synostosis of one coronal suture, but also by bilateral synostoses that may be of different degree of severity.

The growth inhibition is not only confined to the neurocranium, but also may cause facial scoliosis. This malformation is called plagiocephalus, caused by synostosis of the coronal suture. The forehead flattens on the affected side, at the same time the facial axis turns to the non-affected side because of the higher growth pressure in the direction of the affected suture. As a result, the eye axis and occlusal plane are tilted.

Although the intracranial volume is restricted there will hardly ever be problems caused by the regionally increased intracranial pressure. Patients (parents) mainly seek treatment because of aesthetic reasons.

Fronto-orbital advancement is the rational treatment in these patients. The timing of the surgery, however, is of great importance, the best moment being the end of the first year. This premature surgical interventional allows correction of the frontal deformation and normalisation of the regionally increased intracranial pressure. The surgical opening of the cranial sutures stops the disturbed growth of the facial region, so that, during further growth, the facial scoliosis will be eliminated. As a result, extensive surgical interventions as a rule, are not necessary at a later age!

Congenital anophthalmia and facial development

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Congenital anophthalmia as well as severe microphthalmia usually leads to a micro-orbit associated with facial hemi-hypoplasia. This usually goes along with lack of growth and development of the eyelids and conjunctival sac.

The insertion of an aesthetic eye prosthesis is virtually impossible under these circumstances.

Stimulation of growth by inserting an intra orbital expansion device seems to be a logical procedure. If possible eye movements are stimulated as well, which in turn will also stimulate orbital growth.

Since rapid growth takes place in the first year after birth, it is essential to intervene as early as possible to achieve a maximum result!

The technique and results will be shown in this presentation.



Fig. 1. – If there is a lack of eye development, it is not only the bony orbit which does not develop, but all the facial bones contributing to the bony orbit (principally the malar, the frontal, the maxilla, and the greater wing of the sphenoid). Thus an isolated orbital congenital malformation will naturally evolve into a serious hemi craniofacial malformation which is difficult to correct.

Orbital asymmetry

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Introduction/Definition

We define orbital asymmetry as differences between both orbits concerning form, volume, position as well as differences in distance of the orbits from the facial midline.

Evaluation and measurements are performed by cephalometric posterior-anterior radiographs and superimposed tracings, quantitative computed tomography (*Manson* et al., 1986; *Carls* et al., 1994) and standardized reproducible photographs with superimposed tracings. In orbital asymmetry it is most important to first determine the facial midline as a reference line. In some patients with severe orbital and

facial asymmetry the midline must be defined by the 'carpenter's eye'.

Aetiology

There are several causes for orbital asymmetry, but most frequently they include:

1. Plagiocephaly (premature unilateral fusion of the coronal suture, sometimes also the sphenofrontal-parietal, -squamoid, -zygomatic and frontoethmoidal sutures are involved):
   (a) with vertical discrepancy of orbital cavities alone
   (b) without hypertelorism
   (c) with hypertelorism (unilateral brachycephaly)
2. Syndromes with craniosynostosis (*Crouzon*, *Apert* etc)
3. Hemifacial microsomia (severe forms)
4. Unilateral microphthalmus/anophthalmus
5. Posttraumatic conditions
6. Meningocephalocele penetrating between and into the orbits
7. tumors/tumorlike lesions (fibrous dysplasia, neurofibromatosis, osteomas, sarcomas)
8. Hemifacial atrophy
9. *Treacher Collins* and other syndromes
10. Facial clefts
11. Growth impairment because of irradiation
12. Amniotic bands
13. *Sprengel's* deformity (congenital torticollis)

Surgical Correction

The surgical correction of all kinds of orbital asymmetry is closely connected with the development of craniofacial surgery. Those principal methods, developed by *Tessier* (1967, 1972), *Ortiz Monasterio* et al. (1978), *Obwegeser* (1969) and others can also be adapted to the correction of orbital asymmetries of different origin. Most cases of orbital asymmetry require a transcranial approach. *Tessier's* transcranial procedure for the correction of hypertelorism allows for mobilization and movements of the orbits in every direction: vertical and horizontal asymmetries concerning the position of the orbits can be corrected, no matter if the asymmetry is caused by plagiocephaly, hemifacial microsomia or encephaloceles etc.

