective rhinoplasty cases.

Key Words: costal cartilage, rhinoplasty, endoscopy

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The costal cartilage is commonly used for rhinoplasty in reconstructive or cosmetic surgical purposes. It is available in abundance, undergoes minimal graft resorption after surgery, and is easy to carve. Given the location of the donor site, graft harvesting can be performed simultaneously by a second surgeon during surgical exposure of rhinoplasty.[1] Although the quality and quantity of costal cartilage allow for versatile and stable cartilage supply for various deformities, there remains to be donor-site morbidity including iatrogenic pneumothorax, chest wall deformities, persistent postoperative pain, incisional dehiscence, and infection.[2] The conventional procedure involves harvesting the costal cartilage from an incision on the anterior-medial chest wall over the donor site. The apparent scar on the chest wall can be a major concern, especially among Asians, in cosmetic surgery. Several authors have described short incisions facilitated by differential retraction or endoscopic-assisted technique to improve the chest wall cosmesis, but these techniques still resulted in an apparent scar on the chest wall.[3–6] The authors describe a new method for harvesting costal cartilage by transumbilical endoscopic approach to avoid any scar on the chest wall and fulfill the requirement of the cosmetic procedure.

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PROCEDURE

The position and shape of the seventh, eighth, and ninth costal cartilage on the chosen side are confirmed by palpation and are marked. The distance between umbilicus and the costal margin is measured. The donor site and the path of the planned tunnel are infiltrated with a solution of lidocaine 1% and epinephrine 1:200,000, encompassing the entire area that will be undermined. The umbilical incision is marked and made under the hood of the umbilicus and just through the subcutaneous level. Blunt dissection is then carried out to reach the anterior sheath of rectus fascia under direct visualization to prevent an incisional hernia and injury to the intra-abdominal organs. Suprafascial dissection toward the donor site is carried out under direct visualization for the first 4 to 5 cm to create an adequate optical cavity. An endoscopic retractor paired with a 10-mm and 30-degree down-viewing rigid endoscope is then introduced, and the suprafascial tunnel to the costal margin is then completed with electrocautery. On the same plane, dissection between the subcutaneous layer and the musculature over the costal cartilage is made depending on the selected location and size. The eighth rib cartilage appears after incision on the upper abdominal musculature including the superiolateral part of the rectus muscle. Adequate surgical exposure is established by dissection of the loose alveolar tissue above the perichondrium. Dividing the rib cartilage from the abdominal and intercostal musculature is made with electrocautery and elevators specific for endoscopic surgery. Care must be taken to keep the dissection plane on or just above the perichondrium. The incisions on the synchondrosis between the seventh and eighth costal cartilage and the lateral portion of the eighth costal cartilage are made by scissors or the sharp edge of an elevator. The musculature attached to the superior aspect of the segmented costal cartilage then can be divided. After removal of the cartilage segment from the eighth rib, the seventh and ninth ribs can be harvested depending on the required amount for the rhinoplasty. After retrieval of the cartilage from the umbilical wound, bleeding and signs of pneumothorax were evaluated. The umbilical wound is closed in anatomical layers without drains in place. A compressive dressing is then applied to the undermined area for 1 week.

RESULTS

Eight patients underwent rhinoplasty with costal cartilage harvested using this method (Table 1). There were 3 men and 5 women with ages ranging from 18 to 32 years. None of the patients had previous operations on their thoracic or abdominal region. The distances from umbilicus to right costal margin ranged from 9.5 to 13 cm (mean, 10.4 cm). Of the 8 patients, 6 had nasal deformities from cleft lip (2), previous nasal trauma (2; Fig. 1), long-term cocaine abuse (1), and previous rhinoplasty (1). These patients needed cartilage blocks to rebuild the nasal framework. Two patients requested nasal augmentation on the dorsum and the tip for cosmetic purposes; therefore, both nasal septal cartilage and ear cartilage would not provide sufficient cartilage bulks. For the first patient in our series, who had unilateral cleft lip and deformed nose, the authors harvested cartilage from the ninth rib on the right side and used it for columella strut and diced cartilage grafts. The procedure was uneventful, and no associated complication occurred after surgery. After the authors confirmed the feasibility of this technique, the donor site was extended to the seventh

