Deltopectoral Region

9

9.1 Layered Anatomy

The pectoral and the deltoid regions constitute the donor sites of mainly two very popular regional fasciocutaneous flaps that are used in head-neck reconstruction: the cervicopectoral and the deltopectoral flaps. The anatomy relevant in the surgery of these flaps includes in layered arrangement the superficial fascia, the pectoral-deltoid fascia, and the pectoralis major and deltoid muscles.

9.1.1 Superficial Fascia in the Anterior Chest Wall

The superficial fascia in the anterior chest wall consists of loose areolar connective and adipose tissue and is loosely connected to the skin. Depending on gender and ethnicity, the superficial fascia may consist of more than one membranous sheet of varying thickness and variable amount of fat (Abu-Hijleh et al. 2006). The superficial fascia is perforated by small blood vessels and nerves that supply the skin. It is continuous with the SMAS layer at the neck and with the corresponding layer of the upper limb (and hence the deltoid region) superiorly and with that of the abdomen inferiorly. In the chest, it encompasses the mammary gland, giving off septa that pass between its lobes.

9.1.2 Pectoral and Deltoid Fascia

The pectoral fascia (Fig. 9.1) is a fibroelastic sheath that covers the pectoralis major muscle and corresponds to the deep cervical fascia. It is thin (mean thickness of 297 μm) and is thicker in the inferior thorax and thinner in the subclavicular region (Stecco et al. 2009a, b). It is connected to the pectoralis muscle through multiple intramuscular septa that are detached from its inner surface. The pectoral fascia superiorly is fused with the clavicle and the coracoid process and inferiorly is continuous with the ipsilateral and contralateral rectus abdominis sheaths. It consists of two layers: a superficial layer and a deep one. The superficial layer is thin and covers the outer surface of the pectoralis major muscle also separating the muscle from the mammary gland. The superficial layer crosses over the sternum and continues with the superficial layer of the contralateral pectoral fascia, whereas the deep layer covers the inner surface of the pectoralis major muscle and fuses with the sternal periosteum. The deep layer of the pectoral fascia forms the clavipectoral and the axillary fasciae.

The deltoid fascia is a fibrous membrane that overlies the deltoid muscle. Like the pectoral fascia, it sends intramuscular septa into the deltoid muscle. Superiorly it is attached to the clavicle, the acromion, and the spinal crest of the scapula; inferiorly it is continuous with the brachial fascia, medially with the pectoral fascia, and posteriorly with the infraspinous fascia (Standring 2008).

9.1.3 Pectoralis Major Muscle

The pectoralis major muscle (Fig. 9.2) is a triangular-shaped muscle that occupies the major part of the chest. It is separated from the deltoid muscle by a groove termed the deltopectoral groove. The deltopectoral groove transitions upward to the infraclavicular fossa (deltopectoral triangle) that can be seen as a small depression inferior to the clavicle. The cephalic vein runs in the deltopectoral groove and ascends deeply in the infraclavicular fossa where it pierces the clavipectoral fascia to join the axillary vein. The infraclavicular fossa contains furthermore the deltoid branch of the acromiothoracic artery.

The pectoralis major muscle arises from the anterior surface of the medial half of the clavicle; from the half of

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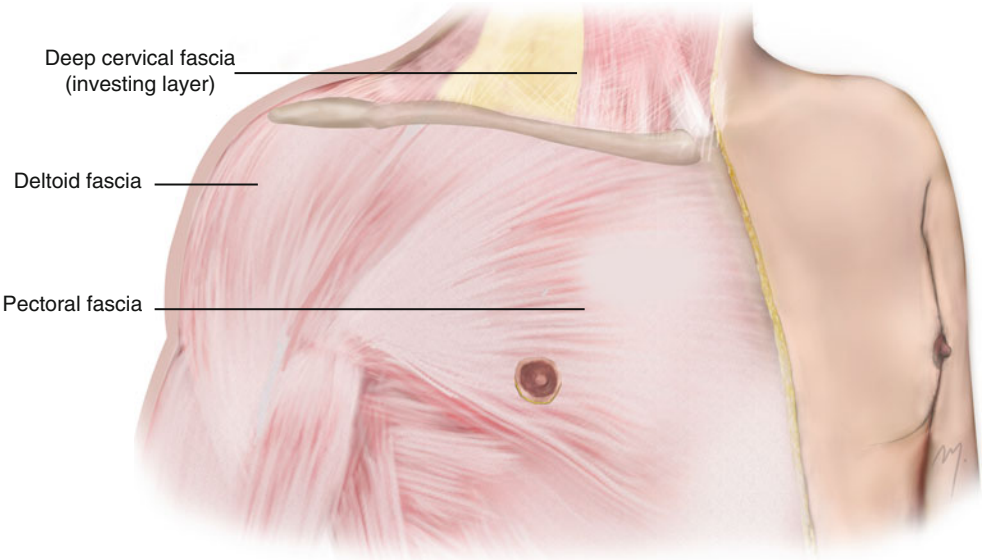

Fig. 9.1 Pectoral and deltoid fascia

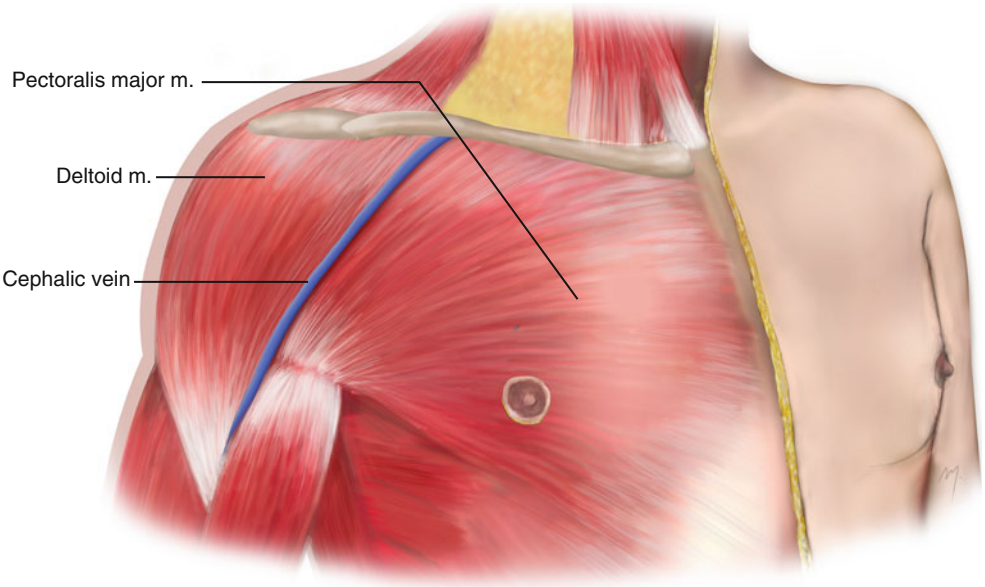

Fig. 9.2 Pectoralis major and deltoid muscles

the breadth of the anterior surface of the sternum, down to the level of the attachments of the sixth or seventh costal cartilage; from the cartilages of the first to seventh ribs; from the sternal end of the sixth rib; and from the aponeurosis of the external oblique muscle. According to the muscle fibers' origin, the pectoralis major exhibits a clavicular and a sternocostal part that are separated by a slight cleft. All of its muscle fibers run horizontally to converge to a tendon approximately 5 cm across. The upper muscle fibers descend obliquely and laterally, the middle fibers run horizontally and laterally, and the lower fibers ascend obliquely and laterally. The tendon that is formed from the converging muscle fibers of the pectoralis major is bilaminar in form (with an anterior and a posterior lamina) and is attached to the lateral lip of the intertubercular sulcus of the humerus.

The pectoralis major is supplied by a primary arterial pedicle from the pectoral branch of the thoracoacromial artery. The pectoralis major musculocutaneous flap is based on this primary arterial pedicle from the thoracoacromial

artery. The perforating branches of the internal thoracic artery and the lateral thoracic artery complete the vascular pedicles of the muscle.

Multiple smaller muscular vessels arising from the deltoid and clavicular branches of the thoracoacromial artery and the superior thoracic artery contribute to the supply of the most upper and lateral clavicular portion of the pectoralis major. It has been reported (Yang et al. 2003) that the pectoralis major muscle and the overlying skin are supplied in approximately 50.7 % by the pectoral branch, in 43 % by the perforating branches of the internal thoracic artery, and in the 6.6 % by the lateral thoracic artery. The pectoralis major musculocutaneous flap traditionally is based only to the pectoral branch of the thoracoacromial artery. Newly improved techniques of harvesting the pectoralis major myocutaneous flap preserve the lateral thoracic artery enhancing thus the vascularity of the distal skin island (Po-Wing Yuen 2006). The muscle is innervated from the medial and lateral pectoral nerves that are branches of the brachial plexus.

The pectoralis major muscle when both of its parts act adducts the humerus at the shoulder and rotates the humerus medially. It also draws the scapula anteriorly and inferiorly. Acting alone its clavicular part flexes the humerus at the shoulder and its sternocostal part extends it.

9.1.4 Deltoid Muscle

The deltoid muscle (Fig. 9.2) is one of the scapular muscles that surround the shoulder joint. It is a thick muscle, having a shape of an inverted Greek letter "delta."

The deltoid muscle originates from the anterior border and the superior surface of the lateral third of the clavicle, the lateral margin and the superior surface of the acromion, and the lower edge of the crest of the spine of the scapula. The muscle fibers descend forming the smooth contour of the shoulder and converge to form a short tendon. The tendon formed by the converging muscle fibers inserts to the deltoid tuberosity on the lateral aspect of the humerus. The deltoid muscle receives its blood supply from the acromial and deltoid branches of the thoracoacromial artery, the anterior and the posterior circumflex humeral arteries, the subscapular artery, and the deltoid branch of the profunda brachii. The muscle is innervated by the axillary nerve (C5, C6). When acting, the anterior muscle fibers flex and rotate the arm medially, the middle fibers abduct the arm, and the posterior fibers extend and rotate the arm laterally.

