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Association of Autologous Costal Cartilage Harvesting Techniques with Donor Site Pain in Patients Undergoing Augmentation Rhinoplasty

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ABSTRACT

Objective: To assess the relationship between postoperative pain and the harvesting of autologous costal cartilage grafts using either a muscle-sparing technique with blunt dissection or a muscle-cutting technique with electrocautery in patients undergoing augmentation rhinoplasty.

Study Design: Quasi-experimental study.

Place and Duration of Study: Plastic Surgery Department, Fauji Foundation Hospital, Rawalpindi Pakistan, from Oct 2022 to Jun 2023.

Methodology: A total of 32 patients, aged 15 to 35 years and of both genders, undergoing elective augmentation rhinoplasty with no medical comorbidities, were divided into two groups. Patients who were undergoing surgery due to acute nasal trauma, nasal patency, nasal polyps, and other pathological causes were excluded. Group-A received augmentation rhinoplasty via the muscle-sparing technique, while Group-B received the surgery via muscle-cutting technique using electrocautery. Patients in both groups were assessed in terms of postoperative donor site pain.

Results: The mean age in Group-A was 20.7±5.5 years while in Group-B, it was 21.7±4.9 years. The comparison of mean pain scores at rest (p<0.005) was calculated for both groups on 0 to 10th postoperative day that resulted in significant decrease for Group-A. The mean pain score during movement from the 0 to 10 postoperative days and after 1 month (p=0.003), was also compared between both groups and it was significantly lower in Group-A as compared to Group-B.

Conclusion: Muscle-sparing techniques have shown to be superior to muscle-cutting techniques for harvesting autologous costal cartilage grafts, both in terms of resting pain and pain during movement.

Keywords: Costal Cartilage Graft, Post-Operative Pain, Rhinoplasty.

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INTRODUCTION

Rhinoplasty (improving the appearance of your nose) is a constructive as well as cosmetic procedure & is divided into primary or secondary/revision rhinoplasty. Indications of rhinoplasty include a dorsal hump, a crooked dorsum, a crooked and asymmetric tip, an inadequate or wide dorsum (saddle nose deformity), alar retraction, post-traumatic nasal deformities along with functional nasal obstruction. In order to maintain structural integrity and long-term functionality, nasal building procedures prioritize cartilage grafting.[1] Autologous cartilage is a perfect graft material for rhinoplasty since it is readily available, biocompatible, and simple to utilize.[2]

In rhinoplasty, the septal cartilage, auricular cartilage, rib cartilage, and iliac or calvarial bone are the five possible donor sites. The septum is the preferable source since it doesn't require any extra incisions, has minimal donor site morbidity, and its harvest may enhance the airway by correcting septal abnormalities. Unfortunately, there is frequently not enough septal cartilage available, necessitating the use of alternative donor locations. Sometimes ear cartilage is employed, although it performs less well when structural support is required. Because of its unpredictable postoperative resorption, bone is rarely used.[3]

The most plentiful supply of cartilage with adequate inherent strength for graft fabrication is the rib/costal cartilage, which is also the material of preference when trustworthy structural support is required.[4] The most important benefit of using rib cartilage is the ability to manufacture grafts with a great deal of variability in terms of shape, length, and width. This makes it easier for patients with a variety of functional and aesthetic needs to have their nasal frameworks rebuilt. However, it has drawbacks including warping and calcification, which obstruct carving and suturing. In both primary and revision rhinoplasty, satisfactory long-term outcomes

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depend on the correct rebuilding of the nasal osseocartilaginous framework.

With its quantity and backing, autologous costal cartilage grafting (ACCG) is regarded as the graft of choice in revision rhinoplasty.[5] Because of its location in the infra-mammary crease, the resulting scar is around 5 cm long and is often unnoticeable in women. The disadvantages include postoperative discomfort, the danger of pneumothorax, and the possibility of rib cartilage warping. The latter may result in long-term postoperative nasal shape abnormalities.[6]

A muscle-sparing approach used during an ACCG may lessen postoperative pain and the requirement for postoperative painkillers, according to anecdotal evidence from eminent researchers. The purpose of this study was to compare the effects of muscle-sparing and muscle-cutting costal cartilage harvesting techniques on postoperative resting and movement pain at the donor site at day 0, day 1, day 2, day 3, day 10, and day 30 after surgery.[3,4]