TABLE 1. Clinical Details

No.	Sex	Age, y	Indications	Distance (Umbilicus to Costal Margin), cm	Harvested Rib(s)	Rib(s) Length, cm	Follow-up, mo	Complications
1	F	18	Cleft lip nasal deformity	10.0	Ninth	2.5	5	Nil
2	F	31	Aesthetics	10.0	Seventh	5.0	5	Seroma
					Eighth	5.0		
3	F	25	Cocaine nose	9.5	Seventh	6.5	4	Nil
					Eighth	4.5		
4	F	18	Secondary rhinoplasty	9.0	Seventh	6.0	4	Nil
					Eighth	5.0		
5	M	25	Traumatic deformity	11.0	Seventh	7.0	4	Nil
					Eighth	5.5		
6	M	32	Cleft lip nasal deformity	9.0	Seventh	4.5	4	Nil
					Eighth	6.5		
					Ninth	3.5		
7	M	25	Traumatic deformity	13.0	Seventh	5.0	3	Nil
					Eighth	6.0		
8	F	32	Aesthetics	12.0	Seventh	7.0	2	Seroma
					Eighth	7.0		

F indicates female; M, male.

and eighth ribs. Of the subsequent 7 patients, 6 had their cartilage blocks harvested from both the seventh and eighth ribs, and 1, from the seventh, eighth, and ninth ribs. The length of the harvested blocks from the seventh and eighth ribs ranged from 4.5 to 7 cm. The cartilage blocks harvested from the ninth ribs were 2.5 and 3.5 cm in length. The operative time of cartilage harvesting ranged from 2 to 2.5 hours. There were no associated intraoperative complications, such as uncontrolled bleeding, penetration into the chest cavity, or pneumothorax. The cartilage grafts harvested by this method provided enough volume for reconstructive and cosmetic rhinoplasty in all but the first case. If the authors had spared cartilage, it was stored in the retroauricular area subcutaneously for further revision surgery. The umbilical wounds healed without significant scarring within 2 weeks (Figs. 1 and 2). During the postoperative follow-up, 2 patients did not follow the instructions to wear the compressive dressing and developed subsequent seromas within the subcutaneous tunnel. The seromas resolved spontaneously after conservative management in 3 to 4 weeks and left no abdominal contour deformities (Fig. 3).

The umbilical scars were assessed by 2 independent evaluators 2 months after surgery based on hyperpigmentation, pliability, and itching and were graded on a 5-point scale. Hyperpigmentation was graded as follows: 0 (no hyperpigmentation), 1 (trace hyperpigmentation), 2 (mild hyperpigmentation), 3 (moderate hyperpigmentation), or 4 (severe hyperpigmentation). Pliability was graded as follows: 0 (no induration), 1 (trace induration), 2 (mild induration), 3 (moderate induration), or 4 (severe induration). The severity of itching was graded as follows: 0 (no itching), 1 (trace itching), 2 (mild itching), 3 (moderate itching), or 4 (severe itching). The mean hyperpigmentation score assessed at 2 months was 1.8. The mean score of pliability and itching was 2.1 and 0.4, respectively. Patient satisfaction was also assessed based on a 5-point scale from very unsatisfied (0) to very satisfied (5). The mean satisfaction obtained at 2 months after surgery was 3.8.

DISCUSSION

In Asians, augmentation rhinoplasty consists of a major portion of cosmetic rhinoplasty. For the tip augmentation or tip support, septal cartilage and ear cartilage are commonly used. As for the dorsum, these donor sites cannot provide enough block for dorsal augmentation.[7] Common materials used in augmentation rhinoplasty are alloplastic implants, such as silicone, polyethylene, and polytetrafluoroethylene. Although autologous costal cartilage graft for rhinoplasty has no implant-associated complications and provides enough bulk for nasal augmentation, it still has not gained popularity in Asian cosmetic surgery. Scarring on the anterior chest is definitely a major drawback in cosmetic surgery, especially among Asians, whose scars are generally more apparent than that of whites. With conventional and previously reported techniques for costal cartilage harvesting, the scar on the chest wall is inevitable, no matter how short it is. Furthermore, to shorten the scar on the chest, strong traction force is usually applied on the wound edges to gain access to the costal cartilage. Skin congestion and necrosis on the wound margin can occur after surgery, resulting in delayed wound healing, widening, or hypertrophic scarring.[5] The authors describe a new technique for costal cartilage harvesting without any scarring on the chest wall. The natural skin creases and the concavity of the umbilicus hide the surgical scar well. The transumbilical approach applies instruments used in conventional endoscopic surgery and enables the surgeon to harvest enough volume for almost all kinds of cosmetic or even reconstructive rhinoplasty via a single incision.

