An alternative single-stage application of the paramedian forehead flap in reconstruction of the face

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ABSTRACT

title.

Background: Paramedian forehead flap represents a workhorse in facial soft tissue reconstruction but always requires a second step in order to interrupt the skin bridge. Direct visualization and dissection of vascular pedicle may avoid this drawback.

Methods: Twenty one patients were treated between January 2012 and January 2014: 6 underwent nasal reconstruction and 15 full thickness defect of medial canthus of an orbital region. The follow-up ranges between 6 months and 2 years. All procedures were carried out in a single stage.

Result: All flaps were performed in a single-stage procedure, survived and healed uneventfully.

Conclusion: The authors describe a refinement of the original technique to be reserved for cases where vessels could be identified by Doppler, consisting in the direct visualization and dissection of the initial tract of the vascular pedicle, thus providing an extremely mobile pedicle whose size allows to locate the first part of the pedicle in the nasion, tunneling under a skin bridge between the emergence of the vessels and the defect.

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1. Introduction

Paramedian forehead flap is still one of the most popular flaps for repair of full thickness defect of the nose, the eyelid and the cheek, although the nose reconstruction remains a specific indication.

It is an evolution of the median forehead flap widely used since 700 BC when it was known as “Indian flap”, and reduces the morbidity of the donor site (Whitaker et al., 2007). The supratrochlear perforator flap is a recent refinement of the original technique which further improves the outcome in the donor area and allows a single surgery stage because, as a propeller flap, a skin bridge containing the vascular pedicle and secondary surgery are unnecessary (Geddes et al., 2003).

Although paramedian forehead flaps by subcutaneous pedicle have been already described in literature, we present a further modification consisting of a flap with a very narrow pedicle in its initial tract based on the direct visualization and dissection of the emergence of the vessels thus permitting its localization in the nasion avoiding deformities. Furthermore this allows reducing delayed and secondary procedures as well as debulking and has a very low morbidity in the donor site.

2. Materials and methods

In the preparation of the manuscript the authors have adhered to the STROBE guidelines.

Inclusion criteria: partial nose reconstruction, medial aspect of orbital reconstruction, traceable Doppler signal, patients’ specific demand of single-stage procedure — patients refuse embarrassing delayed “bridging” procedures.

Before surgery, all patients were informed about the different reconstructive procedures including the multi-step choice. All advantages and disadvantages were preventively discussed.

2.1. Surgical technique

In cases of compliant patients, the procedure can be performed under local anesthesia. The first step consists of the identification of emergence of the pedicle at supratrochlear notch by a handled Doppler probe. Once identified, the supratrochlear artery is followed upward marking its course on the skin. A custom-made template is tailored on the defect and transferred onto the donor area. The skin flap is designed in the forehead taking into account

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that the skin island should be placed at a distance from the pivot point, namely the emergence of the artery from the supratrochlear notch, compatible with the location of the defect. The greater the distance of the area to be reconstructed from the pivot point, more cranially the flap will be designed. The first tract of pedicle dissection is performed under direct visualization using a 3.5× loupe magnification so as to obtain a narrow initial pedicle up to 1–1.5 cm long to permit its localization in the nasion avoiding deformities. Dissection must take into consideration comitantes veins present. Usually dissection of the pedicle does not include the covering skin; if present it must be removed. Afterward, the dissection of the pedicle continues upwards as a traditional subcutaneous pedicle: as long as the dissection proceeds cranially the amount of soft tissue surrounding the vessels should be wider to include as much vascular network as possible. The cranial portion of the skin paddle can be defatted and thinned carefully. However more aggressive thinning can be safely done at a later stage. In order to prevent any compression or kinking of the pedicle, it is mandatory to release any fibrous bands of the surrounding tissue at the level of the pivot point. In addition, when the skin bridge between the supratrochlear notch and the skin island to be harvested is not too wide, a meticulous subcutaneous dissection of the pedicle could be refused by some patients. Several dressings are necessary during the entire delay period. Even for the narrowest pedicles, wide undermining of the forehead is often required to allow the primary closure of the donor site. The tension of the advanced flaps often results in a poor cosmetic scar quality (Menick, 2002, 2012; Rohrich et al., 2004). In 2009 Mutsumi Okazaki et al. proposed an expanded paramedian forehead flap, including the frontal muscle and the supraorbital artery performed in two surgical steps to increase the freedom of the flap (Okazaki et al., 2009). Later Kazuo Kishi et al., in 2012, proposed to enlarge the arch of rotation through an intraorbital transection of the supratrochlear artery and centering the paramedian forehead flap on the vascular connections among the supratrochlear-anterior-and dorso-nasal artery around the medial canthus, which may be compromised in case of major facial traumas reducing the vitality of the flap (Kishi et al., 2012).