Asian rhinoplasty is unique in the sense that there is this prevalent Westernized concept of beauty, dorsal augmentation, and tip modifications are more emphasized among many rhinoplasty procedures. Because achieving adequate tip projection requires enough amount of dorsal augmentation and because it is difficult as a result of the weak nasal framework, costal cartilage is considered ideal as a source of autologous material.[7,8]

METHODOLOGY

A quasi-experimental study was conducted in the Department of Plastic Surgery, Fauji Foundation Hospital, Rawalpindi Pakistan, from Oct 2022 to Jun 2023 after obtaining ethical approval from the Institutional Review Board of Fauji Foundation Medical College and Hospital vide letter number **662/RC/FFH/RWP**. The sample size was calculated by using the WHO sample size calculator, keeping the power of test as 90%, level of significance was 5%, the test value of population mean (pain score on the first postoperative day) was 2.1, while anticipated population mean was 4.1. The standard deviation was 1.6. The minimal sample size came out to be 14 patients in each group. The minimum total sample size was 28 patients.

In this research protocol, a total of 32 patients who were undergoing elective septorhinoplasty were recruited using consecutive non-probability sampling. The participants were equally divided into two groups i.e., Group-A (in which muscle sparing was done using blunt dissection) and Group-B (in which monopolar electrocautery was used for muscle cutting), for the assessment of postoperative donor site pain. (Figure-3) Under the guidelines of the Helsinki Declaration, a written informed consent was obtained from all the study participants before data collection procedure.

Inclusion Criteria: Patients undergoing augmentation rhinoplasty with definite indications for ACCG, ages ranging from 15 to 35, and medically fit with no comorbidities were included.

Exclusion Criteria: Patients who were undergoing surgery due to acute nasal trauma, nasal patency, nasal polyps, and other pathological causes were excluded from this study. Patients with other medical comorbidities (hypertension, ischemic heart disease, and diabetes mellitus, etc.) and with a history of fibromyalgia & who developed postoperative complications (hematoma, seroma, pneumothorax, warping, etc.) were also excluded from this study.

All individuals who underwent rhinoplasty surgery underwent the procedure while under general anaesthesia for a variety of cosmetic and functional problems. Local anaesthesia was given 20 minutes before incision. All autologous costal cartilage was harvested. Mainly of 5th, 6th, or 7th ribs on the Left side were chosen for ACCG. A 5cm skin incision, regardless of any technique, was made with surgical blade no.15 at desired Rib. In females, the incision corresponds to the inframammary crease. The difference in surgical technique was at the dissection level. A No.15 blade was used to make a skin incision, and a hemostat was employed to bluntly dissect the subcutaneous tissue layer. The deep muscle fibers were then spread in the direction of their natural alignment, rather than cutting with electrocautery. The muscle was separated bluntly using the hemostat, following the direction of the muscle fibers. Following the skin incision, a monopolar electrocautery device operating in blend mode at 45 W was used to transect all layers, including subcutaneous fat, muscular fascia, and muscles.

After this, the costal cartilage is separated from the perichondrium using a free periosteal elevator, and the ACCG of the desired length is harvested. Perioperative Valsalva manoeuvre (positive intrathoracic pressure) was performed to rule out the possibility of pneumothorax. The absence of air bubbles indicates no pleural injury. Reverse closure

was done in layers, i.e., perichondrium, muscle, and fascia, with Vicryl 3-0. Skin closed with Prolene 5-0 in a subcuticular fashion in all patients. Post-operative Care, IV antibiotics & analgesics & position of patients were identical for all patients. I/V Ketorolac, opioids, and topical Bupivacaine were advised on an SOS basis. Patients were informed that they could request adequate pain relief, which included IV Ketorolac, followed by topical Bupivacaine, with IV opioids reserved as a last resort. This information was documented by the nursing staff. All patients were discharged on the third postoperative day.