The musculature that lies underneath the lower ribs provides adequate tissue barrier to separate the dissection plane from the thoracic and abdominal cavities. The subcostalis muscles lie on the internal surface of the lower ribs. These muscles arise from the inner surface of 1 rib and insert into the inner surface of the second or third rib below.[8] There are also transversus thoracis muscles and endothoracic fascia separating the ribs from parietal pleura.[9] In addition, the dome-shaped diaphragm originates from the lower 6 ribs laterally and the xiphisternum ventrally.[10] Therefore, harvesting cartilage with perichondrium from the lower ribs (seventh, eighth, and ninth) medially on the costal margin without penetrating into the thoracic cavity is feasible if one keeps the dissection plane tightly on the surface of perichondrium. This technique also prevents injury to the subcostal neurovascular bundles. The authors routinely checked for iatrogenic pneumothorax by pouring normal saline solution into the wound and observed if there was any air leakage from the thoracic cavity after cartilage graft harvesting. In this preliminary report, no signs of pneumothorax were found in all the patients who received costal cartilage harvesting using this technique. Given that the musculature underneath the cartilage separates the dissection plane from the

FIGURE 1. Case 5. Above, Preoperative frontal and lateral views of the patient with nasal deviation, asymmetry, and broad tip. Below, Postoperative frontal and lateral views after 3 months.

abdominal and chest cavities, attention should be made not to violate this musculature.

The right seventh, eighth, and ninth ribs are preferred because of several reasons. First, the seventh, eighth, and ninth rib cartilage that is located on the medial portion of the costal margin is easily accessed from the inferior aspect. Second, the cartilage harvested from these ribs can provide adequate bulk for almost all of the conventional rhinoplasties. Third, as mentioned previously, the relatively lower position of these ribs decreases the risk of iatrogenic pneumothorax. The left side is less preferred because of the proximity to the heart and the possibility of iatrogenic injury.

Several drawbacks are noted from this preliminary result of our new approach. For instance, longer operation time is required, compared with other methods that harvest cartilage from incisions on chest wall. Because of the steep learning curve for this new approach, operative time can last between 2 and 2.5 hours. With modified instruments specific to this approach, operative times potentially could be reduced. In addition, the incision on the muscle cannot be repaired easily by this approach, although the incision needed is usually 3 to 4 cm. Oozing from the muscle incision resulting in hematoma or seroma formation with subsequent infection can occur. Adequate hemostasis is more difficult to achieve by this approach compared with other methods involving a chest wall incision. With electrocautery, hemostasis is maintained during subcutaneous tunnel dissection, cavity enlargement, muscle dissection, and rib harvesting. Before wound closure, adequate hemostasis is confirmed by careful endoscopic inspection of the complete cavity. The authors routinely applied compressive dressings to the entire involved area to seal the subcutaneous space and prevent hematoma or seroma formation. Two patients failed to comply with wearing the compressive dressings and developed subcutaneous seroma. Another potential complication with this approach is iatrogenic pneumothorax. Although the authors did not encounter this complication, this technique still caries a risk for it. In addition, wound pain can be more severe compared with methods that harvest cartilage from a chest wall incision. This is because of the more extensive dissection required to access the desired ribs from the umbilicus. In our experience, intercostal or subcostal nerve blocks with long-acting local anesthetic immediately after costal cartilage harvesting can help reduce wound discomfort after surgery.

