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SHORT COMMUNICATION

The pivot point in transposition flap planning: concept and surgical implications

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It was recently demonstrated that rotation flaps are *curvilinear advancement* flaps and do not rotate [1]. Transposition flaps, however, are flaps that do rotate on the surface plane of the body. The verb "transpose" means to change something from one position to another, or to exchange the positions of two things. In a surgical context, it means that the position of tissue is changed by an operative procedure (nerve transposition, vessel transposition, skin transposition). The term "transposition" was used as early as 1855 by Denucé, as a general term for local skin transfer ("transfer" being the currently preferred term) [2]. The term "transposition flap," to describe a skin flap that rotates around a pivot point in the base of the skin pedicle to close an adjacent skin defect, became popular in the 1970s.

In geometrical terms a pivot point is the center point of any rotational system [3]. In surgical terms, it is the center of the arc around which a flap moves during its transfer [4]. This concept is easy to understand for an axial pattern flap where the pivot point is (almost always) the identifiable vascular pedicle in the base of the flap. However, in a random pattern skin flap, it is different. In a random pattern transposition flap, the pivot point is usually depicted to be the point furthest from the apex of a defect. This "classic" transposition flap is designed as a relatively large flap which is moved laterally with a fixed pivot point at the base of the flap, situated furthest from the adjacent, triangularized defect (Fig. 1; left) [5].We would call this a *contralateral* pivot point.

Not all transposition flaps have a *contralateral* pivot point. One of the best-known transposition flaps is the rhombic flap of Alexander Limberg (Fig. 2). This flap rotates around a pivot point that coincides with the defect: an *ipsilateral* pivot point. The donor defect is closed by advancing the contralateral base of the flap from A to C. A prerequisite for this procedure is that there is enough slack skin to advance the contralateral base of the flap over the length of one side of the rhombus to close the defect. The LLL-flap of Dufourmentel [6] and the oblong parallelogram-shaped or "Schwenklappen"-plasty of Roggendorf [7], both variations of the Limberg flap, similarly have an *ipsilateral* pivot point.

The location of the pivot point of a Limberg flap is still graphically portrayed by some [8] to be on the contralateral side of the defect, which is clearly wrong. In the well-established literature one may also encounter the depiction of a contralateral pivot point, which clinically then proves to be ipsilateral. Figure 3 (above) shows a schematic representation of a nasolabial flap to cover a labial defect, as proposed by McGregor and McGregor [9]. To close the donor defect of a nasolabial flap, the skin of the cheek is commonly undermined. Sufficient skin laxity will ensure that the closed donor defect lies more or less in the original nasolabial fold. During this process, the contralateral base of the flap moves towards the fold, as depicted in Fig. 3 (middle and low).

The *contralateral* and *ipsilateral* pivot points are the extremes of a spectrum of pivot points around which transposition flaps may rotate. It is not only the geometrical shape of the defect and the design of the flap that determine the ultimate location of a pivot point but also the reserve or laxity of skin in the donor area. Availability thereof will permit advancement of the contralateral base of the flap. In a properly planned Limberg flap, this will happen with the acme of mathematical grace that accompanies this method. In a transposition flap in which the contralateral base can be partly advanced towards the defect, the pivot point will be found between the two extremes: that of the *contralateral* pivot point in the "classic" transposition flap and that of the *ipsilateral* pivot point of Limberg's rhombic flap. Knowledge at the outset about the position of the pivot point has clear implications for the planning of a transposition flap. If the donor defect of a transposition flap can be closed by advancing skin from the area at the contralateral base of the flap, the pivot point will shift in the direction of the ipsilateral base of the flap. Hence, a shorter flap than

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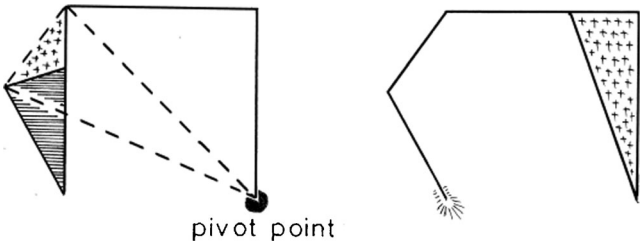

Fig. 1 Schematic representation of a "classic" transposition flap. Left: design of the flap for a triangularized defect. Note that the pivot point is *contralateral* to the defect. Right: postoperative situation. Drawing by the first author

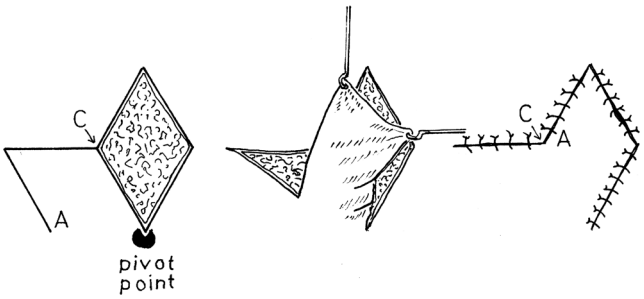

Fig. 2 Design of a Limberg flap. This transposition flap rotates on an *ipsilateral* pivot point. Drawing by the first author

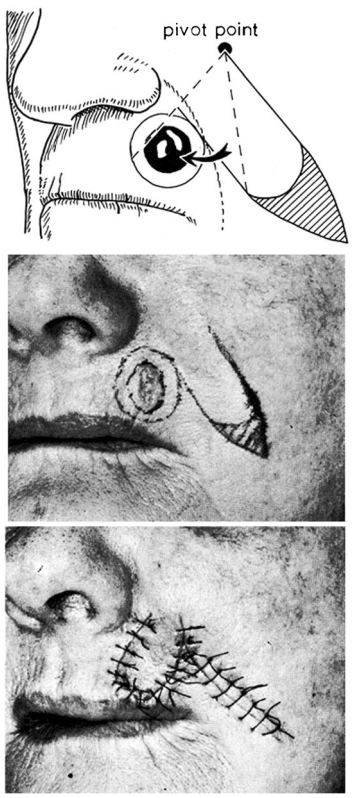

Fig. 3 Above: schematic design of a nasolabial flap to close a defect in the upper lip after excision of a tumor and its excision margin, showing a *contralateral* pivot point. Middle and low: the clinical situation, which shows the same design and the postoperative result, in which, due to closure of the donor defect by advancement of the cheek, the pivot point has shifted to an *ipsilateral* location. Drawing by the first author, photos from reference [9]

expected will be required, as is shown in the planning of a nasolabial flap (Fig. 3). Alternatively, a transposition flap around an ankle, for example, will have to be longer than young surgeons may expect or may learn the hard way.

There is one notable exception to this rule, the deltopectoral flap. Although there is hardly any laxity of skin around its sternal base, it can be planned through an *ipsilateral* pivot point. The elasticity of the skin of the flap and its design (the contralateral side of the flap is longer than its ipsilateral side) make this possible.

We conclude by stating that the planning of a transposition skin flap requires careful consideration regarding the way in which the donor defect can be closed. Primary closure through advancement of surrounding tissue results in the need for a shorter flap because of the shift of the pivot point in the direction of the ipsilateral base of the flap. In stark contrast, a flap that rotates through a *contralateral* pivot point will have to be longer than expected.

Compliance with ethical standards

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Conflict of interest Klaas W. Marck and Jan J. van Wingerden declare that they have no conflict of interest.

Ethical approval For this type of article, formal consent from a local ethics committee is not required.

Informed consent For this type of article, informed consent is not relevant.

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