

# Use of mid-forehead flap in nasal reconstruction

## *Uso do retalho médio-frontal na reconstrução do nariz*

HENRIQUE P. L. CINTRA<sup>1</sup>

ALI BOUCHAMA<sup>2</sup>

THIAGO HOLANDA<sup>2</sup>

CARLOS ALBERTO JAIMOVICH<sup>1</sup>

IVO PITANGUY<sup>3</sup>

### ABSTRACT

**Background:** Six hundred years before Christ, the mid-forehead flap was described by the Indian Sushruta Samhita. Until today, this flap called “Indian flap”, has a major role in the reconstruction of the nose. The aim of this work was to analyze the results of the 38<sup>th</sup> Infirmary of the Santa Casa da Misericórdia of Rio de Janeiro, Professor Ivo Pitanguy’s Service, in nasal reconstruction with the mid-forehead flap. **Methods:** We did a retrospective study of 10 cases operated in the service for nasal reconstruction with Indian flap, during a 21 year period (1991-2012). **Results:** The number of nasal sub-units affected varied from 4 to 9, with an average of 6.5 subunits. In 70% of the patients, was performed a previous expansion of the mid-forehead flap and in 90% were used cartilage grafts and/or bones. Five patients had postoperative distortions, that were corrected with other surgeries. No cases of infection, necrosis of the flap or graft extrusion were recorded. **Conclusions:** This study allowed to demonstrate that the mid-forehead flap still have an important role in nasal reconstruction of major defects, showing satisfactory results due to its vascular safety, the amount of skin which is obtained, likeness of color, texture and skin thickness.

**Keywords:** Reconstructive surgical procedures. Nose/surgery. Surgical flap. Forehead/surgery. Plastic surgery/methods.

### RESUMO

**Introdução:** Seiscentos anos antes de Cristo, foi descrito o retalho médio-frontal pelo indiano Sushruta Samhita. Até hoje, esse retalho, chamado “retalho indiano”, é usado na reconstrução do nariz. O objetivo deste trabalho foi analisar os resultados da 38<sup>a</sup> Enfermaria da Santa Casa da Misericórdia do Rio de Janeiro, Serviço do Professor Ivo Pitanguy, na reconstrução nasal com emprego de retalho médio-frontal. **Método:** Foi realizado estudo retrospectivo com 10 casos operados no serviço referido para reconstrução nasal com retalho indiano, no período de 21 anos (1991 a 2012). **Resultados:** O número de subunidades nasais atingidas variou de 4 a 9, com média de 6,5 subunidades. Em 70% dos pacientes foi realizada expansão prévia do retalho médio-frontal e em 90% foram utilizados enxertos cartilagosos e/ou ósseos. Cinco pacientes apresentaram distorções pós-operatórias, que foram corrigidas por outras cirurgias. Nenhum caso de infecção pós-operatória, de necrose do retalho ou de extrusão de enxertos foi registrado. **Conclusões:** Este trabalho permitiu demonstrar que o retalho médio-frontal tem ainda importante papel na reconstrução nasal de grandes defeitos, com resultados satisfatórios, atribuídos a sua segurança vascular, à quantidade de pele que se obtém, e à semelhança de cor, textura e espessura cutâneas.

**Descritores:** Procedimentos cirúrgicos reconstrutivos. Nariz/cirurgia. Retalhos cirúrgicos. Testa/cirurgia. Cirurgia plástica/métodos.

This study was performed at the 38<sup>a</sup> Enfermaria da Santa Casa da Misericórdia do Rio de Janeiro, Serviço do Professor Ivo Pitanguy (38<sup>th</sup> Infirmary of the Santa Casa da Misericórdia of Rio de Janeiro, Professor Ivo Pitanguy’s Service), Rio de Janeiro, RJ, Brazil.

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1. Plastic surgeon, full member of the Sociedade Brasileira de Cirurgia Plástica (Brazilian Society of Plastic Surgery - SBCP), assistant professor at Ivo Pitanguy Institute, Rio de Janeiro, RJ, Brazil.
2. General surgeon, postgraduate student at the Institute Ivo Pitanguy, Rio de Janeiro, RJ, Brazil.
3. Full professor of PostGraduation in Plastic Surgery at Pontifícia Universidade Católica do Rio de Janeiro (Pontifical Catholic University of Rio de Janeiro - PUCRio) and Institute Carlos Chagas, head of the 38<sup>a</sup> Enfermaria da Santa Casa da Misericórdia do Rio de Janeiro, Serviço do Professor Ivo Pitanguy (38<sup>th</sup> Infirmary of the Santa Casa da Misericórdia of Rio de Janeiro, Professor Ivo Pitanguy’s Service), full member of the SBCP, full member of the National Academy of Medicine and the Brazilian Academy of Letters, PUCRio, Rio de Janeiro, RJ, Brazil.

