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Mini Review

The Pedicled Latissimus Dorsi Myocutaneous Flap for Reconstruction in Head and Neck Surgery. Mini Review

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Abstract

The pedicled latissimus dorsi myocutaneous flap (PLDMF) is long vascular pedicled myocutaneous flap, which allows it to reach virtually any region in the head, neck, and scalp and its large surface area make this flap especially useful for secondary head and neck reconstruction. For areas beyond the range of pectoralis major flap, PLDMF is also used as a primary reconstructive procedure when a free flap is not available or not possible. Donor site morbidity after PLDMF procedure is minimal in almost cases. The latissimus dorsi muscle flap is an axial flap, highly reliable, and easy to harvest. Depending on the defect, the flap may be used as a muscle, musculocutaneous, osteomyocutaneous, or as a thoracodorsal artery perforator (TDAP) flap. Due to its large quantity of muscle, this flap may be used for large defects of the lateral skull base, scalp, and craniofacial area, reconstruction of total glossectomy defects, complex reconstruction including the mandible or the maxilla or as a "backup" flap.

Keywords: *Pedicled Latissimus Dorsi Myocutaneous Flap; Head and Neck Reconstruction; Plastic Surgery*

Introduction

Primary flap failure, primary flap contraction and dehiscence, orocutaneous or pharyngocutaneous fistula, osteoradionecrosis, chondroradionecrosis, re-exploration for bleeding or recurrent tumor, and other secondary reconstructive indications may dictate the need for a secondary flap procedure. Although free flaps are often times used for this purpose, many head and neck surgeons still prefer the more simple and less time-consuming pedicled flap procedures. Because the pectoralis major flap is the most common pedicled flap used for primary reconstruction in head and neck surgery, secondary reconstruction is usually performed with the trapezius, deltopectoral, contralateral pectoralis or other regional muscle flaps than the pedicled latissimus dorsi myocutaneous flap (PLDMF) [1].

The literature reports reconstructions in the cervicofacial area of all kinds with the PLDMF, either as a single technique or by combining other flaps.

The wide spectrum of indications reflects the great versatility of this flap in locations that range from the clavicle to very far from its arc of rotation, such as the frontoorbital region.

History

PLDMF was the first pedicled myocutaneous flap reported in the medical literature. PLDMF for breast reconstruction was first described by Tansini in 1896 and used for breast reconstruction for first time [2]. Even when D'este published in 1912 another article on the

topic, the technique was forgotten for many years [3]. Olivari in 1976 and Mühlbauer and Olbrisch, in 1977, took to apply it again in the mammary reconstructions [4,5]. Deprez., *et al*. reported and performed this flap in the closure of myelomeningoceles [6]. For their part, McCraw., *et al*. used it to close defects of the chest wall [7]. More than 70 years after its initial description, finally begins to be used in the cervicofacial area. The pioneer was Quillen, in 1978, who described the first reconstruction of a cheek defect after excision of a recurrent carcinoma [1]. In the review that this author published in 1979 recommended the use of the myocutaneous muscle flap latissimus dorsi in oral cavity defects, of the oropharynx and others of the head and neck [8].

From then on, the technique became very popular both in its pedunculated and free microvascularized modality. The publications of Sabatier and Bakamjiam, Barton, Bricout, McCraw and Labbé reflect the widespread use both in the United States and in Europe [9-13].

Anatomy

The latissimus dorsi muscle is located at the back and bottom of the trunk and from there it goes to the humerus, passing through the axillary region. Is a very broad flat muscle, triangular in shape whose vertex goes to the arm. It inserts into the spinous processes of the last six thoracic vertebrae, in the thoracolumbar fascia, in the posterior end of the iliac crest and in the last three ribs. Sometimes it is also inserted in the angle lower scapula. Muscle fibers are directed in a convergent direction upwards and laterally, surrounding the round muscle older and then moving ahead of him. In its tour next to the teres major, the muscle turns around its longitudinal axis (torsion) and the lower fibers they become superior. Ends in a flattened tendon and quadrilateral that reaches the anterior face of the humerus, to insert into the bottom of the intertubercular sulcus. In its upper part, the latissimus dorsi integrates the wall back of the armpit. Its bottom, flattened, it is located on a plane superficial and covers the other muscles of the back, except to the trapezius. Its lower edge forms with the upper edge of the iliac crest and the posterior border of the muscle external oblique abdomen the lower lumbar triangle [from Jean Louis Petit]. The latissimus dorsi is innervated by the thoracodorsal nerve, branch of the posterior cord of the brachial plexus (C6, C8), which descends in front of the subscapularis and reaches the anteromedial aspect of the muscle. In the region dorsal, the arteries supplying it come from the arteries intercostals; in the axillary region, of the thoracodorsal artery [14]. The artery is directly accompanied by the thoracodorsal nerve [15]. This muscle is a powerful adductor of the arm and rotator medial humerus. It also directs the arm towards behind. Taking the humerus as a fixed point, raise the trunk in the action of climbing.