9.2 Arteries Supplying the Skin of the Deltopectoral Region

The skin of the deltopectoral region is supplied by branches of the acromiothoracic, internal thoracic, and lateral thoracic arteries and by the supraclavicular artery (Fig. 9.3).

9.2.1 Acromiothoracic Artery

The acromiothoracic (thoracoacromial) artery is a short arterial trunk (1–1.5 cm) that arises from the anterior aspect of the second part (sometimes it arises from the first part) of the axillary artery usually 3 cm from its starting point. Its mean diameter is 2–2.5 mm. It curves around the superior margin of the tendon of the pectoralis minor muscle, pierces the clavipectoral fascia, and after its origin gives off four branches: the pectoral, the acromial, the clavicular, and the deltoid branch.

The point related to the midclavicular line where the acromiothoracic artery originates from the axillary artery differs in the left and right sides probably due to the different embryologic origins of the right and left subclavian systems (the right originated from the brachiocephalic trunk and the left from the aortic arch). In the right side, the acromiothoracic artery originates from the axillary artery in a point 2–3 cm below the clavicle and laterally to the midclavicular line, and in the left side, 2–3 cm below the clavicle and usually medial to the midclavicular line (Nakajima et al. 1997; Park et al. 2004).

9.2.1.1 Branches

9.2.1.1.1 Pectoral Branch

The pectoral branch is the largest branch of the acromiothoracic artery and the main feeding vessel of the myocutaneous pectoralis major flap. It runs inferiorly on the deep surface of the pectoralis major muscle, after giving a branch to the pectoralis minor muscle. It penetrates the pectoralis major muscle and anastomoses within the muscle mass with the branches of the perforators of the internal thoracic and the lateral thoracic arteries. The course of the pectoral branch corresponds to a line that runs from the middle of the clavicle vertically downward and then turns medially at the point where it meets a line that connects the acromion and the xiphoid process, running along this line (Ariyan 1979; Freeman et al. 1981). The pectoral branch of the acromiothoracic artery supplies more of the half of the muscle parenchyma of the pectoralis major (Yang et al. 2003). Through the musculocutaneous perforators, it also supplies the over-

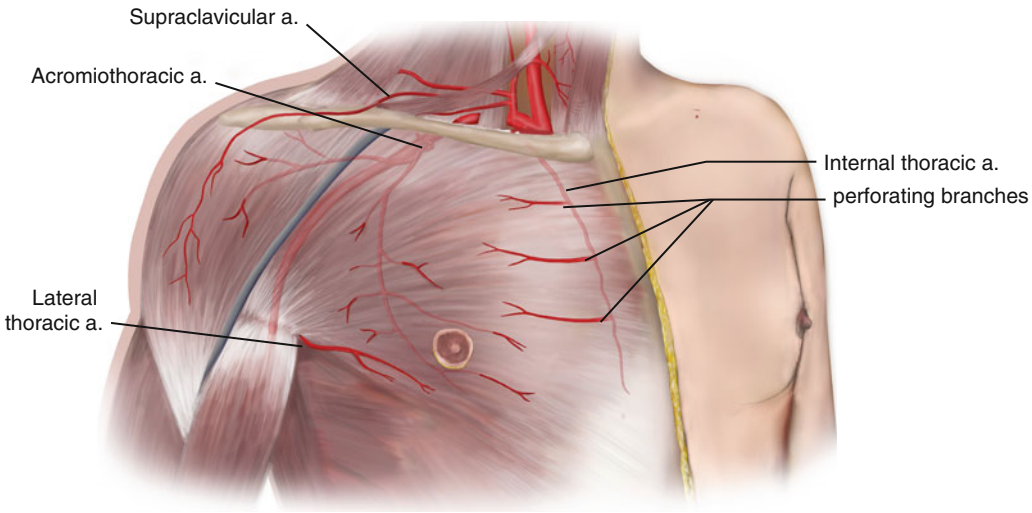

Fig. 9.3 Main arteries that supply the skin of the anterior chest and deltoid region

lying chest skin. The skin area that is supplied by the pectoral branch can range from 7×12 cm to 24×30 cm in the region between the 3rd and 6th rib from the parasternal line to the anterior axillary line (Kovacević et al. 2008).

9.2.1.1.2 Clavicular Branch

The clavicular branch runs superomedially, between the clavicular part of the pectoralis major muscle and the clavipectoral fascia, and supplies the subclavius muscle.

9.2.1.1.3 Deltoid Branch

The deltoid branch crosses pectoralis minor muscle and travels within the infraclavicular fossa in company with the cephalic vein. It supplies the pectoralis major and deltoid muscles.

9.2.1.1.4 Acromial Branch

This branch crosses the coracoid process and runs initially beneath the deltoid muscle, penetrates the muscle, runs over its surface, and reaches the acromion. The deltoid and the acromial branches of the acromiothoracic artery anastomose each other, and via musculocutaneous perforators and direct cutaneous branches, they supply the skin of the anterior part of the deltoid region.

9.2.2 Internal Thoracic Artery

The internal thoracic artery (internal mammary artery) arises from the inferior surface of the first part of the subclavian artery exactly opposite to the origin of the thyrocervical trunk. Its average diameter is approximately 3 mm. It runs inferiorly inside the chest in a parasternal plane, 1–1.5 cm lateral to the border of the sternum. It ends in the sixth intercostal space, where it divides into its terminal branches: the superior epigastric artery and the musculophrenic artery. It is accompanied by 1 or 2 veins, the internal thoracic veins, which ascend and drain into the brachiocephalic vein.

The internal thoracic artery gives off thymic branches that supply the thymus; sternal branches that supply the sternum and the medial part of the transversus thoracic muscle; the mediastinal arteries, which supply the structures of the anterior mediastinum; and the pericardiophrenic artery which travels in company with the phrenic nerve and supplies the pericardium and the perforating branches.

9.2.2.1 Perforating Branches

These are direct perforating branches that pierce through the internal intercostal muscles of the upper five or six intercostal spaces in company with the anterior cutaneous branches of the corresponding intercostal nerves and one perforating vein. They next penetrate the pectoralis major muscle comprising part of its blood supply. After penetrating the muscle, they become cutaneous, curve laterally, and supply the overlying skin. The perforator in the second intercostal space is usually the largest followed by the perforator in the third intercostal space and is termed as the "principal perforator" (Palmer and Taylor 1986). The average diameter of the second perforator has been found to measure 1.6 mm while the third perforator 1.4 mm and their lengths 9.6 and 8.7 cm, respectively (Schmidt et al. 2010).

These perforating branches of the internal thoracic artery constitute the dominant blood supply of the deltopectoral flap and of the pectoral portion of the cervicopectoral flap.

9.2.3 Lateral Thoracic Artery

The lateral thoracic artery (external mammary artery) arises from the second part of the axillary artery, being its second branch. The artery descends to the side of the chest initially along the lateral (axillary) border of the pectoralis minor muscle, afterward proceeds to the undersurface of the pectoralis major, and ends at the fifth intercostals space distributed to the lateral thoracic wall, the pectoral muscles, and the breast. It gives off branches that supply the serratus anterior and pectoral muscles and branches across the axilla to supply the subscapularis muscle and the axillary lymph nodes. It anastomoses with the subscapular, intercostal, acromiothoracic (pectoral branch), and internal thoracic arteries.

The lateral thoracic artery gives off cutaneous branches that course around the lateral border of the pectoralis major muscle and supply a portion of the skin of the lateral thoracic wall and the lateral part of the breast (Standring 2008).

A vessel that often has been confusingly described in this area is the superficial thoracic artery. The superficial thoracic artery constitutes either the direct continuation or a branch of the lateral thoracic artery (Standring et al. 2008; Loukas et al. 2006).

9.2.4 Supraclavicular Artery

An important cutaneous artery that contributes to skin supply of the deltoid region is the supraclavicular artery, a vessel that is branched from the superficial cervical/transverse cervical artery. The supraclavicular artery after arising at the medial portion of the omoclavicular (supraclavicular) triangle courses laterally. At the angle between the anterior border of the trapezius and the superior border of the clavicle, it pierces the deep cervical fascia, crosses the clavicle, and travels subcutaneously to the deltoid region. It supplies the skin of the lateral and upper part of the deltoid region, giving off branches to the pectoralis major muscle, which, after piercing the muscle, contribute also to the supply of the upper thoracic skin.

This vessel is the main feeding vessel in the design of an axial flap that uses the skin of the deltoid region (Pallua et al. 1997; Pallua and Magnus Noah 2000; Vinh et al. 2009; Hormozi and Shafii 2010; Pallua and Wolter 2013).

9.3 Superficial Veins

Small veins that coalesce into larger ones and drain into the anterior intercostal veins drain the anterior thoracic wall. The anterior intercostal veins which accompany the intercostal arteries are tributaries of the internal thoracic and musculophrenic veins. The veins that accompany the perforating branches of the internal thoracic artery drain directly into the internal thoracic vein. The internal thoracic vein, sometimes double, travels along the border of the sternum just medial to the internal thoracic artery and drains in turn into the brachiocephalic vein.

The lateral thoracic vein contributes to the venous drainage of the lateral chest wall and the breast. The lateral thoracic vein runs with the corresponding artery and drains into the axillary vein. The lateral thoracic vein normally is connected inferiorly with the superficial epigastric vein through the thoracoepigastric vein that runs superficially on the anterolateral aspect of the trunk (Fig. 9.4).

9.4 Cutaneous Nerves

The skin of the thorax receives its sensory innervation by cutaneous branches of the cervical and the thoracic nerves. The supraclavicular nerves of the cervical plexus (see Chap. 8) through their branches supply the skin of the upper thoracic region.

Particularly the medial supraclavicular branches supply the skin of the medial part of the upper thoracic region. The intermediate supraclavicular branches supply the skin of the middle and lateral part of the upper thoracic region. And the lateral supraclavicular branches distribute to the skin of the lateral part of the upper thoracic region and to the skin of the upper part of the deltoid region.

The thoracic nerves supply the skin of the anterior part of the anterior chest through their anterior cutaneous branches and the anterolateral part through the lateral cutaneous branches, respectively (Fig. 9.5).

