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Analysis of the Effect and Complication of Costochondral Graft in Constructing Nasal Tip Cartilage Composite for Rhinoplasty

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Abstract: *Objective:* To analyze the therapeutic effect of costochondral graft (CCG) in constructing nasal tip cartilage composite for rhinoplasty. *Methods:* 84 rhinoplasty patients who were admitted to the hospital between September 2021 and September 2023 were selected and randomly grouped into a study group and a reference group of 42 cases each. The study group was prepared with CCG to construct a nasal tip cartilage composite and the reference group was filled with silicone material to compare the effectiveness of plastic surgery. *Results:* The plastic effect scores and the perioperative indexes of the study group were all higher than those of the reference group ($P < 0.05$). Before treatment, there was no difference in the nose-shaping indexes between both groups ($P > 0.05$). After treatment, the nasal plasticity indexes of the study group were all better than those of the reference group ($P < 0.05$). The complication rate of the study group was lower than that of the reference group ($P < 0.05$). *Conclusion:* The preparation of nasal tip cartilage composite using CCG improved the therapeutic effect of rhinoplasty, improved the perioperative indexes and nasal contouring indexes, and had fewer complications.

Keywords: Costochondral graft; Nasal tip cartilage composite; Rhinoplasty; Complications

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1. Introduction

Abnormal nasal morphology, such as nostril deformity or tip hypertrophy, significantly affects facial aesthetics and requires rhinoplasty treatment [1]. This procedure is more effective in the correction of nasal defects and can change the shape of the bridge and tip of the nose at the present stage and enhance the aesthetic appearance. In rhinoplasty, a large amount of silicone material is used, which can achieve a better effect, but it has a strong rejection reaction and is prone to postoperative complications. In comparison, costochondral graft (CCG) is a new type of plastic material and has a relatively simple method of extraction, which is taken from the patient's rib cage, so there are fewer postoperative complications [2]. Based on this, 84 rhinoplasty patients were selected in this study to evaluate the therapeutic efficacy of CCG in constructing nasal tip cartilage composite.

2. Information and methods

2.1. General information

84 rhinoplasty patients who were admitted to the hospital between September 2021 and September 2023 were selected and randomly grouped into a study group and a reference group of 42 cases. The study group consisted of 23 males and 19 females aged 23–66 years old, with an average of 39.65 ± 2.74 years. There were 16 cases of hypertrophied nasal tip, 10 cases of a broad nose, 9 cases of saddle nose, and 7 cases of low noses. The body mass index (BMI) ranged from 18.8–27.6 kg/m^2, with an average of 22.18 ± 3.25 kg/m^2. The reference group consisted of 24 males and 18 females aged 23–68 years old, with an average age of 40.26 ± 2.65 years. There were 17 cases of hypertrophied nasal tip, 11 cases of a broad nose, 8 cases of saddle nose, and 6 cases of low noses. The BMI ranged from 18.5–27.8 kg/m^2, with an average of 22.38 ± 3.14 kg/m^2. The data between the groups were comparable and were not significant ($P > 0.05$). Inclusion criteria: (1) Patients who meet the indications related to the surgery of rhinoplasty; (2) legal adults; (3) good mental status; (4) know the surgical operation process and CCG-taking process; (5) good coagulation function; (6) consented. Exclusion criteria: (1) Patients with cardiopulmonary insufficiency; (2) during lactation or pregnancy; (3) acute/chronic infection; (4) liver and kidney failure; (5) dropped out halfway.

2.2. Methods

Silicone materials were used for the reference group and patients were assisted in completing the preoperative examination. After entering the room, patients were placed in the supine position and the multifunctional monitor was connected to the room for continuous monitoring. After local anesthesia treatment, the patient's disease condition was evaluated, and targeted surgery was performed. An incision at the tip of the nose and nostrils was made and the subcutaneous tissue was separated layer by layer, to reach the cartilage of the nasal septum, and reveal the operation area. A silicone prosthesis model was prepared according to the shape of the nose. The prosthesis was inserted from the bottom up and the angle of the prosthesis was adjusted to ensure satisfactory results. Then, the prosthesis was fixed and the incision was closed after removing the excess tissue.

The study group utilized CCG to prepare the nasal tip cartilage composite and combined with the nasal shape conditions, cosmetic needs, and expectations, the rib cartilage was selected, and the sampling location was at the 5th/6th/7th rib cartilage. Before the operation, the patient was assisted to adopt the correct position. Their vital signs were measured and the local anesthesia operation with nerve block was performed. During the operation, the incision was performed in the center of the chest. After an incision along the skin lines, the costal cartilage was removed. Local anesthetic was injected into the cartilage membrane layer for analgesic treatment, and the chest incision was closed. After simple disposal of the rib cartilage, it was set aside. An incision was made at the tip of the nose and inside the nostrils, and the tissues were peeled off layer by layer to separate the lateral cartilages of the nose and the nasal columella to expose the cartilage area of the nasal septum. The deformity of the nasal septum was also adjusted to correct its deviation. The cartilaginous bones of the nasal flanks were removed to reduce the size of the nasal tip, and the bone fragments were placed from the bottom to the top. The position of the bone fragments was adjusted according to the degree of protrusion of the nasal tip and its specific shape of the nasal tip, and the cartilaginous complex of the nasal tip was moderately pulled and fixed to improve its stability. The nasal tip was elevated, the nearby soft tissues were removed, and the subcutaneous tissues were closed and sutured.