Figure-1: Muscle Sparing Technique

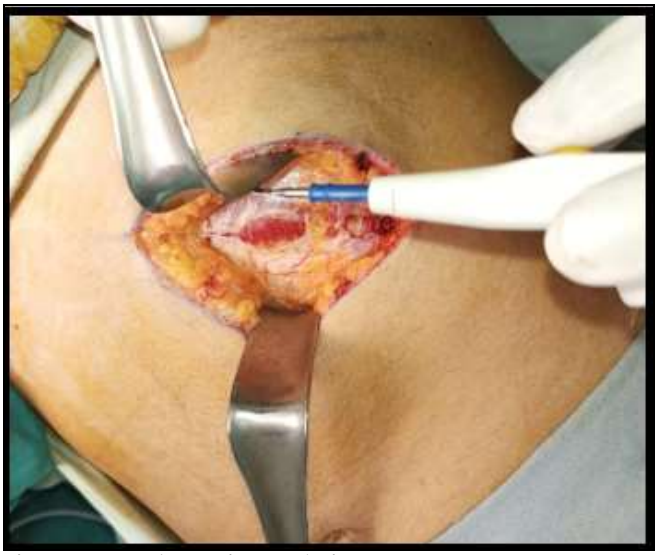

Figure-2: Muscle Cutting Technique

Detailed sociodemographic information was recorded, and for the assessment of the pain Visual Pain Analogue Scale (VAS) was used. VAS is a Likert-based 10-item scale with a score range of 0 to 10, in which 0 indicates no pain while 10 is suggestive of very high pain levels. Scores were recorded on zero postoperative days, followed by pain levels on the first, second & third days. Patients were discharged on the 3rd POD and called for follow-up in OPD & VAS for pain was recorded on the 7th, 10th, and 30th POD. Results were compared in both groups. Pain levels at rest or with movements (Active torso rotation) were also documented.

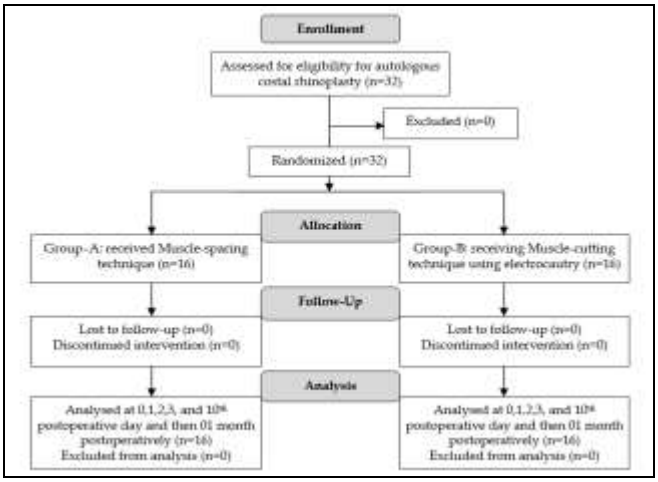

Figure-3: Patient Flow Diagram representing 2 Groups Receiving Muscle-Sparing Technique and Muscle-Cutting Technique for Autologous Costal Rhinoplasty (n=32)

Data was entered and analysed by using Statistical Package for Social Sciences (SPSS) software version 25. Mean and standard deviation were calculated for numerical variables like age and VAS pain score. Frequency and percentage were computed for categorical variables like gender. Independent sample T test was used to compare postoperative pain in both groups using *p*-value of <0.05 as significant.

RESULTS

The study consisted of a total of 32 patients. The mean age in Group-A was 20.7±5.5 years while in Group it was 21.7±4.9 years (p=0.602). Group-A consisted of 15 patients with 8(53.3%) females and 7(46.7%) males. They underwent surgery via the muscle-sparing technique. Group-B consisted of 17 patients with 11(64.7%) females and 6(35.3%) males. They underwent surgery via the muscle-cutting technique using electrocautery. The difference between the groups was non-significant (p=0.513).

Patients were asked about their postoperative pain both at rest and during movement. They were

requested to rate the severity of their pain using a Visual Analog Scale (VAS) ranging from 0 to 10, as previously discussed in the literature. This assessment was conducted on the day of surgery and the 1st, 2nd, 3rd, 7th, 10th, and 30th postoperative days, as illustrated in Table.

Table: Postoperative VAS Scores for Resting and Movement Pain

Postoperative Day	VAS Score, Mean±SD		*p*-value
	Group-A (n=15)	Group-B (n=17)	
Pain at Rest			
0	1.6±1.29	3.1±1.2	0.002
1	1.2±1.3	2.5±0.9	0.005
2	0.7±0.8	1.8±0.9	0.001
3	0.5±0.7	1.1±0.6	0.020
10	0.0±0.0	0.2±0.4	0.022
1 month	0.0±0.0	0.1±0.3	0.181
Pain at Movement			
0	2.8±1.4	5.1±1.1	<0.001
.01	2.4±1.4	3.9±1.2	0.003
2	1.6±1.0	2.8±0.9	0.002
3	1.1±1.1	1.9±0.9	0.043
10	0.53±0.7	1.0±0.7	0.056
1 month	0.0±0.0	0.5±0.7	0.003