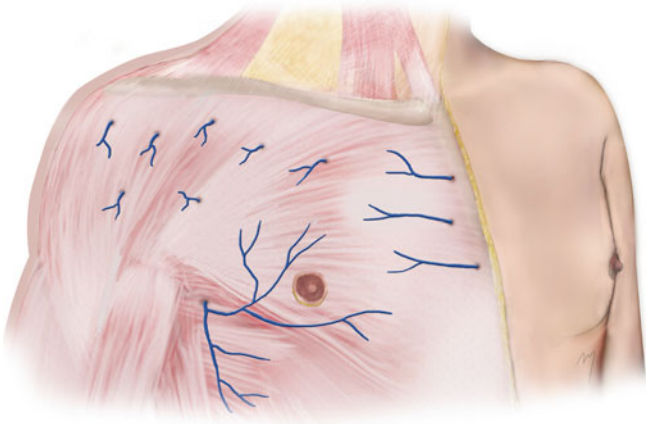

Fig. 9.4 Superficial veins of the anterior thorax

Fig. 9.5 Cutaneous nerves of the anterior thorax

9.5 Deltopectoral Flap

The deltopectoral flap is one of the two most widely used fasciocutaneous flaps in head and neck reconstruction that are derived from the deltopectoral region, the other one being the cervicopectoral flap.

The deltopectoral flap is a transposition flap that has first been designed by Aymard in 1917 for nose reconstruction. It received increased attention since 1965, when Bakamjian began using the flap for pharyngoesophageal reconstruction. The deltopectoral flap transfers the skin from the deltoid and thoracic region and shows similarities to the thoracic part of the cervicopectoral flap in terms of anatomy, vascularity, and surgical technique. The flap is of axial pattern, based on the internal thoracic artery perforators, in its medial part and of random pattern in its lateral part.

The deltopectoral flap had lost its popularity and was deported by the free vascularized flaps but recently has been reappearing in the international literature (Feng et al. 2006; Sharma and Panda 2006; Bey et al. 2009; Rebelo et al. 2009; Krijgh and Mureau 2012; Nayak and Nilamani 2012).

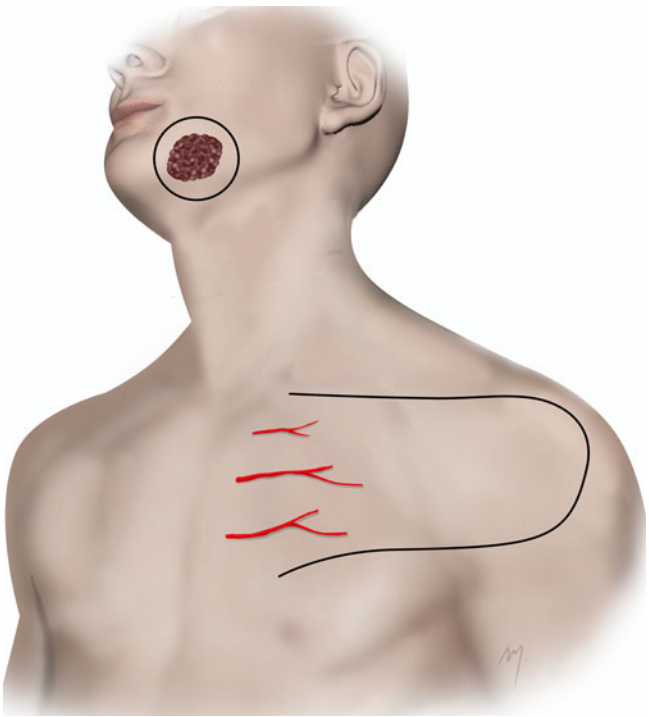

Fig. 9.6 Outline of the deltopectoral flap. The flap is of axial pattern in its medial part and of random pattern in its lateral part

9.5.1 Flap Design

The deltopectoral flap is designed in rectangular shape, in the upper thorax extending from the sternum in a variable degree to the anterior deltoid region. The base of the flap is situated parasternally 2 cm from the sternal edge. The superior boundary follows the clavicle, and the inferior boundary is parallel to the previous line over the 3rd or 4th intercostal space. The flap extends horizontally beyond the deltopectoral groove onto the deltoid region, in an extent depending on the needed length to reach the defect, and ends in a curvilinear distal margin (Figs. 9.6 and 9.7).

There are cases where to reach the defect the needed length of the flap compels it to extend to the lateral deltoid region and a flap delay is required at least 1 week prior to the flap harvest.

9.5.2 Flap Vascularity

The deltopectoral receives its blood supply from the perforating vessels of the internal mammary artery with the main contribution of the 2nd and 3rd perforators in its medial part

Fig. 9.7 Tumor resection margins and flap are outlined

Fig. 9.8 Incision is made through the deltopectoral fascia

having an axial blood supply at this part (Fig. 9.6). The distal part is of random pattern, so far as the musculocutaneous perforators of the deltoid and acromial branches of the acromiothoracic artery are cut during flap elevation.

9.5.3 Flap Elevation

The incision is made deep to the deltoid fascia at the deltoid region and deep to the pectoral fascia at the chest (Fig. 9.8). The flap is raised from distal to the base. The plane of dissection lies between the deltoid muscle and the deltoid fascia including the latter in the flap. As the dissection

Fig. 9.9 Flap raised. Internal thoracic perforator is seen at the lower part as it enters the subcutis

advances, the deltopectoral groove is reached. The cephalic vein passes deep to this area and in most of the cases can be avoided.

The lateral border of the pectoralis major is easily identified and dissection over the muscle continuous in the same plane beneath the pectoralis fascia. Sharp dissection is needed to release the flap from the clavicle as long as the pectoralis fascia fuses with the bone. Mild bleeding from musculocutaneous perforators can be encountered. Dissection stops 1.5–2 cm lateral to the lateral sternal border. The perforating branches of the internal thoracic artery may be seen if dissection extends toward them, as they perforate the pectoral muscle entering the subcutaneous tissue (Fig. 9.9).

The flap length is controlled so as to reach the defect without tension, sutured in place, and the pedicle tubed (Fig. 9.10a, b). The flap pedicle remains for a period of 2–3 weeks until neovascularization of the recipient site occurred (Fig. 9.11). At the second stage, the flap pedicle is divided and returned into place (Figs. 9.12, 9.13, and 9.14). The donor site defect can be covered with a split-thickness skin graft left to heal by secondary intention. The deltopectoral flap achieves usually a very good postoperative result providing tissue with a reasonable color match (Fig. 9.15).

9.5.4 Deltopectoral Flap Combined with Lining Flaps

The deltopectoral flap is a reliable flap that can be safely used in conjunction with other local or regional flaps in

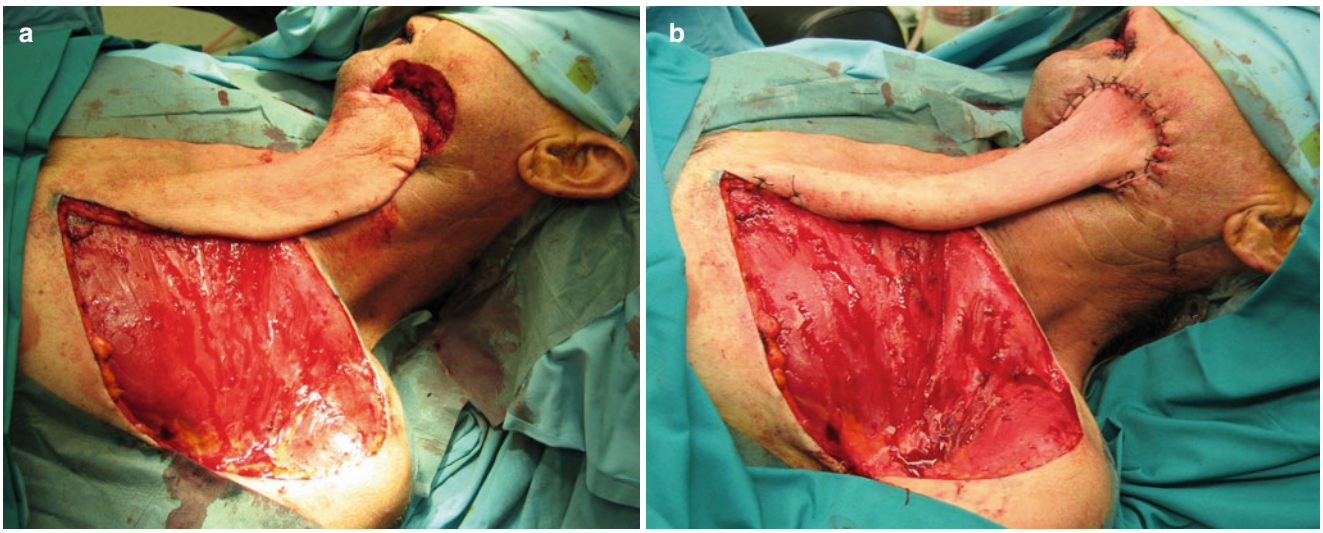

Fig. 9.10 (**a**) Flap is transpositioned to the recipient site. (**b**) The flap is sutured into the recipient site and its pedicle is tubed

Fig. 9.11 The flap pedicle remains for 2–3 weeks

Fig. 9.12 Second-stage operation

Fig. 9.13 Flap pedicle divided

through and through cheek defects. An example is given in the following case.

A large squamous cell carcinoma of the oral commissure is spread into the adjacent cheek skin and buccal mucosa in the patient presented in Fig. 9.16a, b. Tumor excision lead to a through and through cheek defect (Fig. 9.17) that must be reconstructed by internal and external lining. The neighboring buccal fat pad was intact and was unprepared as a buccal fat pad to resurface the defect intraorally (Fig. 9.18a, b). After a supraomohyoid neck dissection was performed, a deltopectoral flap was outlined and raised in the usual manner to provide external coverage (Figs. 9.19, 9.20, and 9.21). The buccal fat pad was sutured in place (Fig. 9.22) and the deltopectoral flap settled in a bed of reduced vascularity and sutured in the periphery (Fig. 9.23). The flap pedicle of the tubed deltopectoral flap remained for 3 weeks (Fig. 9.24a, b). After that period it was divided at the second surgical stage and final restoration took place (Fig. 9.25a, b). The deltopectoral flap had set well in place, and the postoperative appearance of the patient shows a satisfactory restoration (Fig. 9.26a, b).

