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INNOVATIVE TECHNIQUE

Effect of the Sequence of Lateral Osteotomy and Hump Removal on the Aesthetic Outcome

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Abstract
Background The authors hypothesized that by modifying the sequence of the rhinoplasty procedure they could avoid comminuted fractures resulting in suboptimal cosmetic results.
Methods Percutaneous perforated lateral nasal osteotomies were performed in 36 fresh human cadaver heads. In the first group of 19 cadaver heads with big nasal humps, the perforations of the lateral wall were done before and digital infracturing after hump removal in 10 cases (subgroup A1). In the remaining 9 noses with big humps, the perforations and digital infracturing were performed after hump removal (subgroup group A2). In a second group of 17 cadaver heads with small humps, perforations were performed before hump removal in 8 cases (subgroup B1), and in the remaining 9 cases, the lateral walls were perforated after hump removal (subgroup B2). The number of fractured nasal bones was counted. In addition, the size and shape of the nasal bone fragments were described in a blinded fashion.
Results Analysis of the number of fractured nasal bones yields higher rates for "osteotomies after" (8.44 vs. 5.83) and hump size "big" (8.37 vs. 5.76), with some influence of age and gender.
Conclusions The pattern of fractures after perforations of the lateral wall seems to be more regular if the perforations are done before the removal of bigger humps. In noses with small humps or no hump, no difference is seen regarding the sequence of the perforations in relation to hump removal.

Keywords Hump size · Nasal bone fragments · Nasal osteotomy · Sequence of rhinoplasty steps

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The procedural steps of rhinoplasty are temporally and technically interdependent, from reduction of the nasal dorsum to remodeling of the nasal tip and repair of the nasal septum or narrowing of the nasal pyramid [1–5]. In most cases, these fundamental steps should be modified according to the characteristics of each individual case. To achieve the best aesthetic outcome, the surgeon changes the skeletal part with the intention to create the desired shape of the nose [6, 7].

Lateral osteotomy is the basic step in changing the skeletal support of the nose. In many cases, lateral osteotomy is necessary [6, 8, 9]. However, because this procedure is traumatic and poorly controllable, it is difficult to attain consistent results, bearing many minor technical difficulties, regardless how carefully the procedure is performed [8, 9]. It is almost impossible to control the fracture pattern exactly, and in extreme cases, comminution can occur. Because the procedure is performed in a blinded maneuver without sufficient visual control, it is dependent on the detailed knowledge of nose anatomy, including its variations, and of course the surgeon's experience [9–11].

A variety of techniques and tools are used to perform lateral osteotomies [12–16]. Currently, the two methods

most frequently used are the internal continuous procedure and the external perforated technique [17–21].

Although various techniques of lateral nasal osteotomy have been compared in several previous studies [18–20, 22–24], to our knowledge, there has been no report of the final outcome based on a change in the temporal sequence of the procedure. We observed that performing lateral osteotomy before hump removal prevents the development of irregular bony fragments and thus leads to a more favorable aesthetic result.

Materials and Methods

We performed percutaneous perforated lateral nasal osteotomies in 36 cadaver heads (total of 72 lateral nasal walls). The mean age of the cadavers was 77 years (range, 63–92 years) (Tables 1, 2).These osteotomies were performed by three experienced surgeons in the following distribution: 19 cadaver heads with big nasal humps ("big") (group A) and 17 cadaver heads with small or absent nasal humps (group B).

The osteotomy was performed in the following manner:

- *Subgroup A1*: In 10 noses (6 women and 4 men), the perforation of the lateral wall was done before hump removal ("before"), whereas digital infracturing followed hump removal (Fig. 1a, b).

Table 1 Female group

Cadaver	Age (years)	No. of fragments	Group	Hump size	Osteotomy
1	63	5	A1	Big	Before
2	65	5	A1	Big	Before
3	78	6	A1	Big	Before
4	83	6	A1	Big	Before
5	85	7	A1	Big	Before
6	92	7	A1	Big	Before
7	89	12	A2	Big	After
8	79	11	A2	Big	After
9	81	11	A2	Big	After
10	86	13	A2	Big	After
11	80	5	B1	Small	Before
12	79	4	B1	Small	Before
13	73	4	B1	Small	Before
14	71	5	B2	Small	After
15	81	6	B2	Small	After
16	91	7	B2	Small	After
17	88	6	B2	Small	After

Table 2 Male group

Cadaver	Age	No. of fragments	Group	Hump size	Osteotomy
1	67	7	A1	Big	Before
2	65	6	A1	Big	Before
3	82	7	A1	Big	Before
4	83	6	A1	Big	Before
5	87	11	A2	Big	After
6	74	9	A2	Big	After
7	69	9	A2	Big	After
8	73	10	A2	Big	After
9	71	11	A2	Big	After
10	77	6	B1	Small	Before
11	64	5	B1	Small	Before
12	62	5	B1	Small	Before
13	81	7	B1	Small	Before
14	83	7	B1	Small	Before
15	82	7	B2	Small	After
16	79	6	B2	Small	After
17	78	6	B2	Small	After
18	76	7	B2	Small	After
19	68	5	B2	Small	After

- *Subgroup A2*: In the remaining 9 cadaver heads (4 women and 5 men), the perforations were completed after hump removal ("after") and before the infracturing step (Fig. 2a, b).
- *Subgroup B1*: In 8 cases (3 women and 5 men), the perforation was performed before hump removal, followed by digital infracturing (Fig. 1a).
- *Subgroup B2*: In the remaining 9 cadavers (4 women and 5 men), the perforations were performed after hump removal, followed by digital infracturing (Fig. 2a).