## INTRODUCTION

The history of nasal reconstruction is intertwined with the history of plastic surgery. Since the Vedic period (2000-500 BC) in ancient India, when adultery was punishable by amputation of the nose, has already been stories of plastic surgeries performed in the nasal region<sup>1</sup>. Sushruta Shamita presented in Ayur-Veda (600 BC), a technique for total nasal reconstruction based on mid-forehead flap and advised the use of leaves of trees for the same marking. This technique is now called ‘‘Indian method’’<sup>2,3</sup>.

Some years before the birth of Jesus Christ, Aulus Cornelius Celsus (53 BC - 7 AD) marked the history of plastic surgery with its work on grafts. In his book, ‘‘De Re medica’’, he studied various nose, lips and ears defects and describes skin flaps taken from the vicinity.

In the Renaissance, the neo-rinoplasties took a boost due to major injuries resulting from sequels of leprosy and syphilis. In this occasion, the nose reconstruction was performed using a flap arm. Gaspere Tagliacozzi, in 1597, practices a flap of upper third of the inner side of the arm for a full or partial nasal reconstruction. This technique is now called ‘‘Italian method’’<sup>2,4</sup>.

For two centuries, nasal reconstruction goes through a period of bad reputation, as evidenced by the mockery of Amboise Parré who ridiculizes in 1575 the feasibility of this procedure<sup>2</sup>.

The reintroduction of ‘‘Indian flap’’ in the Occident was realized by Lucas in the London’s Gentlemen Magazine, in 1794, and by Carpue, in 1816, both in England<sup>2,3</sup>.

Von Graefe, in 1818, in Berlin and Delpéch, in 1823, in Montpellier, started using the ‘‘Indian Method’’ and the ‘‘Italian method’’<sup>2</sup>.

In the immediate postoperative period, the results were considered good, but the vast subsequent retraction of the mid-forehead flaps observed in the nineteenth century, made Dupuytren and Denonvilliers to criticize it<sup>2</sup>. The first breakthrough in the search for techniques to improve the results was the perception that the bloody surfaces of the flap were responsible of infection, fibrosis and retraction. Carpue, Von Graefe, Blandin and Dieffenbach started then folding the distal part of the flaps to reduce the bloody surface<sup>2,3</sup>. The fold of the flap also allows a more designed columella and alae. Volkmann, in 1874, and Thiersch, in 1879, advance the concept of making flaps of the remaining nasal skin or partial skin grafts to cover the bloody areas.

At this time, König presents techniques of chondro-cutaneous composite grafts that simplify the reconstruction of small to moderate defects<sup>2</sup>.

Gillies, in 1943, and Converse, in 1956, add chondro-cutaneous composite graft of conchal cymba, chondro-mucosal graft of septum and naso-labial flaps to replace the skin fold of mid-forehead flap, to improve the lining and support of alae<sup>2,3</sup>.

A deformity commonly seen after nasal reconstruction in the nineteenth century was the short columella with the nasal tip retracted caudally. Auvert draws the mid-forehead flap with an angle of 45 degrees, promoting stretching of the flap. Oblique flaps started to be the favorite design in the end of nineteenth century<sup>2,4</sup>.

Gillies, in 1935, describes a ‘‘U-shaped’’ flap in the frontal region and Converse, in 1942, describes a flap of the scalp including the skin of the frontal region. Both techniques increase the blood supply and the length of the flap<sup>2</sup>.

With flaps of greater length is then possible the confederation of longer columellas, which in turn allow better nasal tip projection. Millard, in 1966, introduces a flap of labial mucosa through a hole in the lip for lining the columella, dramatically reducing the postoperative retraction<sup>2,4</sup>.

Gillies advocates the anterior rotation of the remaining septum with inferior pedicle at the time of primary reconstruction, and Millard, in 1974, modifies this concept making a flap of the remaining septum with a superior pedicle through a ‘‘L’’ shaped incision, also in the primary reconstruction. These authors also state that in the presence of a suitable length columella, addition of bone or cartilage grafts gives a ‘‘final touch’’ in the nasal reconstruction<sup>2,3</sup>.