The vascular pedicle originates from the thoracodorsal vessels 10 cm distal to the axillary vessels, entering the muscle together with the motor nerve. In most cases, it is divided into 2 branches, one horizontal and one oblique, each supplying a different segment. This vascular anatomy is giving allows dividing the flap into two separate skin paddles in some cases [16]. Numerous intramuscular anastomoses connect the 2 systems reported is cadaver studies [17].

The vascularization of the latissimus dorsi flap is a V type of the Mathes and Nahai classification (a main pedicle and segmental accessory pedicles). The main pedicle is the thoracodorsal artery, coming from the subscapular artery, which a few centimeters from its origin (3 - 4 cm), in the axillary artery, it divides into the circumflex scapular artery and the thoracodorsal artery. It measures about 10 cm in length (6 to 16 cm) and enters the latissimus dorsi muscle below the scapula and one centimeter inside the anterior border of the muscle [18].

The thoracodorsal pedicle originates a large number of branches and perforating vessels that go to the skin tissue, which is why the muscle can be divided into independent segments and remains viable.

The thoracodorsal artery runs down and back obliquely, reaches the lateral border of the latissimus dorsi muscle, and is positioned deep into the latissimus dorsi muscle. A 6 - 8 cm approximately from the crease of the armpit, the vascular pedicle enters the muscle and divides into two branches: a vertical branch, which runs parallel to the anterior border of the muscle, and a transversal branch, which runs parallel to the proximal muscle rim at about 2 cm approximately. Both in turn give cutaneous branches that pierce the muscle and reach

the skin [19]. Very often (70 - 80% of cases), the thoracodorsal artery gives a cutaneous branch that surrounds the edge of the muscle approximately 6 - 8 cm of the armpit, that is, in the place where the pedicle enters the muscle. This cutaneous branch of the thoracodorsal artery is present in 75% of cases according to Cabanie [20] and in 81% among 100 dissections performed by Rosewell [17]. Sometimes it can pass between the first fibers of the muscle a few millimeters from the lateral edge of the muscle. PLDMF harvests can be extended in some cases for reconstruction of the anterior mandible by giving the bone by an angular branch, nourishing the tip of the scapula, branches off from the thoracodorsal artery just proximal to the serratus branch or from the serratus branch directly (42%).

The segmental accessory pedicles are the paravertebral perforating arteries, through which the entire muscle could be nourished, so medial pedicle flaps can be performed for the reconstruction of defects in the back.

This pattern of vascularity makes than flaps designs can be extend as far as 30 × 40 cm, but to closure flap width should not exceed 10 cm.

In few cases the main pedicle is divided into 3 or 4 main branches or only a rudimentary pedicle [21]. The latissimus dorsi also receives a blood supply from the intercostal arteries at the point of insertion into the spine and based on 3 of these pedicles, a distal pedicle can be used to cover defects in the lower spine area.

Flap design

The initial step is the design of the flap in the patient as a whole. To where the limits of the resection zone depending on the extension of the pathology to be treated. We mark the lateral and superior border of the dorsal muscle.

On the lateral edge of it and 7 cm from the armpit crease a point is marked that is the center of a circumference of 3 cm in diameter: this is the approximate location of the proximal cutaneous perforator of the thoracodorsal artery (TDAP) [17].

The flap is centered on the proximal cutaneous perforator of the vertical branch, which is generally the largest. This branch can be identified with a Doppler preoperatively; it is located 6 - 8 cm from the axillary fold and 1 - 2 cm from the lateral border of the muscle. As mentioned above, the possibility of the direct cutaneous branch that is located very close should be taken into account. For this reason, we prefer to mark this 2 - 3 cm circumference in diameter in the approximate area. This area must be within the design of the flap. But flap design can be extended if we need. When conventional latissimus dorsi flap is marked the inferolateral edge of the defect will become the distal portion of the flap, so skin irrigation is determined by the distal perforants, which results in extensive skin island of up to 30 cm in length on the major axis. Sometimes it is a good option for flap design in head and neck reconstruction.