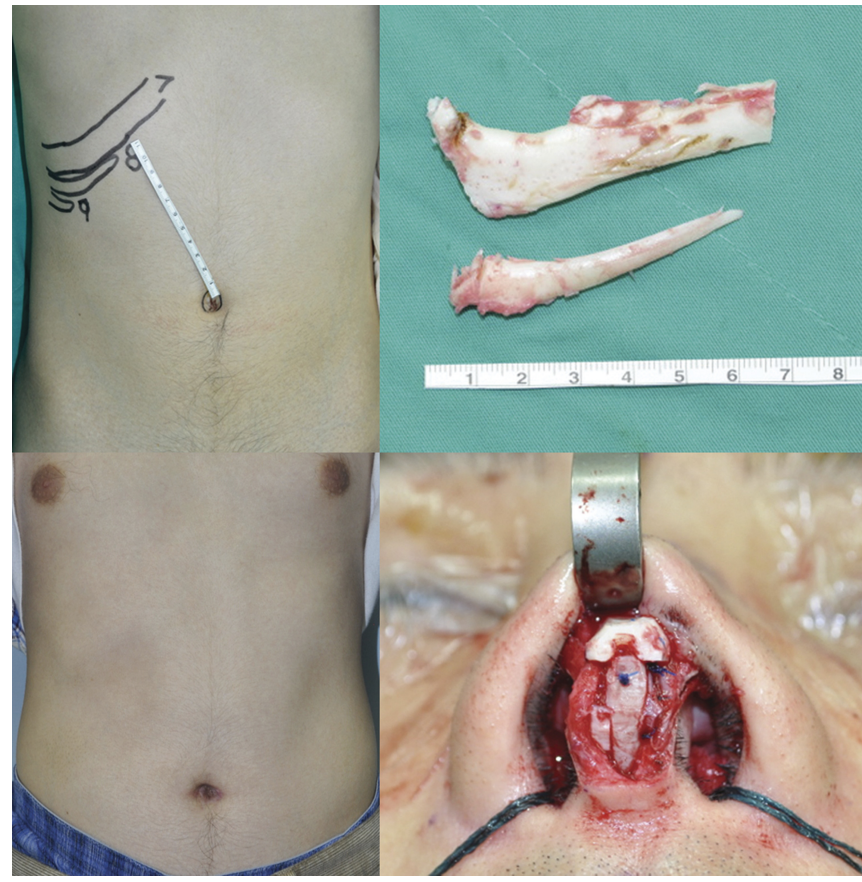

FIGURE 2. Case 5. Above left, Preoperative appearance of the costal cartilage donor site. Above right, The cartilage grafts harvested from right seventh and eighth ribs. Below right, The nasal framework built by costal cartilage grafts, including columella strut, spreader grafts, and dorsum graft. Below left, Postoperative appearance of the donor site after 2 months.

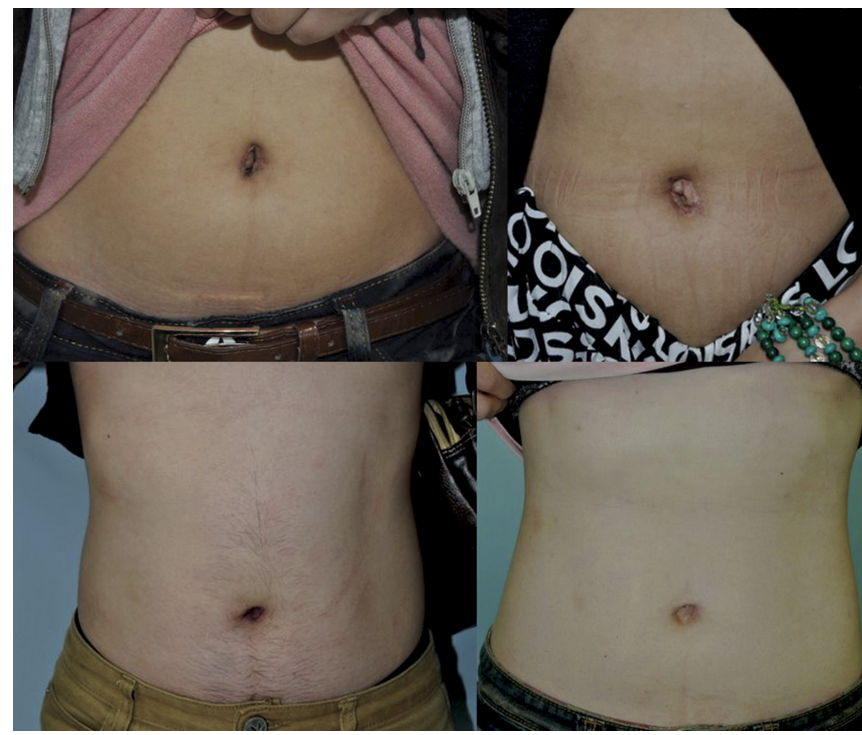

FIGURE 3. Postoperative umbilical scar. Above left, Case 1 followed up at 5 months. Above right, Case 2 followed up at 5 months. Below left, case 7 followed up at 3 months. Below right, Case 8 followed up at 2 months.

An endoretractor is used to maintain a functional subcutaneous optical cavity by applying outwardly directed force on the roof to overcome the weight and elastic recoil of the superficial tissue layers. Significant obesity and thick subcutaneous fat of the abdominal wall could compromise the optical cavity for optimal visualization and efficient tissue manipulation. Previous operations that led to scarring and fibrosis on the lower chest or abdominal region such as liposuction, abdominoplasty, celiotomy, or thoracotomy can complicate the subcutaneous dissection and cartilage harvesting. Entering into the abdominal cavity can occur easily during subcutaneous tunnel dissection if there are defects of the abdominal fascia or if any abdominal hernia is present. Therefore, this technique should be applied conservatively to patients with the above conditions.

CONCLUSIONS

Apparent scarring on the anterior chest compromises the cosmetic results of rhinoplasty using costal cartilage grafts. Harvesting adequate costal cartilage by endoscopic approach via umbilical incision can be performed safely. This new technique provides an effective alternative for costal cartilage harvesting with an inconspicuous scar hidden by the umbilicus that can be applied to selective cases. Specific instruments are necessary for further refinement of this new approach.

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