Fig. 9.14 Flap pedicle returned and sutured in place

9.5.5 Deltopectoral Flap for Intraoral Lining

The deltopectoral flap is a useful tool for resurfacing also large intraoral defects. In the large oral cavity tumor shown in Fig. 9.27, a reconstruction was planned to be performed by a deltopectoral flap. Access to the tumor was gained through a lip-split approach and the elevation of a lower cheek flap (Fig. 9.28). After the lower cheek flap was elevated, the lesion was exposed and the resection margins outlined (Fig. 9.29). The tumor was excised in clear margins revealed by frozen biopsies, leaving a wide defect (Fig. 9.30a). Posterior marginal mandibulectomy was required (Fig. 9.30b). The deltopectoral flap was raised in the usual manner (Figs. 9.31 and 9.32).

The submandibular incision is not sutured in its central part leaving a sufficiently wide tunnel through which the

Fig. 9.15 (**a**, **b**) The postoperative result at 1 year

Fig. 9.16 (**a**, **b**) Oral commissure carcinoma

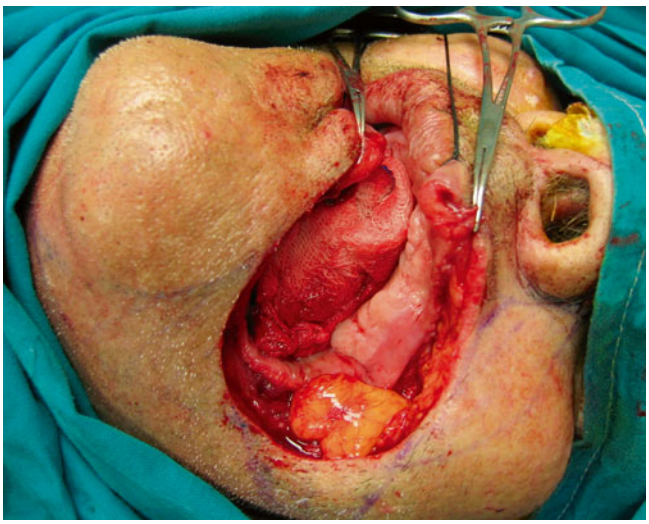

Fig. 9.17 Through and through defect after tumor excision. The buccal fat pad remains intact

deltopectoral flap passes intraorally reaching the defect (Figs. 9.33 and 9.34). The lower cheek flap returns to its normal position and is sutured. Care is taken not to tighten the submandibular tunnel, which can lead in struggling of the arterial supply and the venal outflow (Fig. 9.35).

After two weeks the pedicle is divided and final restoration takes place. The postoperative appearance of the patient 5 months following surgery shows a satisfactory functional and cosmetic result (Fig. 9.36a–c).

The deltopectoral flap is a reliable, safe, easy to perform, and quick to raise flap. It provides a thin, pliable, and large soft tissue with a reasonable color match. It can reach all regions of the lower and midface providing coverage in wide defects. Its main disadvantage is the second surgical procedure needed for the flap division.

9.6 Cervicopectoral Flap

The cervicopectoral flap is a large rotation flap that is best used in the reconstruction of large lateral facial defects. The cervicopectoral flap was first described by Becker (1978) and actually constitutes the thoracic extension of the cervicofacial flap.

It is consisted of a facial, a cervical, and a thoracic part. The cervical and the thoracic parts are of standard extent due to their standard design. The extent of its facial part depends on the remaining healthy facial skin after the excision of the facial lesion and the produced defect.

The flap is of axial pattern, based on the internal thoracic artery perforators, in its thoracic part and of random pattern

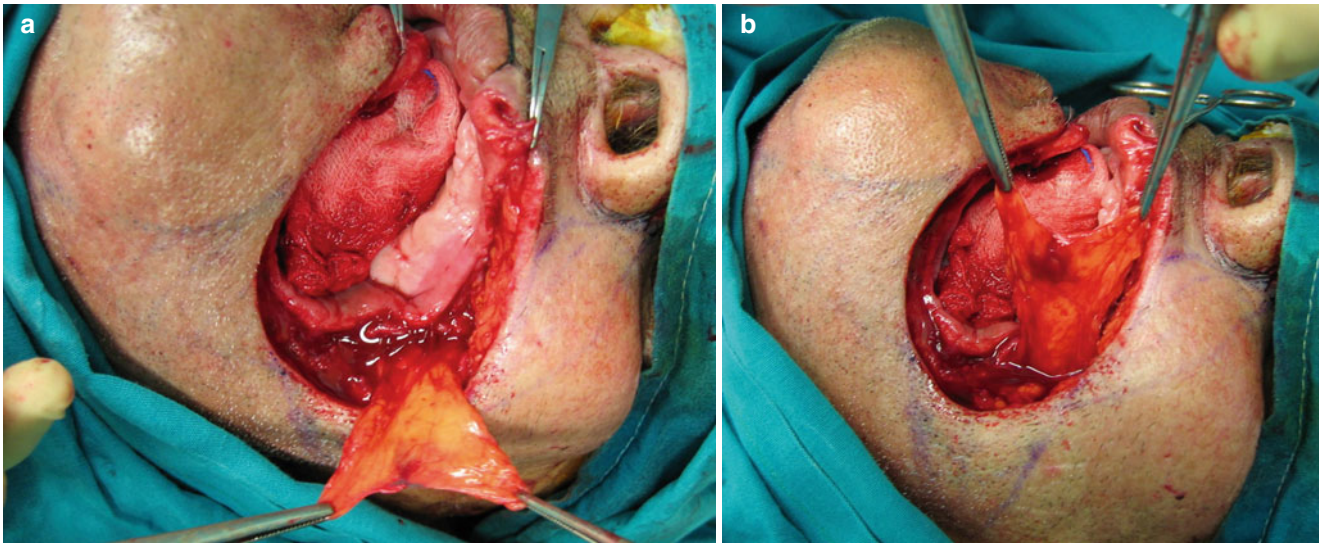

Fig. 9.18 (**a**) The buccal fat pad is dissected and prepared as a flap. (**b**) The buccal fat pad flap is of adequate length and width to provide intraoral lining

Fig. 9.19 Deltopectoral flap outlined

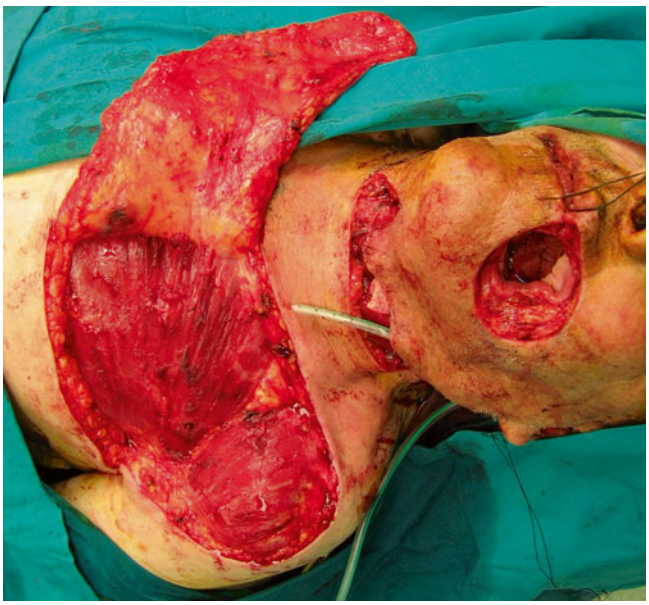

Fig. 9.20 Flap raised

in the rest of it. In a large basal cell carcinoma (Fig. 9.37) located at the lateral face, excision and reconstruction of the defect with a cervicopectoral flap is planned.

9.6.1 Flap Design

The proposed area of the cheek excision and the cervicopectoral flap are marked (Fig. 9.38). The inferior border of the resection is the upper border of the flap. The outline curves posteriorly around the earlobe and then runs inferiorly, in a distance of up to 2 cm, behind and parallel to the anterior border of the trapezius muscle. It then traverses the acromioclavicular part of the shoulder and the deltopectoral groove and continues along the lateral border of the pectoralis major muscle. The inferior limb of the flap turns to the anterior chest running parallel to the clavicle approximately 2–3 cm above the nipple. Due to the fact that the nipple is not a stable landmark especially in female patients, more precisely the level of the inferior limb must correspond to the third intercostal space. The horizontal inferior limb ends

Fig. 9.21 Flap length control

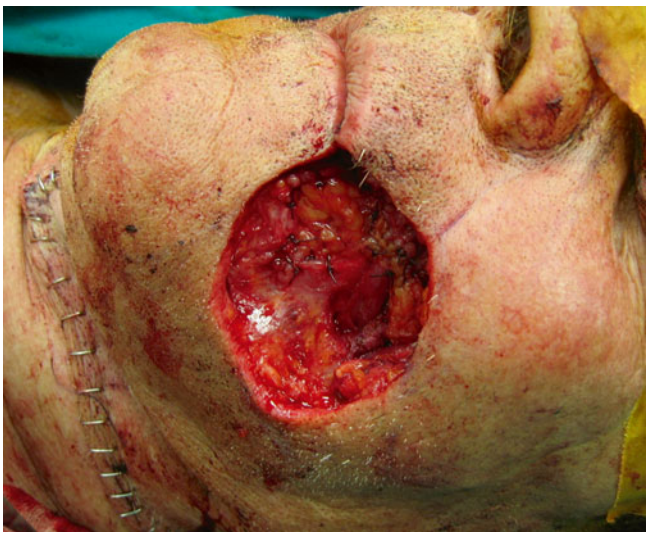

Fig. 9.22 Internal coverage completed

2 cm lateral to the sternal border. A back-cut at the flap's base might be needed to increase rotation.