Indications in head and neck reconstruction

The latissimus dorsi muscle flap is an axial flap, provide a solution practical for its surprising adaptability, as an instrument for reconstruction relatively fast and safe, and it is easy to harvest. Depending on the defect, the flap may be used as a muscle, musculocutaneous, osteomyocutaneous, or as a thoracodorsal artery perforator (TDAP) flap. Due to its large quantity of muscle, this flap may be used for: large defects of the lateral skull base, scalp, and craniofacial area, reconstruction of total glossectomy defects, complex reconstruction including the mandible or the maxilla, and as a "backup" flap [22].

Preoperative considerations

- Not indicated when the patient's history and physical exam confirm previous surgery to the axillary nodes, injury, or previous trauma.

- When shoulder function is in the normal range, vessels are intact.
- Use a Doppler probe to assess the pedicle.
- Expose and drape a potential donor site for the skin graft.
- With the patient in sitting position and with both hands pressed on the hips, mark the lateral edge of the latissimus dorsi muscle.

Surgical technique

Once the oncological resection is completed the patient is placed in the lateral decubitus and the skin island incision is marked, where the inferolateral edge of the defect will become the vertex anterior cutaneous island. We always follow same steps: The shoulder and upper extremity position needs to be supported during latissimus dorsi flap harvest in order to avoid a traction injury to the brachial plexus. The long-term donor site morbidity after harvest of a latissimus dorsi flap is often quite acceptable. Patient is in strict lateral decubitus with flexion of the lower limb for support and both shoulders vertical with 90° flexion of the ipsilateral upper limb, supported by a C-arch or by second assistant for traction and identification of the vessels at the axillary level. The skin island is marked according to the size and the location of the defect. The defect's cephalic layout on the head and neck region influences the length of the flap pedicle. It should also be taken into consideration that the perforating vessels decrease within the caudal part of the flap. The incision extends from palpable posterior axillary fold to the midpoint of the iliac crest. We prefer design a lazy-S shaped incision a few centimeters behind the anterior edge of the muscle, incise the skin and subcutaneous tissue and extend the incision down to the muscle. The anterior border of the latissimus dorsi muscle is exposed. The anterior border of the latissimus dorsi muscle is elevated off the underlying serratus anterior muscle and rolled posteriorly. The thoracodorsal vascular pedicle is identified on the deep surface of the latissimus dorsi muscle, about 4 cm posterior to the anterior border of the latissimus dorsi muscle. The vascular pedicle enters into the hilum of the latissimus dorsi muscle at a distance of about 12 cm inferior to the insertion of the latissimus dorsi muscle into the humerus. The vascular pedicle is then traced superiorly through the axilla up to the takeoff of the subscapular vessels from the axillary vessels. During this dissection, branches of the vascular pedicle including the serratus anterior branch, the angular branch, branches to teres major muscle and the circumflex scapular vessels are encountered. These side branches of the vascular pedicle are ligated unless they are supplying additional osseous or soft tissue flap components that are to be incorporated into the flap for reconstruction of large or complex defects. Flap harvest is then completed by elevating the superficial surface of the latissimus dorsi muscle from the overlying flank skin and then detaching the insertions of the latissimus dorsi muscle from the ilium inferiorly, from the vertebrae posteriorly, and from the humerus superiorly. The muscle is carefully tunneled through the axilla to the neck. Immediately distal to the axilla, however, the upper arm skin is incised to prevent compression of the pedicle. When a myocutaneous flap is needed, an oval flap skin paddle is often designed overlying the anterior border of the latissimus dorsi muscle. The width of the flap skin paddle is determined by the width of the defect to reconstruction and also by pinching the flank skin to determine how much flank skin can be removed while allowing for primary closure of the flank donor site wound. Before closing the defect, we secure haemostasis. We use 2 large suction drains left in situ for 2 weeks. We close the skin in layers. The amount of flank skin that can be removed while allowing for primary closure of the resulting flank skin defect usually varies from 8 to 10 cm in width. In cases where a myocutaneous flap is needed but the width of skin paddle defect exceeds 8 to 10 cm, skin graft reconstruction of the flank donor can be possible (Figure 1).