Before further preparation, a number was assigned to each cadaver head, and the nasal parts were respectively packed in a net to avoid loss of bony fragments of the nasal framework. After the fractured nasal bones had been dried, two experienced anatomists examined the fragments in terms of number, size, and shape in a blinded fashion.

The lateral osteotomy was performed with a 2-mm sharp, straight osteotome. The osteotome was inserted transcutaneously in a horizontal plane parallel to the surface of the maxilla or from an infraorbital incision [12, 15, 21].

Multiple perforations were made with the sharp edge of the osteotome. After completion of the bilateral osteotomies, the thumb and forefinger were used to infracture the lateral bony wall to shape the nasal framework to the desired state. Respectively, the digital infracturing was performed as the last operating step to ensure the stability of the nasal pyramid during hump removal.

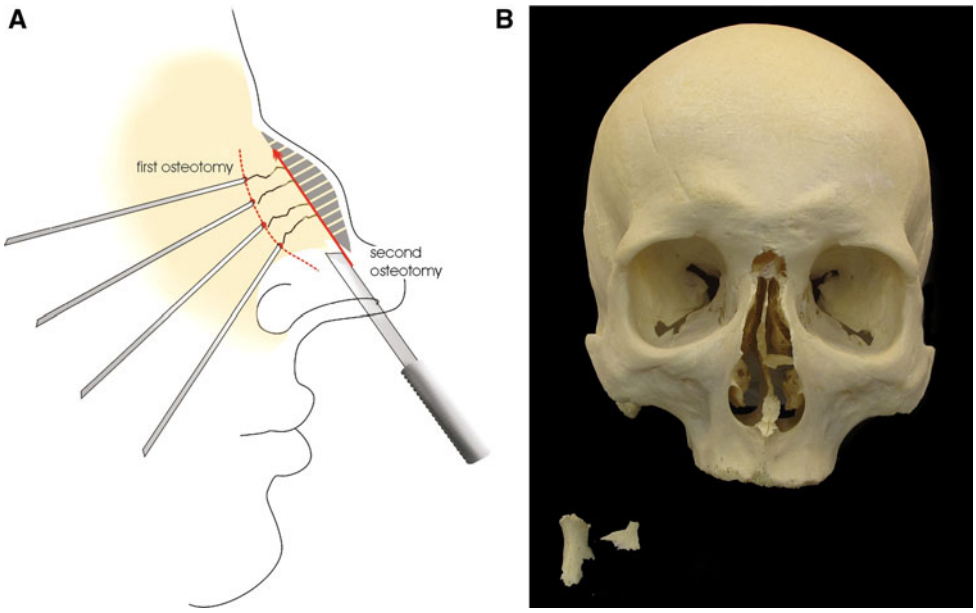

Fig. 1 Lateral osteotomy before removal of a big hump. **a** Outcome regarding bony fragments schematically. **b** Cadaver head with removal of a big hump after drying

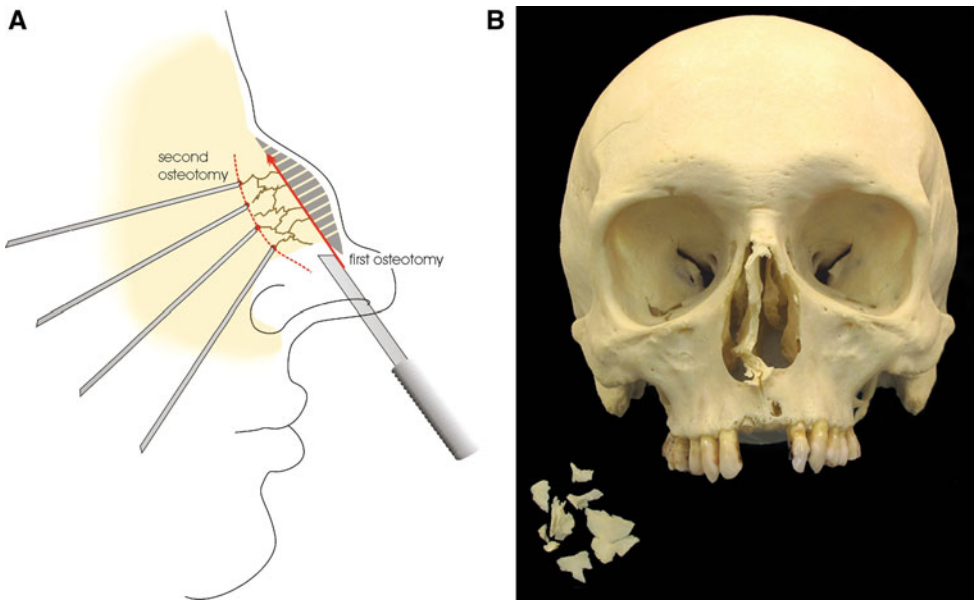

Fig. 2 Lateral osteotomy after removal of a big hump. **a** Outcome regarding bony fragments schematically. **b** Cadaver head with removal of a big hump after drying