9.6.2 Flap Vascularity

As the flap is raised from its periphery to its base, at the neck the vessels that supply the skin of the neck are cut. Starting from lateral to medial by row, these are lateral from top to bottom: the neck branches of the posterior auricular artery, the sternocleidomastoid branches of the occipital artery, the cutaneous branches of the transverse cervical artery and as dissection proceeds to the midline, the cutaneous branches of

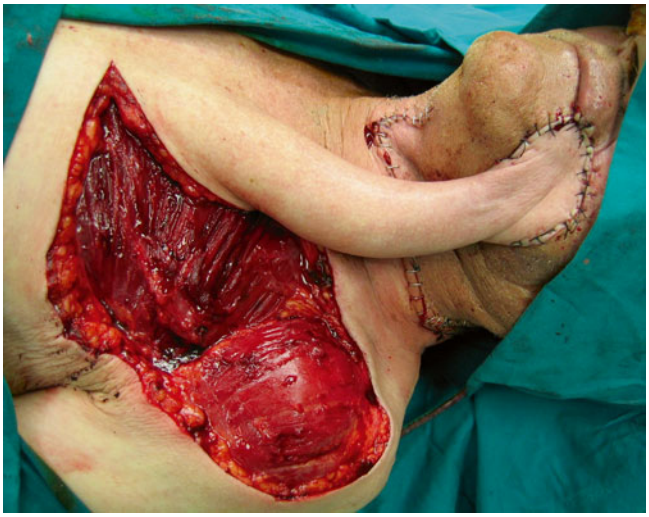

Fig. 9.23 The deltopectoral flap provides the external coverage of the defect

the facial artery, the cutaneous branches of the submental artery, and the cutaneous branches of the superior thyroid and suprascapular artery. At the thoracic part from lateral to medial, the vessels that are divided are the musculocutaneous perforators of the acromial, the deltoid, and the pectoral branches of the acromiothoracic artery. Despite this, the flap shows an excellent viability that is ensured in its wide base that is perfused by the rich anastomosis of the cutaneous vessels across the midline in the cervical skin and the maintenance of the perforating vessels from the internal mammary artery. The flap is essentially a mixed axial-patterned and random-patterned flap (Fig. 9.39). It is axial in the thoracic part where it catches the first four internal thoracic perforators. Random pattern is in its cervical part where at its base receives reverse flow from the anastomoses with the contralaterals: submental, superior thyroid, and inferior thyroid arteries.

The lesion was excised in clear margins revealed by frozen biopsies. The deep plane of excision was mostly above the parotidomasseteric fascia (Figs. 9.40 and 9.41).

9.6.3 Flap Elevation

9.6.3.1 Thoracic Part

At the thoracic part (Fig. 9.42), the incision is made through the superficial fascia of the chest deep to the deltoid and pectoral fascia. Elevation of the flap starts at the deltoid region in a plane deep to the deltoid fascia and over the deltoid muscle fibers. Preceding at the deltopectoral groove, the cephalic

Fig. 9.24 (**a**, **b**) Pedicle remains for 3 weeks

Fig. 9.25 (**a**, **b**) Pedicle division and final restoration

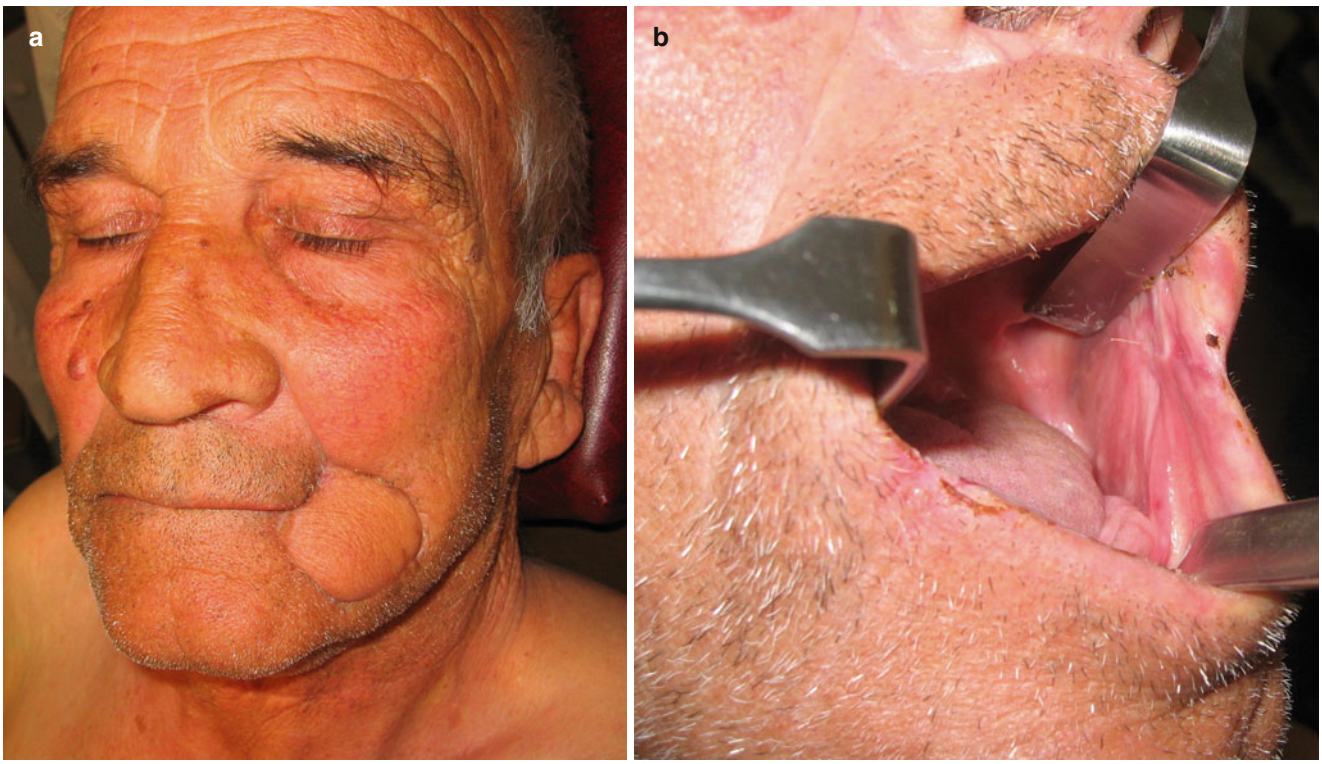

Fig. 9.26 (**a**) Result at 6 months. (**b**) Intraoral view

Fig. 9.27 Squamous cell carcinoma of the buccal mucosa

Fig. 9.28 Deltopectoral flap and lip-split approach outlined

vein passing deeply to it most of the time can be avoided and left intact. At the anterior chest, the plane of dissection continues deep to the pectoral fascia just above the fibers of the pectoralis major muscle. The fascia is fused with the clavicle, and sharp dissection by using a scalpel is needed to release it from the bone. Incorporation of the deltopectoral fascia in the flap strengthens its vascularity. Proceeding medially elevation is quick and easy without encountering any anatomical structure except small perforating vessels that are cauterized.

As the lateral border of the sternum is reached, the perforating branches of the internal thoracic artery may be located and preserved, each of them in its intercostal space. Alternatively the dissection can stop approximately 1.5–2 cm lateral to the lateral border of the sternum, protecting thus the perforating branches without locating them.