After the operation, the blood pressure and heart rate of both groups were measured. The patient's facial expressions were evaluated and the speed and dose of anesthesia drugs were reasonably adjusted. The patients were asked to stay in observation for 2 hours after the operation and were sent to the general ward after their signs stabilized. Antibacterial drugs prescribed by the doctor were also used.

2.3. Observation indexes

The effect of plastic surgery was assessed via a homemade questionnaire containing items like nasal tip mobility, nasal stiffness, natural beauty, three-dimensional sense of nasal shape, and satisfaction with the effect, with 20 points for each item. Perioperative indicators, such as the success rate of surgery were analyzed, whether the position of the nasal body is centered, the nasal shape is beautiful and natural, and if the nose is coordinated with the five senses. The incision healing time and hospitalization time were also measured. Nasal contouring indexes between the two groups were compared. The nasal root height was evaluated with vernier calipers, which refers to the distance between the nasal root notch and the lateral intraorbital rim. The frontal/nasofacial/nasal tip angles were measured with Image pro-plus 6.0, in which the frontal angle refers to the angle between the dorsal nasal oblique surface and the root of the nose, the nasal facial angle refers to the angle between the nasal facial surface and the dorsal nose, and the nasal tip angle refers to the angle between the nasal dorsal nose and nasal columella. The complication rate of infection, swelling and oozing blood, nasal deformation, and prosthesis protrusion between the two groups were also compared.

2.4. Statistical analysis

Data were analyzed using the SPSS28.0 software. Measurement data were expressed as mean ± standard deviation and the count data were expressed as %. Measurement data were analyzed using a *t*-test, and count data were analyzed using a chi-squared (χ^2) test. Results were considered statistically significant at $P < 0.05$.

3. Results

3.1. Comparison of plasticizing effect between the two groups

As shown in **Table 1**, the plasticizing effect scores of the study group were higher than those of the reference group ($P < 0.05$).

Table 1. Comparison of the plasticizing effect of the two groups (mean ± standard deviation, points)

Group	Cases, *n*	Tip mobility	Stiffness of the nose	Natural aesthetics	Three-dimensional nose shape	Satisfaction with results
Study group	42	16.53 ± 1.87	17.12 ± 1.53	16.97 ± 1.61	17.23 ± 1.58	17.86 ± 1.06
Reference group	42	13.26 ± 1.80	15.03 ± 1.51	14.24 ± 1.53	15.12 ± 1.55	15.34 ± 1.02
t	-	8.165	6.301	7.966	6.178	11.102
P	-	0.000	0.000	0.000	0.000	0.000

3.2. Comparison of perioperative indicators between the two groups

As shown in **Table 2**, the perioperative indicators of the study group were better than those of the reference group ($P < 0.05$).

Table 2. Comparison of perioperative indicators between the two groups (mean ± standard deviation, %)

Group	Cases, *n*	Surgical success rate	Incision healing time (d)	Length of hospitalization (d)
Study group	42	97.62 (41/42)	8.01 ± 1.36	4.71 ± 0.67
Reference group	42	80.95 (34/42)	15.10 ± 1.49	6.79 ± 0.78
χ^2/t	-	6.098	22.777	13.110
P	-	0.014	0.000	0.000

3.3. Comparison of the nose-shaping indexes of the two groups

As shown in **Table 3**, before treatment, there was no difference in the comparison of the nose-shaping indexes between the two groups ($P > 0.05$). After treatment, the nose-shaping indexes of the study group were better than those of the reference group ($P < 0.05$).

Table 3. Comparison of nose-shaping indexes between the two groups (mean ± standard deviation)

Group	Cases, *n*	High nasal root (mm)		The angle between the forehead and the nose (°)		Nasofacial angle (°)		Tip of the nose (°)	
		Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Study group	42	6.26 ± 1.27	6.22 ± 0.45	137.68 ± 4.74	137.12 ± 3.82	28.39 ± 3.11	28.09 ± 2.67	89.42 ± 3.66	89.16 ± 3.57
Reference group	42	6.29 ± 1.22	5.98 ± 0.41	136.54 ± 4.90	135.02 ± 3.72	28.42 ± 3.15	26.51 ± 2.60	89.38 ± 3.71	87.01 ± 3.50
t	-	0.110	2.555	1.084	2.552	0.044	2.748	0.050	2.787
P	-	0.912	0.012	0.282	0.013	0.965	0.007	0.960	0.007

3.4. Comparison of complication rates between the two groups

As shown in **Table 4**, the complication rate of the study group was lower than that of the reference group ($P < 0.05$).