DISCUSSION

The study showed that the muscle-sparing technique significantly decreased postoperative pain from day 1 to one month as compared to the muscle-cutting technique. The pain scores measured at rest and during movement showed "no pain," with a value of 0.0±0.0 one month postoperatively for the muscle-sparing technique. Graft harvesting operations are associated with certain complications, including scar-related problems, donor site pain, pleuritic chest pain, pleural tear, or seroma and hematoma formation.[11] However, postoperative pain at the donor site has been the most common morbidity when it comes to harvesting autologous grafts for rhinoplasty.[10] The study endorses that these complications can be minimized by the use of the proper technique and by following the required guidelines.[12] This research evaluated post-operative pain to assess the effectiveness of the muscle-sparing technique as compared to the muscle-cutting technique, and the results favored the muscle-sparing technique as it is associated with less postoperative pain in patients.

The same results were reproduced by Özücer *et al.,* in 2018, where both these techniques were compared in a non-randomized controlled trial.[9] Moreover, another study by Drake *et al.,* also stated the fact that the muscle-sparing technique is associated with less post-operative pain, and this supports the results of our work too. Additionally, the necrosis caused by the electrocautery used in the muscle-cutting procedure may be responsible for the discomfort at the donor site.[14]

Yi *et al.,* highlighted that postoperative complications and pain can be reduced if it is well managed in the postoperative period.[15] This study also considered the need for analgesics in the postoperative period for both techniques. Oral analgesics were effective for the muscle-sparing technique. However, intravenous strong analgesics, in addition to topical Bupivacaine, were necessary for the muscle-cutting techniques used in graft harvesting, as highlighted by Won *et al*.[13]

In Asia, very little work has been done in this field. Yet, autologous graft has been termed ideal for the augmentation rhinoplasty procedure. Additional work is needed to establish guidelines, safety procedures, and to explore new options endorsed by Zhang *et al*.[16] However, McGuire *et al.,* also considered the use of evidence-based protocols best for revision surgeries, and surgeons who have been working to find effective ways to reduce the effect of warping.[17]

Tutoplast is considered a great alternative to create allogeneic tissue grafts for surgical use and is now being evaluated for effectiveness.[18] Yoo *et al.,* has established that solid block costal cartilage and diced cartilage have proven to be appropriate alternatives for dorsal rhinoplasty with or without the use of wrapping material.[19] Irradiated homogenous costal cartilages have proven to be equally effective with less donor site morbidity in cleft surgeries. Hence, been recommended to be used.[20]

LIMITATION OF THE STUDY

The use of a small sample size has restricted the generalization of the results. Additionally, the gender imbalance in the muscle-cutting group may explain the increased need for analgesics in Group-B, as women tend to experience more severe pain and use more analgesics compared to men. In contrast, the muscle-sparing group does not exhibit any gender imbalance, which may introduce bias in the findings related to the muscle-cutting group.

CONCLUSION

The use of a muscle-sparing technique in the Autologous Costal Cartilage Graft procedure significantly reduces both resting pain and pain during movement at the donor site throughout the postoperative period. As a result, there is less need for analgesic medication. Therefore, the

study recommends the routine application of the muscle-sparing method to decrease postoperative pain at the donor site for these patients.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MM & AA: Data acquisition, data analysis, critical review, approval of the final version to be published.