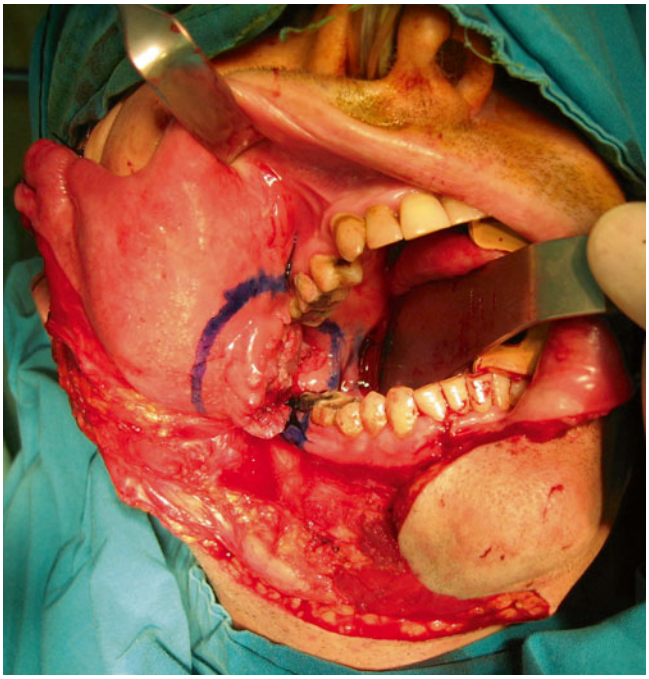

Fig. 9.29 Tumor exposed and the area of proposed excision outlined

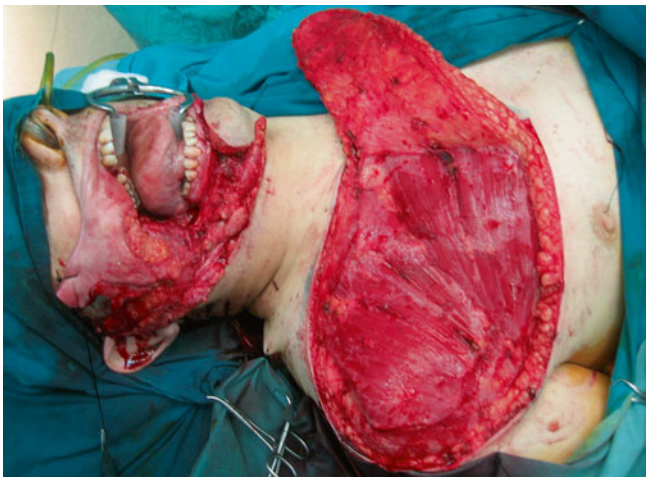

Fig. 9.31 The deltopectoral flap raised

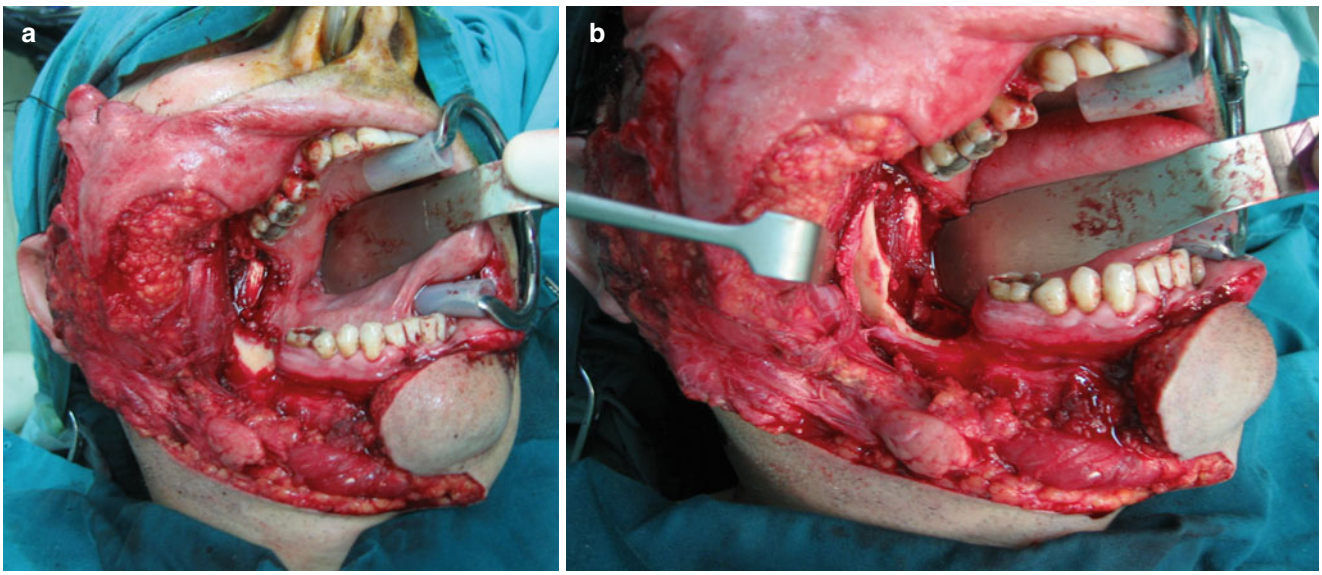

Fig. 9.30 (**a**) The defect after tumor excision. (**b**) Posterior marginal mandibulectomy was performed

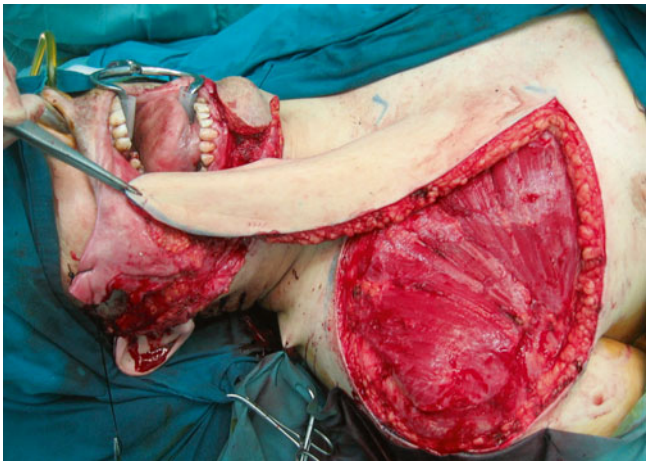

Fig. 9.32 Flap reaches the defect easily and without tension

Fig. 9.33 Deltopectoral flap passes through a submandibular tunnel intraorally

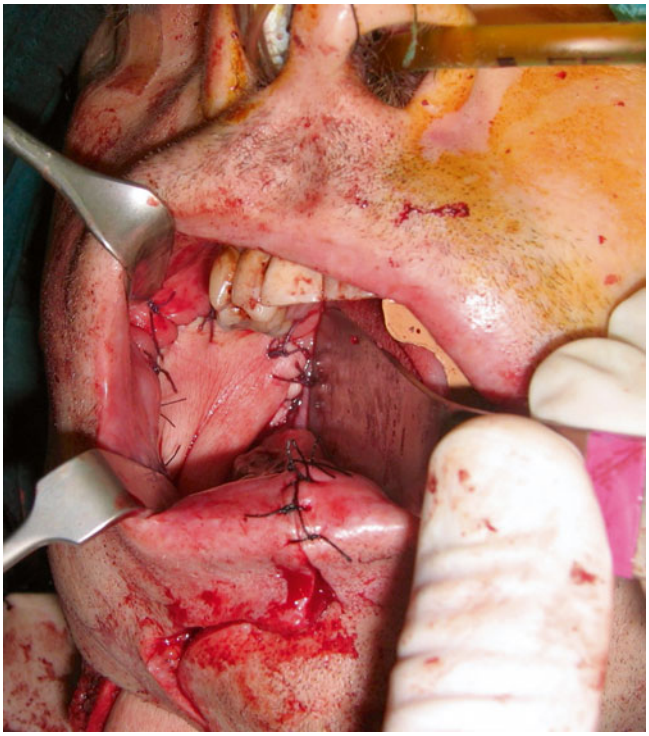

Fig. 9.34 Flap sutured in place resurfacing the intraoral defect

Fig. 9.35 Immediate postoperative view. The tubed pedicle passes freely through the tunnel without constriction

9.6.3.2 Cervical Part

The cervical part of the flap is elevated in the sub-SMAS layer, below the platysma muscle and above the investing layer of the deep cervical fascia. After incising deep to the trapezius muscle, the plane of dissection is easily created above it, until its anterior border. Moving on anteriorly, the elevation proceeds at the roof of the posterior neck triangle where the platysma might be very hypoplastic or even absent at this area especially in its posterior part, and from the other hand the investing layer of the deep cervical fascia might be indistinguishable. Therefore, the plane of dissection is slightly more difficult to determine taking care to avoid or to identify and protect the terminal part of the accessory nerve (Fig. 9.43).

Dissecting further anteriorly, the elevation proceeds with ease just under the platysma muscle. Reaching the sternocleidomastoid prominence, the muscles posterior border is easily identified. Care is taken to locate Erb's point, where the cutaneous branches of the cervical plexus and the accessory nerve emerge. Cutaneous filaments of the plexus that prevent mobilization of the flap can be sacrificed (Fig. 9.44). Elevation proceeds over the outer surface of the

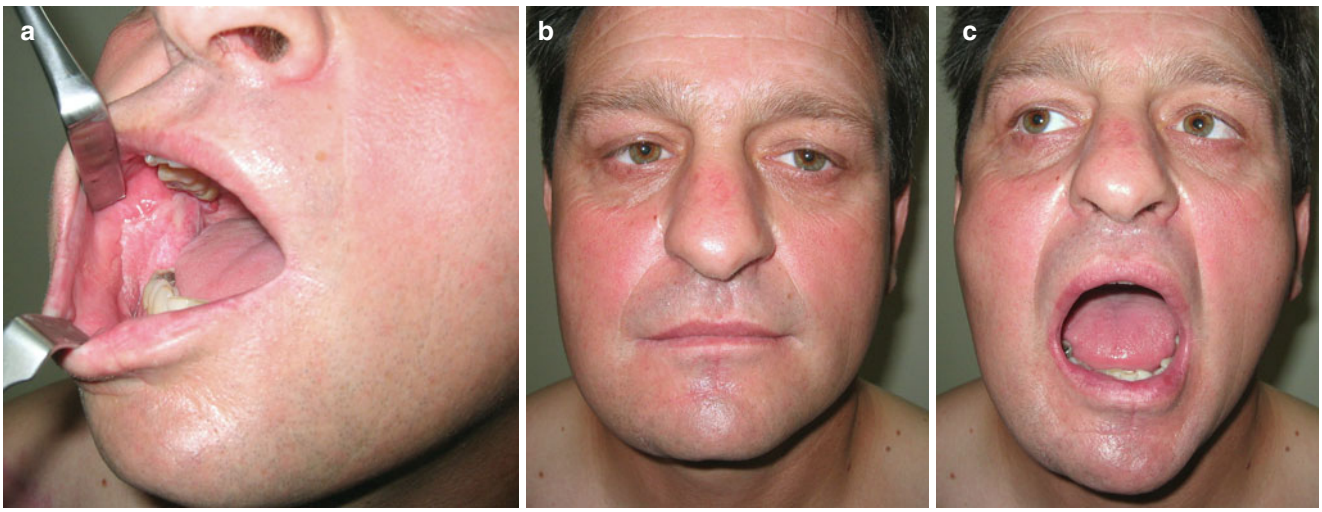

Fig. 9.36 Result at 5 months. (**a**) The defect fully restored. (**b**) The cheek lump produced from the bulk of the deltopectoral flap reduces with time. (**c**) Function is accomplished

Fig. 9.37 Preoperative view of a large basal cell carcinoma of the cheek

Fig. 9.38 Outline of the cervicopectoral flap

sternocleidomastoid continuing medially and stops near the midline of the neck were the anterior jugular vein might be found.

At the upper part of the cervical dissection of the flap, special care is taken to avoid or to identify and prevent the marginal branch of the facial nerve (Fig. 9.45a, b). The elevation continues on the subplatysmal plane to the midline of the neck exposing the lateral surface of the submandibular gland invested by the investing layer of the deep cervical fascia.

When following the subplatysmal plane, the superficial veins (e.g., external jugular vein, anterior jugular vein) are exposed and whenever possible are protected (Fig. 9.46).

As long as the vertical limb of the flap in the neck is in the same position as the incision in the Lazaridis modification of the Conley incision for neck dissection and the elevation of the flap sufficient enough to expose the neck, a simultaneous neck dissection can be performed with ease and with no need for further incisions (Lazaridis et al. 1994, 1997).