Burget & Menick<sup>5</sup> introduce the concept of aesthetic units of the nose, claiming that the incisions should be located at the limits of these aesthetic units. If it is necessary to remove more than one third of a unit, it must be completely removed and reconstructed.

This study aims to demonstrate the versatility of the flap in the mid-forehead flap in extensive nasal reconstructions, but it requires repeated surgical refinement process until we get adequate support and contour.

## METHODS

A retrospective study of 10 cases of nasal reconstruction with mid-forehead flap, between 1991 and 2012, was performed. The patients were operated at the 38<sup>a</sup> Enfermaria da Santa Casa da Misericórdia do Rio de Janeiro, Serviço do Professor Ivo Pitanguy (38<sup>th</sup> Infirmary of the Santa Casa da Misericórdia of Rio de Janeiro, Professor Ivo Pitanguy’s Service).

The following parameters were analyzed: the patient’s age, sex, cause of injury that led to the reconstruction, the number of sub-units hit in the nose, presence of associated injuries, the number of surgical steps that were necessary, the prior expansion of the flap, the type of graft used, the surgical methods used for reconstruction of the nasal lining, the number of surgeries per patient and postoperative complications.

In the studied population, 6 (60%) patients were female and 4 (40%) male. The mean age was 43 years, ranging from 20 to 61 years (Figure 1).

The most frequent etiologies that motivated the nasal reconstruction were sequelae of infection (40%) and tumor (40%) (Figure 2).

The number of affected nasal sub-units range from 4 to 9 (entire nose) with an average of 6.5 subunits affected (Figure 3).

In 4 (40%) patients, lesions of the nose were associated with other injuries. In 3 (30%) cases, lesions of the upper lip were associated, and in 1 (10%) case, various injuries were found (Figure 4).

The patient's demand for medical consultation was mainly due to the aesthetic aspect, with complaint present

in 100% of them. Respiratory difficulty was observed in 4 (40%) patients.

All patients underwent nasal reconstruction by mid-forehead flap with or without prior expansion. In all cases, the flap was based on the supra-trochlear artery.

The number of surgical steps that were required for each nasal reconstruction ranges from 2 to 32, with an average of 8.1 surgical steps per patient (Figure 5).

In 7 (70%) patients was performed a prior expansion of the mid-forehead flap and in 9 patients (90%) cartilaginous and/or bone grafts were used. Fifteen grafts were placed, the most used was the costal cartilage graft, which represents 46.7% of the grafts (Figure 6).

The Figure 7 shows the several surgical methods used to reconstruct nasal lining.

The first surgical step corresponded to the placement of the expander in the frontal region when necessary. The second surgical step corresponded to the removal of the expander and rotation of the mid-forehead flap. The third step was characterized by the section of the pedicle. All surgeries beyond these three surgical steps were considered "refinement surgeries": its objectives were to improve the aesthetic appearance of the nose and correct the distortions observed in the postoperative period.

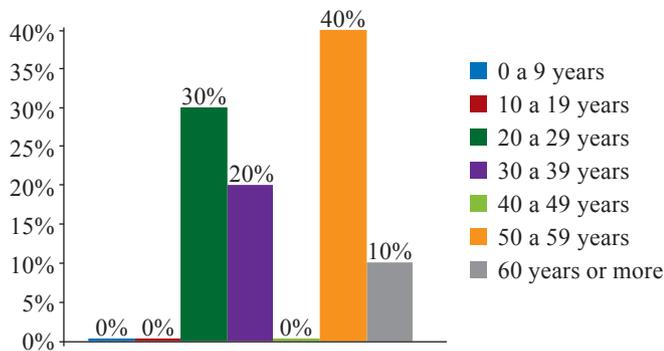


Figure 1 – Distribution of patients according to age.

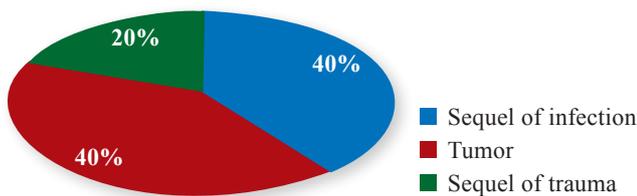


Figure 2 – Etiology of nasal lesions.