3. Results

Twenty one patients aged between 22 and 68 years have been treated in the last two years according to the described procedure. The flap has been used to cover defects of the nose in 6 cases and full thickness defect of medial canthus of an orbital region after basal cell carcinoma in 15 cases. The follow-up ranges between 6 months and 2 years. All flaps survived and healed uneventfully. All flaps were performed in a single stage, no secondary procedures were required. There were no major complications in either the donor or the recipient area, except for a transient venous congestion in one case which resolved itself spontaneously in three days. In all cases of nasal reconstruction cartilaginous frameworks have been used taken from the septum and concha cimbae; the procedures have been used to repair loss of substance involving the entire nasal pyramid in one case, the entire nasal lobule in 3 cases or part of it in other two cases. The repairs of the 15 cases of medial canthus ranged in size from 1 up to 3.2 cm in diameter. In all cases of nostril reconstruction, conformers were used to avoid retractions during the first 6 months post-operation.

4. Discussion

Paramedian forehead flap is an axial perforator flap based on the supratrochlear vessels which emerges from supratrochlear foramen. Supratrochlear artery is a terminal branch of ophthalmic artery which exits the orbit superior of the medial canthal ligament, enters the glabellar region and exits the supratrochlear notch, medially to the supraorbital artery, approximately 2 cm from the midline, and then courses cranially beneath the frontalis muscle accompanied by venae comitantes and nerve. As pointed out by several anatomical studies, the main trunk of supratrochlear artery, once exited from supratrochlear notch, travels under the orbicularis oculi muscle, over the corrugator muscle for a while, and then gradually becomes shallow during the course of traveling upward. It moves supero-medially, traveling subcutaneously in the fat tissue over the frontalis muscle during almost the whole course. The terminal branch of the supratrochlear artery is a muscular branch that travels under the frontalis muscle, only in a minority of cases, once the corrugator muscle has been overcome, the artery directly supplies the skin without any muscular branch. After perforating the depressor supercilii muscle, from the main artery several small branches rise interconnecting each other with the dorsal nasal branches forming a rich microvascular network over the glabella (Skaria, 2015). Although the blood supply for conventional paramedian forehead flap in this area allows a great flexibility in flap design, the use of this flap often requires delayed procedures especially for nasal reconstruction. Unfortunately after flap transposition, bridging of the pedicle from the radix of the nose to reach the more distal part of the recipient area is required, and must be left exposed for at least 3 weeks. This condition is uncomfortable for the patients because of social embarrassment due to unacceptable cosmetic appearance and need of secondary surgery that could be refused by some patients. Several dressings are necessary during the entire delay period. Even for the narrowest pedicles, wide undermining of the forehead is often required to allow the primary closure of the donor site. The tension of the advanced flaps often results in a poor cosmetic scar quality (Menick, 2002, 2012; Rohrich et al., 2004).

Fig. 1. Intra-operative view of the harvested flap showing the dissected pedicle with a narrow size especially in its initial tract.
Recently Adriana Cordova et al. proposed a new one-stage method for nose reconstruction using the supratrochlear artery perforator propeller flap with the frontal blade superiorly and the nasal inferiorly. Both of them are centered on supratrochlear emergence vessels. This flap is planned and raised as a conventional propeller flap, with the frontal blade planned according to a template of the area to be repaired, and then rotated up to 180° clock or counter clockwise in order to reach the defect. The nasal blade includes the tissue between upper margin for the defect and the pivot point and covers the donor site defect partially. This is a safe and reliable procedure but as the author suggests, it should be considered only as a second choice when one-single stage can be a real advantage, due to non optimal cosmetic results (Cordova et al., 2014).

In our opinion, however, the main drawback of this brilliant refinement of the conventional forehead flap consists of the anatomical limits of the territory which must be covered. As a propeller flap, its distal blade must be located in continuity with the defect. Therefore, in case of distal reconstruction such as the tip of the nose, a long propeller flap should be designed and a large skin bridge interrupted by the distal blade of the flap with a final cosmetic result not different from that achievable with a conventional flap and maintaining the advantage of a single-stage

Fig. 2. a) A 22-years-old girl suffering from a major facial trauma. All the lateral part of the right side of the nasal pyramid also the entire dorsum was lost in an accident trauma. A tunnelized one step paramedian forehead perforator flap was used for nasal reconstruction with a cartilage framework harvested from the nasal septum and the concha cimbae. The procedure was performed five hours after the injury in concomitance with facial and eyelid repairing; b) intra-operative view of harvested flap. In this case the pedicle has been raised with a narrow skin paddle which was immediately removed; c) final view of one step procedure showing the location of the first tract of the vascular pedicle onto the nasion without causing any major deformities and the distal part of flap with a skin island satisfactorily performed entirely lost nasal tissue reconstruction; d) 1 year post-op; e) lateral post-op view showing no major glabella bulking.