9.6.3.3 Facial Part

The extent of its facial part depends on the remaining healthy facial skin after the excision of the facial lesion and the produced defect. The flap can be elevated in its facial part either superficial to the superficial musculoaponeurotic system (SMAS) layer or in a deep sub-SMAS plane (Fig. 9.47). The superficial dissection plane provides protection of the branches of the facial nerve, but the sub-SMAS dissection

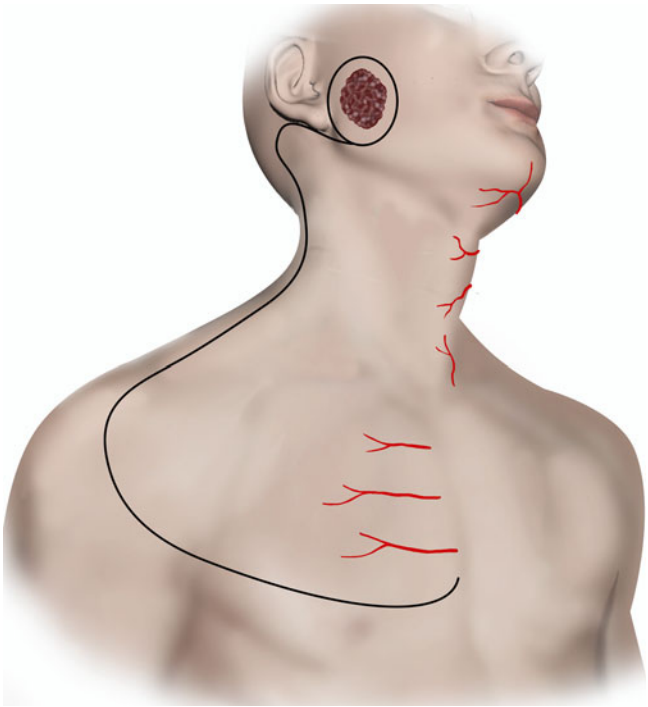

Fig. 9.39 The cervicopectoral flap is a mixed axial-patterned and random-patterned flap

Fig. 9.40 The cheek defect after the lesion has been excised

enhances vascularity of the facial part of the flap. The decision is made depending on the depth of the defect and the appropriate bulk of the transferred tissue that is needed to provide an improved contour and the patient's sufficiency in blood microcirculation, especially if the patient is prone to microangiopathy from diabetes mellitus, smoking, etc.

The above partitioned description in flap elevation is only for descriptive reasons as long as the flap is not raised by parts but as a whole from lateral to medial with the separate parts connected in the transition zones.

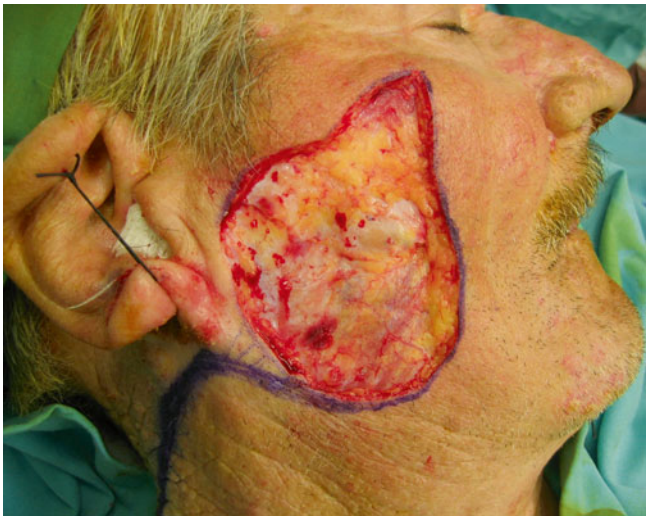

Fig. 9.41 The lesion had to be excised in its greater extent in the sub-SMAS layer. Parotidomasseteric fascia is clearly visible

Fig. 9.42 Elevation of the thoracic part deep to the deltopectoral fascia

After the flap has been fully mobilized (Fig. 9.48), parotidectomy and/or any type of neck dissection can be performed as already mentioned at this stage. The flap is then rotated (Fig. 9.49) to the recipient site and is controlled to reach and

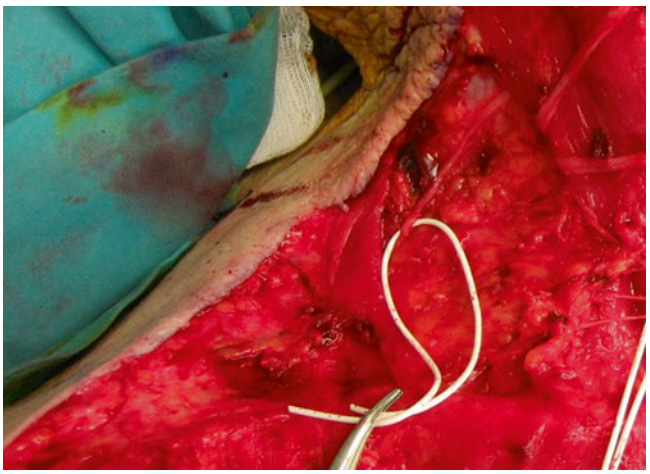

Fig. 9.43 Deep plane dissection at the posterior neck triangle may risk inadvertent injury of the accessory nerve

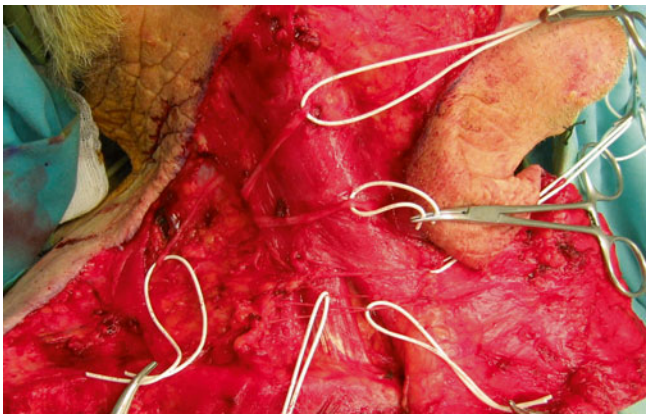

Fig. 9.44 Accessory nerve (*left*). Greater auricular nerve (*top*). Transverse cervical nerve (*middle*). Branches of the supraclavicular nerves (*bottom*). Filaments of the supraclavicular branches were sacrificed to allow further mobilization of the flap. The lesser occipital can just be seen above the exiting point of the accessory nerve

resurface the defect without tension. A back-cut at the sternal border of the inferior flap limb might help gaining more rotation if needed. Possible "dog-ear" may be formed medially at the upper border of the flap and at the axillary fold, which are trimmed as necessary. The flap is then sutured in position without tension. The donor site is closed primarily while

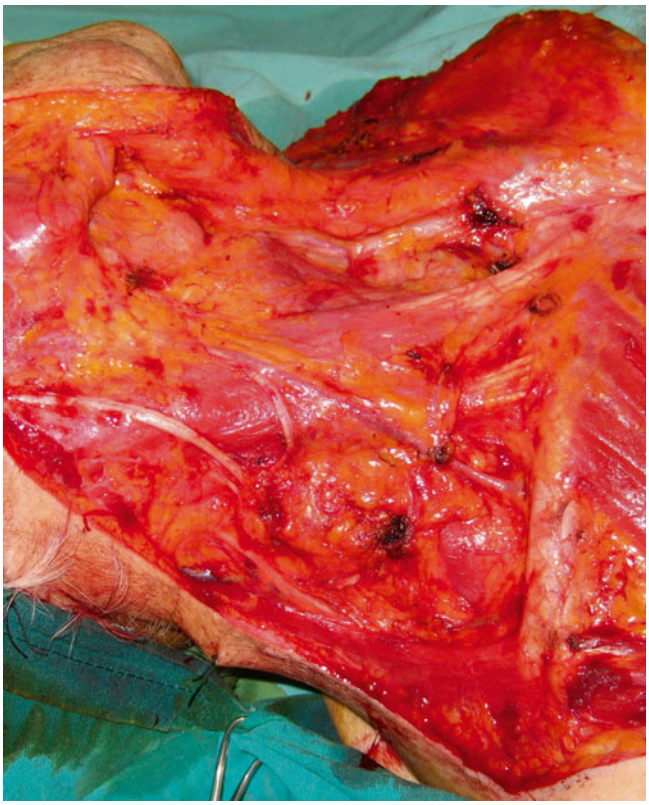

Fig. 9.46 Complete elevation of the cervical part of the flap. The trapezius muscle; the accessory, the greater auricular, and the transverse cervical nerves; and the external and anterior jugular veins are exposed

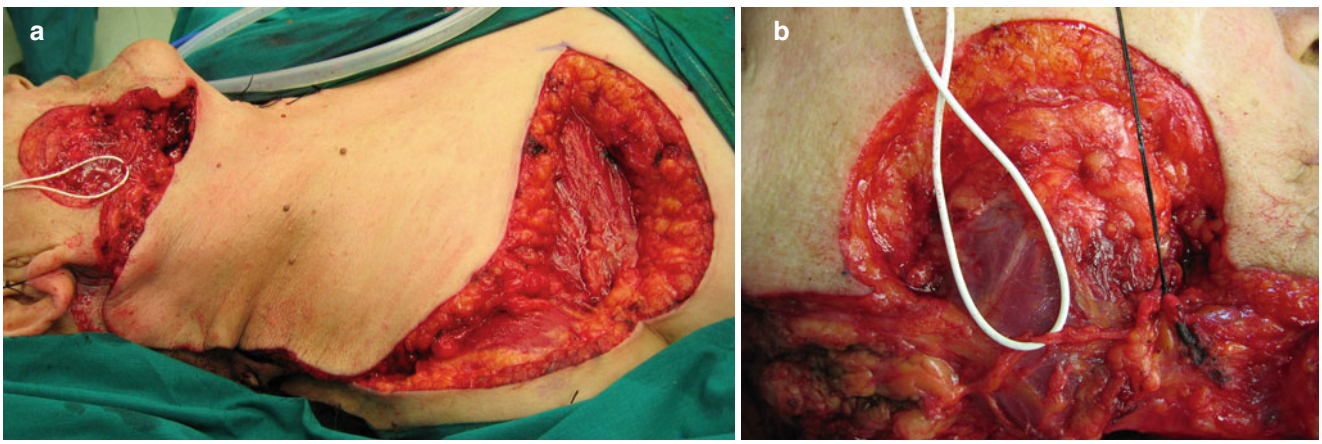

Fig. 9.45 (**a**) During the upper cervical part elevation, the marginal branch of the facial nerve must be protected. (**b**) The marginal branch of the facial nerve as it emerges from the parotis and runs superior to the lower border of the mandible superficial to the facial artery and vein. In this patient the lower pole of the parotis is cut and the facial pedicle ligated and cut, due to a simultaneous neck dissection (closeup view of Fig. 9.45a)