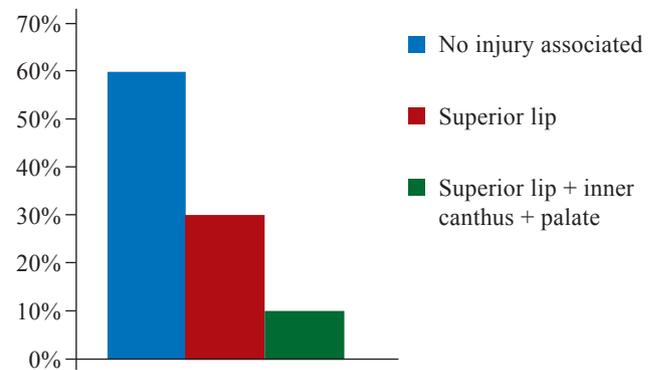


Figure 4 – Associated lesions.

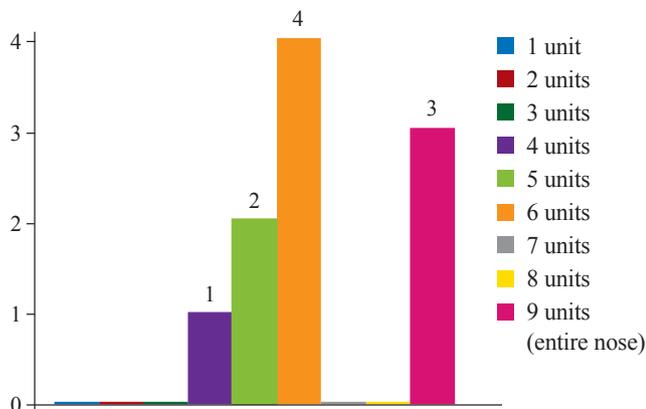


Figure 3 – Number of nasal affected sub-units.

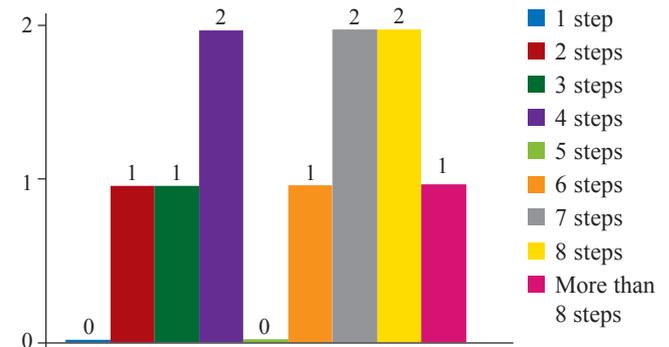


Figure 5 – Number of surgical steps per patient.

The number of “refinement surgeries” that were required to achieve the final result ranged from 0 to 26, with an average of 5.1 procedures per patient (Figure 8). Regarding patient who was operated 32 times (patient 3), were made 2 mid-forehead flaps (ie 4 surgical steps) and were placed 2 expanders in the frontal region (ie 2 more additional surgical steps). In the end, 26 “refinement surgeries” were needed to achieve the final result.

**RESULTS**

Five patients had postoperative distortions which were corrected by other surgeries (Figure 9).

No cases of postoperative infection or necrosis of the flap or keloid was recorded.

Figures 10 to 12 illustrate some cases in this series.

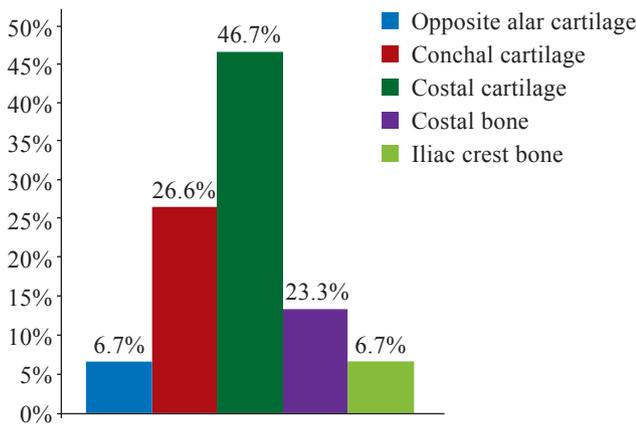


Figure 6 – Grafts used for nasal support.