SA & AA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

HF, NS & HM: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Halepas S, Lee KC, Castiglione C, Ferneini EM. Grafting in modern rhinoplasty. Oral Maxillofac Surg Clin North Am 2021; 33(1): 61-69. https://doi.org/10.1016/j.coms.2020.09.003
2. Ho TT, Sykes K, Kriet JD, Humphrey C. Cartilage graft donor site morbidity following rhinoplasty and nasal reconstruction. Craniomaxillofac Trauma Reconstr 2018; 11(4): 278-284. https://doi.org/10.1055/s-0037-1607065
3. Fedok FG. Costal cartilage grafts in rhinoplasty. Clin Plast Surg 2016; 43(1): 201-212. https://doi.org/10.1016/j.cps.2015.08.002
4. Fu X, Yin C, Liang Y, Zhou R, Wang D, Wang C. Hybrid autologous costal cartilage grafting for augmentation rhinoplasty in Asian patients. J Craniofac Surg 2023; 34(4): 1320-1324. https://doi.org/10.1097/scs.0000000000009281
5. Sinclair S, Walsh WR. Characterization of costal cartilage allografts. ANZ J Surg 2022; 92(9): 2274-2279. https://doi.org/10.1111/ans.17967
6. Wee JH, Park MH, Oh S, Jin HR. Complications associated with autologous rib cartilage use in rhinoplasty: a meta-analysis. JAMA Facial Plast Surg 2015; 17(1): 49-55. https://doi.org/10.1001/jamafacial.2014.914
7. Varadharajan K, Sethukumar P, Anwar M, Patel K. Complications associated with the use of autologous costal cartilage in rhinoplasty: a systematic review. Aesthet Surg J 2015; 35(6): 644-652. https://doi.org/10.1093/asj/sju117
8. Chen H, Wang X, Deng Y. Complications associated with autologous costal cartilage used in rhinoplasty: an updated meta-analysis. Aesthetic Plast Surg 2023; 47(1): 304-312. https://doi.org/10.1007/s00266-022-03075-3
9. Özücer B, Dinç ME, Paltura C, Koçak I, Dizdar D, Çörtük O, et al. Association of autologous costal cartilage harvesting technique with donor-site pain in patients undergoing rhinoplasty. JAMA Facial Plast Surg 2018; 20(2): 136-140. https://doi.org/10.1001/jamafacial.2017.1363
10. Zhao R, Pan B, Lin H, Long Y, An Y, Ke Q. Application of trans-areola approach for costal cartilage harvest in Asian rhinoplasty and comparison with traditional approach on donor-site morbidity. Aesthet Surg J 2020; 40(8): 829-835. https://doi.org/10.1093/asj/sjaa012
11. Balaji SM. Costal cartilage nasal augmentation rhinoplasty: Study on warping. Ann Maxillofac Surg 2013; 3(1): 20-24. https://doi.org/10.4103/2231-0746.110070
12. Olcott CM, Pearlman SJ. The current trend of autologous costal cartilage harvest by facial plastic surgeons for rhinoplasty in the United States. Plast Aesthet Res 2019; 6: 3. https://doi.org/10.20517/2347-9264.2018.79
13. Won TB, Jin HR. Complications of costal cartilage Asian rhinoplasty and their management. Facial Plast Surg 2020; 36(5): 528-538. https://doi.org/10.1055/s-0040-1717146
14. Drake VE, Mowery AJ, Nellis JC. An update on rib grafting in rhinoplasty: which rib is right? Curr Opin Otolaryngol Head Neck Surg 2022; 30(4): 209-214. https://doi.org/10.1097/moo.0000000000000807
15. Yi JS. Preoperative considerations, operative preparation, and postoperative care for rib cartilage use in rhinoplasty. Plast Aesthet Res 2019; 6: 7. https://doi.org/10.20517/2347-9264.2018.77
16. Zhang L, Ma WS, Bai JP, Li XX, Li HD, Zhu T, et al. Comprehensive application of autologous costal cartilage grafts in rhino-and mentoplasty. J Craniofac Surg 2019; 30(7): 2174-2177. https://doi.org/10.1097/scs.0000000000005858
17. McGuire C, Samargandi OA, Boudreau C, Whelan A, Bezuhly M. Prevention of autologous costal cartilage graft warping in secondary rhinoplasty. J Craniofac Surg 2020; 31(5): 1246-1250. https://doi.org/10.1097/scs.0000000000006429
18. Vila PM, Jeanpierre LM, Rizzi CJ, Yaeger LH, Chi JJ. Comparison of autologous vs homologous costal cartilage grafts in dorsal augmentation rhinoplasty: a systematic review and meta-analysis. JAMA Otolaryngol Head Neck Surg 2020; 146(4): 347-354. https://doi.org/10.1001/jamaoto.2019.4787
19. Yoo SH, Jang YJ. Rib cartilage in Asian rhinoplasty: new trends. Curr Opin Otolaryngol Head Neck Surg 2019; 27(4): 261-266. https://doi.org/10.1097/moo.0000000000000547
20. Jenny HE, Siegel N, Yang R, Redett RJ. Safety of irradiated homologous costal cartilage graft in cleft rhinoplasty. Plast Reconst Surg 2021; 147(1): 76e-81e. https://doi.org/10.1097/prs.0000000000007431