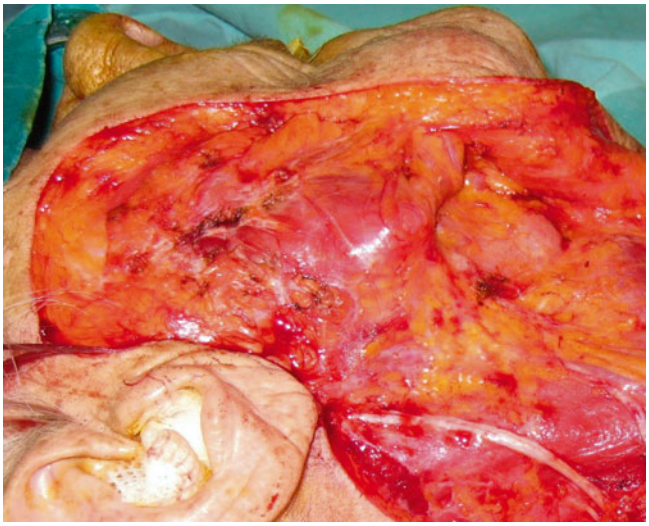

Fig. 9.47 Elevation of the facial part of the flap in this case is done in the sub-SMAS plane

Fig. 9.49 Flap is rotated to the recipient site

Fig. 9.48 The cervicopectoral flap fully mobilized

Fig. 9.50 Immediate postoperative view after wound closure and placement of suction drains

immobilization of the chest and deltoid skin may be needed to achieve suturing without tension (Fig. 9.50). The postoperative result is excellent as long as the flap provides tissues similar in color, thickness, and texture to the facial defect (Fig. 9.51a, b).

9.6.3.3.1 Flap Maximal Outward Extent

It is often referred that the cervicopectoral flap only reaches defects of the lower cheek, below the line that connects the tragus to the oral commissure. This is not true. In fact, the cervicopectoral flap can reach and resurface lateral defects beyond that line up to the midface. Such a case is seen in Fig. 9.52a–c, where the cervicopectoral flap reached and covered an orbital defect after a wide resection combined with an orbital exenteration.

The cervicopectoral flap is a reliable regional flap that provides adequate coverage to large lateral defects of the lower and middle face (cheek, orbit, periauricular region). It can also be used in cases where a big portion of the neck skin has been excised, leading to the reduction of the flap's cervical portion, the resulting neck defect can be resurfaced using the same design, if the flap is extended to the costal margin, with the inferior limb lying quite below the level of areola (Moore et al. 2005).

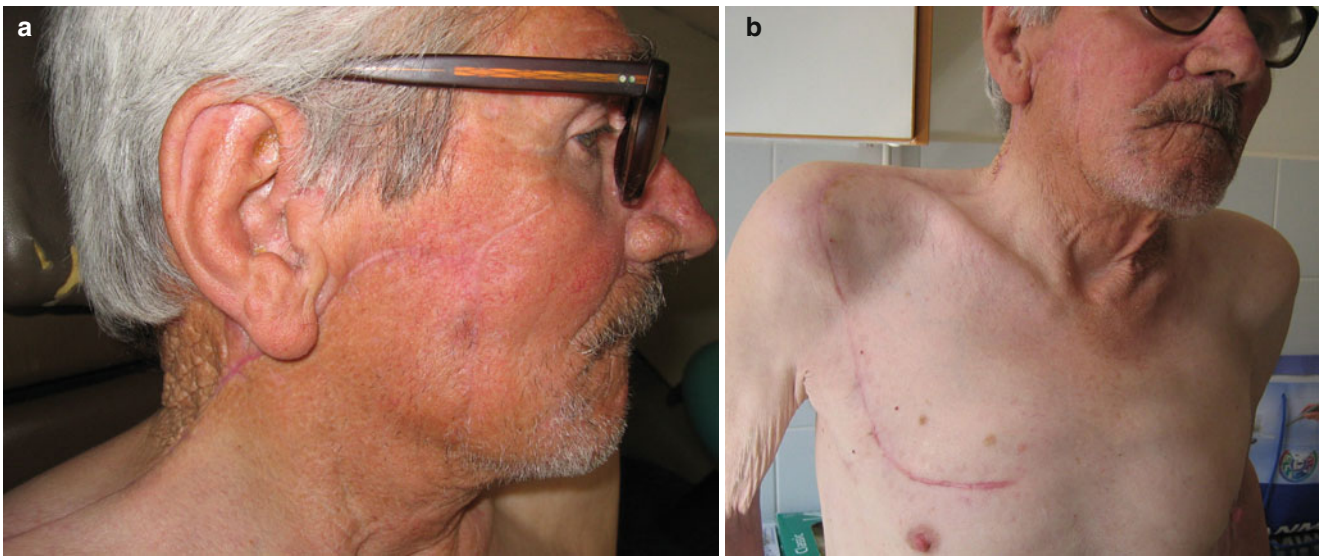

Fig. 9.51 (**a**, **b**) Postoperative result at 4 months

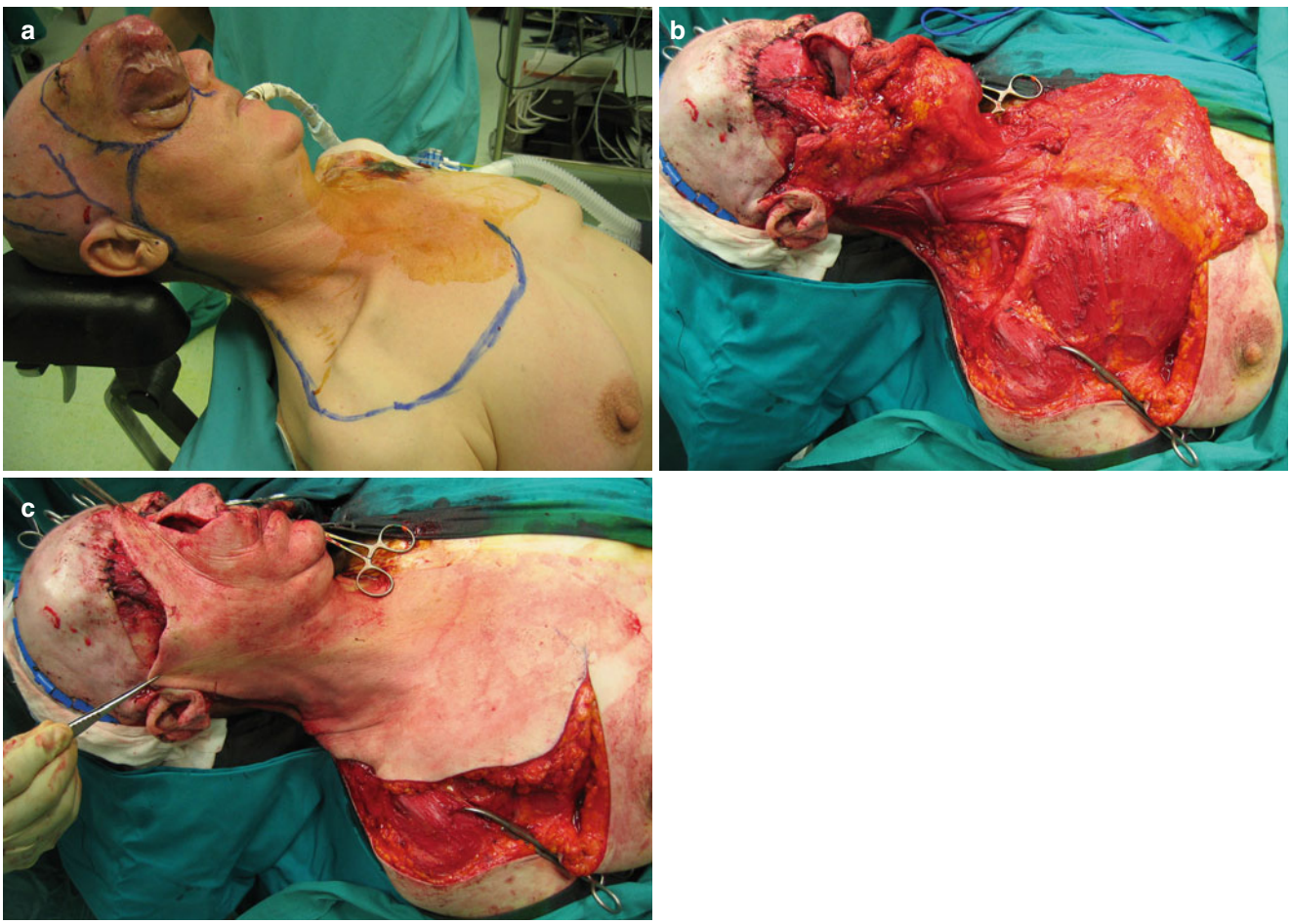

Fig. 9.52 (**a**) A large orbital tumor. Dissection lines are outlined and the cervicopectoral flap is one of the flaps, of the combined restoration, that will provide the external coverage. (**b**) The cervicothoracic flap is elevated. (**c**) The flap easily and without tension reaches the orbit

The cervicopectoral flap provides tissue similar in color, texture, and thickness and fulfills the criteria of functional and aesthetic results. It achieves adequate exposure of the neck and the parotid region; thus, if a neck dissection or a parotidectomy is needed, it can be performed simultaneously. It also can be combined with pectoralis major myocutaneous flap that provides the intraoral coverage, in full-thickness cheek defects in a single-stage reconstruction.

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