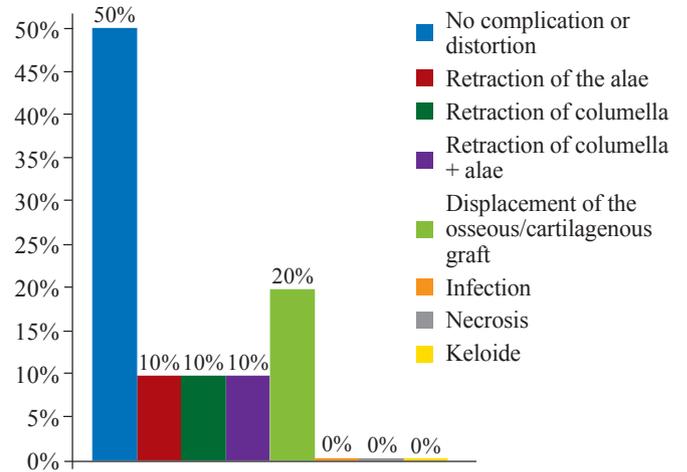


Figure 9 – Complications and distortions.

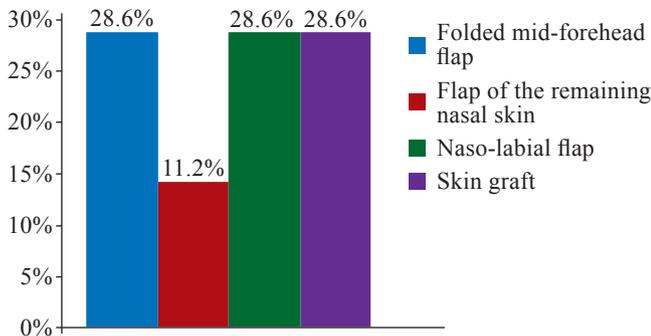


Figure 7 – Surgical procedures used for reconstruction of nasal lining (7 patients).

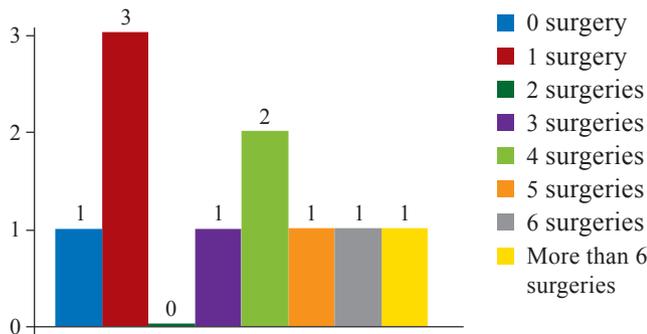


Figure 8 – Number of “refinement surgeries” per patient.



Figure 10 – Patient 1, 54 years old, had a tumor of the nose. After resection, was performed a mid-forehead flap for skin coverage. The bony-cartilagenous structures and nasal lining were intact. In A and B, preoperative appearance in frontal view and right profile, respectively. In C and D, 8 months postoperative appearance in frontal view and right profile, respectively.



**Figure 11** – Patient 2, 61 years old, presented a sequel of trauma (dog bite). A mid-forehead flap was used for skin coverage, conchal and costal cartilage grafts for the support's structures, and full skin graft for nasal lining. In **A** and **B**, preoperative appearance in frontal view and right profile, respectively. In **C** and **D**, 2 years postoperative appearance in frontal view and right profile, respectively.

## DISCUSSION

The average age observed in this study was 43 years, ranging from 20 to 61 years. The younger patients underwent surgery to treat sequel of nasal infection (leishmaniasis) and older to cure nasal tumors.

The most frequent complaint of these patients was the cosmetic deformity, present in 100% of cases. Difficulty breathing was reported by 40% of patients, due to the collapse and the impairment of nasal support structures, as well as soft tissue stenosis by scar retraction<sup>5,6</sup>.

The number of affected nasal subunits varied from 4 to 9 (entire nose) with an average of 6.5 subunits, which represents more than half of the nose. In extensive lesions that affect more than half of the nose, the mid-forehead flap was the best local flap according to several authors<sup>7-10</sup>. This flap proved to be most suitable for its safety, amount of skin obtained, similarity of color, texture and thickness of the skin.