Statistical Analysis

The data were described by means and standard deviations. A four-factor analysis of covariance model was fitted to the data. The model building factors were age, sex, hump size, osteotomy, and effect modifiers (osteotomy within hump sizes, osteotomy within gender groups, and hump sizes within gender groups). Effects were classified as significant if the p value fell below 0.05 (5% significance level). The model was implemented in SAS Proc Mixed V9.02 (SAS Institute, Cary, NC) under Windows XP.

Results

The analysis of the number of fractured nasal bones yielded higher rates for osteotomy "after" (8.44 ± 2.62 vs. 5.83 ± 1.04) and for hump size "big" (8.37 ± 2.56 vs. 5.76 ± 1.03). Furthermore, the rates were smaller for the men than for the women (10.0 vs. 11.75) (Table 3).

We observed a significantly higher number of fragments for osteotomy "after" ($p < 0.0001$), hump size "big" ($p < 0.0001$), gender "women" ($p = 0.0114$), and age ($p = 0.0114$). However, the higher numbers for osteotomy

Table 3 Overview of the main results

Osteotomy	Hump size	Sex	N	Mean	SD	Minimum	Maximum
0:Before	Small	Female	3	4.33	0.58	4.00	5.00
		Male	5	6.00	1.00	5.00	7.00
	Big	Female	6	6.00	0.89	5.00	7.00
		Male	4	6.50	0.58	6.00	7.00
1:After	Small	Female	4	6.00	0.82	5.00	7.00
		Male	5	6.20	0.84	5.00	7.00
	Big	Female	4	11.75	0.96	11.00	13.00
		Male	5	10.00	1.00	9.00	11.00

"after" were mostly a difference between hump size small versus big. In big humps, the number was smaller for osteotomy "before" than for osteotomy "after" ($p < 0.0001$), as seen by the least square means.

Similarly, the higher numbers for osteotomy "after" were dependent on the gender ($p = 0.0007$). This relationship was obvious by the least square means: The mean difference for osteotomy "before" (5.1 for the women vs. 6.5 for the men) was ranked in the opposite direction for osteotomy "after" (8.4 for the women vs. 8.2 for the men).

Finally, the higher numbers for hump size "small" depended on the gender ($p = 0.0012$) too, as deduced by the least square means again. For hump size "small," they showed a mean difference of 4.95 for the women and 6.3 for the men, which again was in the opposite direction for hump size "big," with 8.6 for the women and 8.5 for the men.

Discussion

Aesthetic surgery continually seeks improved and novel techniques to achieve the best aesthetic outcomes with a minimum of complications, ease of performance, and a high rate of reproducibility, controllability, and reliability [5–7, 9, 13–18] Lateral osteotomy, said to be the most traumatic part of rhinoplasty, is required in many cases of cosmetic rhinoplasty to narrow the nasal width if there is an open roof after hump reduction.

Most methods in use have the disadvantage of being a blinded manipulation that depends significantly on the surgeon's skills and experience, bearing the potential for imprecision and variability. Therefore, it is not surprising that the lateral osteotomy can cause an undesired fracture pattern, resulting in many irregular bony fragments of the lateral nasal wall. Because the nasal skin is very thin, any irregularity of the nasal dorsum will be easily seen, causing a disappointing outcome. To keep the nasal vault standing stably, similar to a tent, the perforation of the lateral wall should be done before removal of a bigger dorsal hump.

We have performed external lateral osteotomy in a perforating manner as the last stage of rhinoplasty for more than 10 years and have realized the necessity of modifying our approach. Looking for a solution to avoid the described irregularities, we performed the external lateral osteotomy in a suitable collection of fresh cadaver noses, varying the sequence of the operating steps. Thus we aimed to obtain valid data regarding our study objective.

In cadaver noses with bigger humps (group A), many smaller, irregular bony fragments were detected if the osteotomies were performed after hump removal (subgroup A2) (Fig. 2a, b), whereas in all other noses, fewer bony fragments with a bigger size and a more regular shape were visualized (subgroups A1, B1, and B2). (Fig. 1a, b). In addition, our examination confirmed that with advancing age, the bony nasal pyramid becomes more brittle and fragile due to atrophy with aging [25–30]. Also in women, the nasal bone is thinner and becomes more unstable [31]. This explains the unpredictability of the osteotomy outcome because the bone is more prone to comminution and irregularity.

Conclusions

Although it is suggested that lateral osteotomy be performed as the last step in rhinoplasty to reduce postoperative ecchymosis and edema, it can be performed at any time during the surgical procedure without the feared complications by staying subperiostally [15]. Our results suggest that for big humps, lateral osteotomy should be performed before hump removal to avoid instability of the nasal wall and to achieve better and more predictable cosmetic outcomes.

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