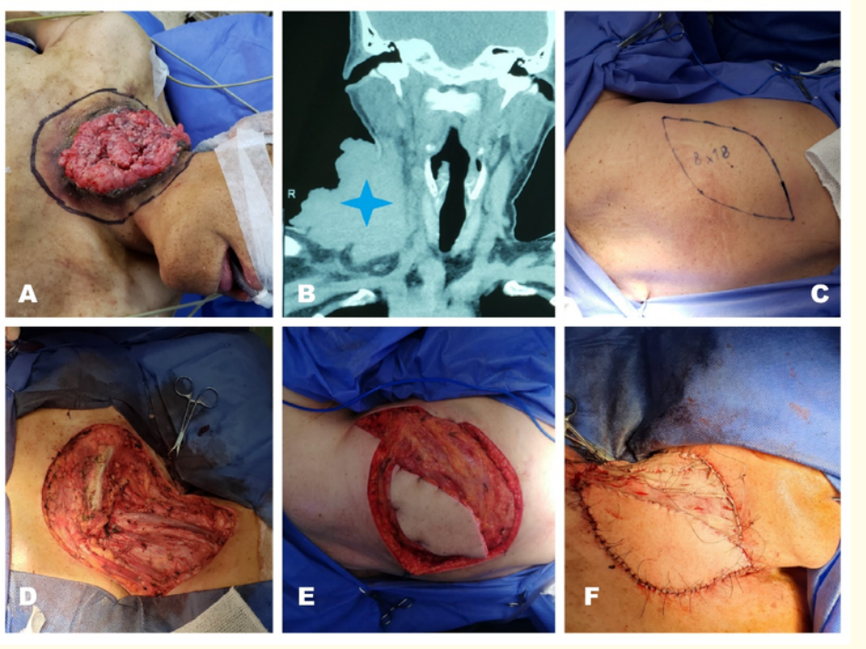

Figure 1: *A: Patient with squamous cell carcinoma in neck. B: Computer tomography show tumor in neck. C: Pedicled latissimus dorsi muscle flap design. D: Defect in neck after resection. E: Flap harvest. F: Reconstruction with pedicled latissimus dorsi muscle in neck.*

The advantages of this flaps are easy and rapid harvesting, very reliable, can be harvested as a free or pedicled flap, largest muscle with the longest pedicle that can be harvested, large diameter of vessels, the skin island can be oriented to the defect as desired, one or two skin islands can be harvested, harvesting of combined ("chimeric") flaps is possible, the thoracodorsal nerve can be used for reinnervated latissimus dorsi muscle flap reconstruction.

The disadvantages are very bulky flap, shoulder dysfunction in less than 10% of patients, the patient's position has to be changed intraoperatively for flap harvesting, does not permit a two-team approach, prolongation of anesthesia, the flap shrinks by 30 - 50% over time, formation of seroma at the donor site.

The donor site morbidity of the latissimus dorsi flap has been well studied. The functional deficit associated with procedure is insignificant with mild to moderate shoulder weakness [23]. Inform consent to patients about this potential functional deficit is important and it was reported in the literature [24].

After elevation of the musculocutaneous latissimus dorsi flap, the scar that remains in the dorsal region widens and hypertrophies due to excess tension as well as the contours of the back may appear irregular and depressed.

Disadvantages with regard to donor area scarring can be minimized if the flap elevation is diagrammed parallel to the superomedial to inferolateral back lines of tension. They can be easily determined with a pinch test to release static stress on the back.

Complications

The complications when using this flap are minimal, however they must be mentioned, such as the formation of seromas, hematomas, partial or total necrosis are uncommon.

To decrease the risk of having seromas, closed drains are placed, evaluating their removal when there are less than 30 - 50 mL in 24 hours [25]. We prefer use 2 large suction drains left in situ for 2 weeks It was reported 7% rate of partial or total necrosis, even in patients with diabetes or tobacco use [26]. Partial loss of strength of this muscle, making it difficult to lift and turn the shoulder, dorsal hernial and winged scapula are uncommon complications [27].

Mastering this technique offers the head surgeon and neck a wide range of reconstructive possibilities. Prevention and timely management of complications forms the basis of experience, where the design it is unique in each patient. Surgeons must strive for achieving the best aesthetic and functional results in seeking a better quality of life for patients.

Conclusion

However, PLDMF is nor fist line flap reconstruction performed for head and neck surgeons provides a good choice in selected patients.

Conflict of Interests

The authors do not present/display conflicts of interests.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

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