Table 4. Comparison of complication rates between the two groups [*n* (%)]

Group	Cases, *n*	Infections	Swelling and oozing blood	Nasal deformity	Prosthesis protruding from the body	Rate of occurrence
Study group	42	1 (2.38)	1 (2.38)	0	0	4.76 (2/42)
Reference group	42	2 (4.76)	4 (9.52)	1 (2.38)	1 (2.38)	19.05 (8/42)
χ^2	-	-	-	-	-	4.087
P	-	-	-	-	-	0.043

4. Discussion

Rhinoplasty is treated frequently in plastic surgery departments, to adjust the shape of the nose and improve the aesthetics [3]. During the surgery, plastic materials can be placed in the nose as a way to change the nasal height and shape and adjust the coordination of other features. The surgical technique of this procedure is more developed and has a higher success rate, but there are certain plastic materials available that can affect the results. Hence a scientific selection of treatment materials is needed.

Silicone is a commonly used material for rhinoplasty, which is stable, has high physical inertia, and does not denature easily after being placed into the nose [4]. In addition, the price of silicone is low, which can reduce the financial burden of patients. However, silicone can easily slide and may appear after plastic surgery as prosthesis sagging. It also has poor pressure resistance, which may lead to nasal deformation when exposed to external impact, or even damage the nasal bone, resulting in prosthesis protrusion. In addition, the translucency of silicone material is relatively strong. Under the stimulation of bright light, it will form a more distinctive transparency difference with the surrounding structure of the nose, presenting a translucent nasal structure, which will reduce the aesthetics of plastic surgery. In traditional rhinoplasty, the ear cartilage is chosen as

the plastic material. However, it has a soft texture and poor strength, hence the risk of nasal tip deformation is higher [5]. In contrast, CCG utilizes plastic material taken from the rib cartilage and the nasal tip cartilage composite prepared has high histocompatibility. It does not easily cause a rejection reaction when it is placed into the nose and can maintain the volume of transplanted rib cartilage as well as the cellular morphology. This significantly increases the success rate of the surgery and enhances the aesthetic of the nose. It is more flexible and has a good sense of realism. As the rib cartilage is taken from the surface of the body, the surgical method is relatively simple and convenient and does not cause obvious trauma to the tissues around the incision. Hence, the surgical stress reaction is minimal, and postoperative complications can be avoided [6]. In addition, the autologous rib cartilage has strong plasticity and can be precisely sculpted in combination with the nose shape, which can ensure the molding effect after graft and increase the firmness and fullness of the nose. More importantly, rib cartilage has a strong resistance to compression, hence nasal deformation does not happen easily under external impact, and there are no translucency defects [7].

The results showed that the plasticizing effect scores of the study group were higher than those of the reference group ($P < 0.05$). The surgical success rate in the observation group was higher than that of the study group, and the incision healing time and length of hospitalization of the study group were shorter than those of the reference group ($P < 0.05$). After treatment, the root height of the nose in the study group was higher than that of the reference group, and the frontal angle of the nose and other indicators were better than those of the reference group ($P < 0.05$). The complication rate in the study group was lower than that of the reference group ($P < 0.05$). The reason for this is that the CCG can be highly adhered to the surrounding tissues after being inserted into the nose, has a lower chance of rejection, and thus has a higher surgical success rate and safety. The nasal features of our population are typical, mostly rounded tips and are relatively flat [8]. The nasal tip cartilage composite prepared by CCG can stabilize and support the nasal tip and has a better effect on nasal contouring. The mechanical advantage of rib cartilage is more obvious and its strong support can maintain the sense of nasal straightness and the stability of rhinoplasty. Moreover, rib cartilage is abundant and mostly taken from the 5th/6th/7th rib cartilage, which can be easily removed [9]. The surgical technique of CCG composite is more developed, the surgical equipment is excellent, and the intraoperative incision is small. Hence, there is minimal surgical trauma and the postoperative complications are significantly reduced. CCG composite also promotes the moderate retraction of the nasal wing margin, significantly improves the height of the nasal tip, and does not easily cause long-term adverse events such as the tilting of nasal columnar or nasal tip retraction [10]. However, this procedure requires an additional incision in the chest, and the operation of cartilage separation is relatively difficult, so the technical requirements for the surgeon are high. According to the state of the patient's nose, the surgical plan must be reasonably determined and standardized to ensure the efficacy of the operation.

5. Conclusion

In conclusion, the implementation of CCG preparation of nasal tip cartilage composite for rhinoplasty patients can achieve better plastic surgery results and higher safety benefits.

Disclosure statement

The author declares no conflict of interest.

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