Fig. 3. a) A 68-year-old man suffering from a melanoma involving the nasal lobule. The photo shows the marks of the planned resection and of the skin paddle also. b) two years post-op. The left eyebrow appears slightly raised due to width of the flap but we opted for direct closure to avoid worse repair solutions of the donor site.

Fig. 4. a) A 36-years-old man suffering from an avulsion of the nasal lobule due to a human bite. A tunnelized one step paramedian forehead perforator flap was used for nasal reconstruction with a cartilage framework harvested from the nasal septum and the concha cimbae. The lining was reconstructed with mucosa grafting. The procedure was performed 72 h after the injury; b) post-operative frontal view 2 years later; c) lateral post-op view showing no major glabella bulking.
procedure. We believe that the narrow dissection of the vessels at the initial part of the pedicle allows the harvest of an axial flap provided by a vascular pedicle which, due to its small size in its initial tract, can be easily located in a subcutaneous tunnel under the nasion, thus sparing the skin interposed between the defect and the pivot point. The key point is to obtain a skin paddle, nourished by a pedicle as thin as possible at its emergence for a tract of about 1–1.5 cm long, which must become wider cranially, so as to include most of the subcutaneous vascular network, as described in the traditional subcutaneous pedicle of the paramedian flap.

In case of nose reconstruction, especially of the distal part, the small size of the first portion of the pedicle can be driven into a subcutaneous tunnel at nasion level preventing distortion of the glabella profile. In our series of cases none of the patients needed any further glabella debulking. The other part of the pedicle can be wider since it is located in an area less sensitive to deformations such as the lateral part of the nose. In fact, according to our one-step method it is vital that only the first part of the pedicle, the one located in the glabella area is small enough to avoid deformities. We believe that the originality of this presentation is based on usage of: a) local anesthesia; b) Doppler probe to locate the emergence of the vessels following upwards the course of the initial portion of the pedicle; c) loop magnification thus to obtain the narrowest size of the initial tract of the pedicle up to 1.5–2 cm long to pass onto the nasion without high noticeable deformities, nourishing an optimal tissue for repairing distant parts of the nose such as the nasal tip, obtaining satisfactory results and avoiding secondary procedures such as debulking of the glabella; d) unlike the most popular classical techniques for paramedian forehead flap such as the one proposed by Menick, our method does not utilize the frontalis muscle because it is based on the subcutaneous course of the supratrochlear artery. This expedient allows, with the dissection of the initial portion of the pedicle, a single stage without delay procedure. The possibility to perform most of the proximal dissection of the pedicle subcutaneously further improves the cosmetic outcome by significantly reducing also the cranial scar only to the horizontal scar perfectly located in the horizontal rhytidis so as to avoid the vertical frontal scar. Although the vertical scar heals quite well and is rarely disfiguring, avoiding it is clearly preferable. Due to limited clinical experience, we suggest to plan this flap only in those cases where a pre-operative Doppler investigation clearly detects a good signal from the supratrochlear artery for at least 2 or 3 cm after its origin in the supratrochlear notch. In case of a weak signal, we recommend to shift to a conventional paramedian forehead flap. Finally our clinical experience, although based on only a few cases, goes in an opposite direction, namely that the majority of our patients showed a high rate of subcutaneous course of the main vessels. However we need to confirm this aspect after further anatomical studies.

5. Conclusion

This single-stage technique is applicable in those cases of partial nasal reconstruction and is more complex surgically, but may represent a choice offering considerable advantages. According to the one stage reconstruction, the dissection of the initial portion of the pedicle allows its subcutaneous collocation in an area quite sensitive to distortion, namely the glabella, avoiding unsatisfactory deformities. This revisited paramedian forehead flap may easily reach distant areas such as the tip of the nose, with a lower impact on the donor site and improved cosmetic outcome avoiding further refinements and reducing patients’ discomfort providing satisfactory final results. We retain that the described procedure as a refinement of a workhorse in face soft tissue reconstruction is to be reserved for cases in which the Doppler can locate the vessels clearly. If the pedicle cannot be followed for a few centimeters, delay of the flap should be considered (Figs. 1–4).

References