Prior expansion of this flap allows overcoming its greatest limitation, the length, providing enough material for making long columella, alae and the coverage of large defects<sup>11,12</sup>. In this study, prior expansion of the frontal region was used in 70% of cases. This facilitates primary closure of the donor area, improving scar due to lower tension. Concerning characteristics of the flap, with the effect



**Figure 12** – Patient 3, 24 years old had a sequel of nasal infection due to leishmaniasis. A first mid-forehead flap was made for skin coverage, iliac crest graft for support's structures, naso-labial flaps for reconstruction of nasal lining. In **A** and **B**, preoperative appearance showing a severe retraction of the columella and ala, in frontal view and right profile, respectively. In **C** and **D**, 7 years postoperative appearance showing severe retraction of the columella and alae, in frontal view and right profile, respectively. In **E** and **F**, 2 years postoperative appearance after surgical sequel of nasal reconstruction. Distorted cartilage grafts were removed, old flap was used for reconstruction of the nasal tip lining and a new mid-forehead flap was done after expansion. This new flap was sutured on the dorsal flap desepithelized, and the support's structure was done with costal cartilage arranged in L. In total 32 surgeries were performed between 1991 and 2010.

of the skin expansion, it provides a thinner skin which facilitates the surgical modeling of the flap. However, it is difficult to predict the degree of secondary tissue retraction following the expansion, which may represent the shortening of the nose in the immediate postoperative period or later. The expansion also can be used secondarily to improve the scar of the donor area<sup>3,13-15</sup>.

The patients in this study had involvement of more than 4 nasal sub-units (average of 6.5 sub-units), thus, the naso-labial flap alone was not indicated for reconstruction of

nasal coverage. However, it was used in 28.6% of cases for reconstruction of the lining. Other surgical modalities have been used to reconstruct the nasal lining: the mid-forehead flap folded in its distal part was used when the length of the flap was enough to make this fold (28.6% of cases), the hinge flap of remaining nasal skin was done when the remaining skin was sufficient to cover the defect (14.2%), and the latter was the full-thickness skin graft (28.6% cases).

Patients underwent several surgeries (8.1 on average), due to the large deformity that often has to be rebuilt. Some authors have suggested that cartilage or bone grafts, when necessary, were performed in a second surgical procedure, when the soft parts had already reached an adequate stabilization<sup>16</sup>. Other authors prefer to do the cartilaginous support structure and skin coverage in a single surgical procedure for prevent soft tissue collapse and late contraction<sup>3,14,17</sup>. In this study, the sequence of surgical steps depended on the preference of each surgeon.

If only bone is used, the patient often develops a rigidity of the nasal tip, whereas if only cartilage is used, this tends to fold up<sup>18</sup>. Cartilage remains the best material for reconstitution of the dorsum, especially with bone support in the cranial two thirds of the nose, but it is limited in quantity and shape<sup>19</sup>. The costal cartilage is the best option if the septal or auricular cartilage is not sufficient<sup>19</sup>. In this study, several types of grafts were used, combination of cartilage and bone grafts, for patients who lost supporting structures of the nose (30% of cases). The costal cartilage was the most used (46.7% of grafts) due to the large amount of cartilage that was needed, knowing that 90% of patients had a major loss of cartilaginous support.

There are many options to refine the primary reconstruction of the nose<sup>10</sup>. The “refinement surgeries” are aimed at improving the aesthetic aspect of the mid-forehead flap and the correction of the distortions observed in the postoperative period. The techniques employed in the Professor Ivo Pitanguy Service are local flaps for lining or external skin, grafts of skin, bone and cartilage, alar resection, correction of nostril position, degreasing flaps, and z-plasties. On average, 5.1 “refinement surgeries” per patient were required, with extremes of 0 to 26. The patient who needed 26 “refinement surgeries” presented an important retraction of the columella and alae in the postoperative period. Several local flaps were performed without favorable result, and so an expansion of the frontal region was realized allowing the use of a new mid-forehead flap with satisfactory results (patient 3).

Finally, 32 surgeries were performed: 2 mid-forehead flaps (ie 4 surgical steps), 2 expanders in the frontal region (ie 2 more surgical steps) and 26 “refinement surgeries”.

## CONCLUSIONS

The mid-forehead flap, with or without previous expansion, proved a suitable technique in nasal reconstruction, easy to use, but requires numerous surgical procedures of refinement.

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### Correspondence to:

Ali Bouchama  
Rua Resedá, 27 – ap. 201 – Lagoa – Rio de Janeiro, RJ, Brazil – CEP 22471-230  
E-mail: alidocsurf@gmail.com