The most common orbital asymmetry caused by premature fusion of the coronal and other sutures: Plagiocephaly, comprises usually a new position of the supraorbital rim, the forehead and the temporal area uni- or more often bilaterally (*Marchac* and *Renier*, 1979). In tumor cases approaches derived from elective craniofacial surgery are also used. After the lesion has been removed, the orbital walls are placed into normal position or reconstructed by homologous or autologous tissues. Orbital wall as well as cranial base and clavarial reconstruction in these cases are performed in our department with the use of lyophilized cartilage and bone (*Sailer*, 1992) and bone morphogenetic proteins (*Sailer* and *Kolb*, 1994).

Micorphthalmus/anophthalmus are corrected by orbital bone expansion using a spherical tissue expander which simulates the growth pressure of the eye globe. Secondary orbital asymmetries like post-traumatic conditions, hemifacial atrophy and growth impairment caused by irradiation are also treated using craniofacial surgical methods.

Orbital asymmetry seen in relation to facial clefts or amniotic bands need individual often sequential reconstructive surgery.

In many cases of orbital asymmetry a hard and soft tissue problem is present. Both need individual correction. Assessment and surgical correction should be performed in close collaboration with the ophthalmologist and the neurosurgeon.

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Midface asymmetry

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Classification or better grouping of asymmetries of the middle third of the face may be attempted according to the phenotype, if the issue is surgical correction. Isolated asymmetries of the middle third of the face are mostly caused by fractures of the malar bone with displacement of bone and soft tissues, the

series, bilobed flaps were used in four cases. In one case, in which the flap was raised as a true neurovascular island flap, leaving only the fascial attachments with the vessels, necrosis of the distal island occurred, while the proximal island survived. The reliability of the myocutaneous pectoralis major flap is also illustrated in another paper on 47 bipaddled musculocutaneous flaps and six bipaddled rib-osteomusculocutaneous flaps in a series of 600 reconstructions with pectoralis major flaps[5]. The total number of patients with successful reconstruction with a bilobed flap was 48 (91%), primary healing occurring in 35 (66%) of them. There was a total loss of the flap in three patients (6%). Fistulas occurred four times (8%), and dermoepidermal separation four times. Although TOBIN et al.[19] mention that folding flaps also requires additional procedures to close mucocutaneous fistulas that are often left adjacent to the hinged portion of the flap, this did not occur in our cases.

Although the bilobed pectoralis major flap proved to be reliable in our series, its successful use is subject to some conditions, including prediction of the arch of rotation, anatomic limitations such as obesity or the combination of a long neck with a short thorax, and vascularization endangered by previous operation.

Although current microsurgical methods are able to transfer soft tissues and bone to orofacial defects, the myocutaneous pectoralis major flap is still a valuable asset in our armamentarium. The bilobed variant enables the surgeon to close primarily through and through defects. This method saves much time at surgery, and it may obviate a second flap, to the advantage of these patients, who are often in the older age group, and often in poor general condition. The method described also appears to be reliable, because adequate closure occurred in all cases, with acceptable aesthetic results. The possibility of raising two skin flaps supported by one muscular and vascular pedicle from one donor site which can be closed primarily is the major advantage of this method.

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pectoral fascia. ORD & AVERY[15] stressed the importance of placing the skin paddles, not one vertically above the other, but side-by-side horizontally, emphasizing that this position allows easier cheek reconstruction and is less risky. WILSON et al.[23] concluded that the flap may be split axially or folded either axially or contra-axially with a de-epithelialized strip along the fold. They stated that it is not essential to incorporate the lateral thoracic artery in the pedicle together with the acromiothoracic artery, because of the extensive anastomoses between these arteries, ensuring abundant vascularization. BHATHENA & KAVARANA[5] confirmed that the cutaneous layer can be divided in any direction. In our cases, the skin islands were situated such that the nipple area was preserved, the "intraoral" skin island being situated medially and the "extraoral" one caudally to the nipple complex. The position of the skin islands is probably irrelevant to the viability of the flap, as long as both skin islands are situated within the limits of the pectoralis muscle, and the musculocutaneous vascularization units remain intact. Although a caudal extension of the skin island by a subcutaneous pedicle vascularizing the additional skin has been described[13], this was not necessary in our series because the arch of rotation was sufficient to cover the defects without tension on the pedicle.

Several authors have commented upon the versatility of the bilobed pectoralis major myocutaneous flap. In a retrospective study of a series of 211 consecutive patients undergoing pectoralis major myocutaneous flap reconstruction, SHAH et al.[17] used a bilobed flap in seven cases (3%). They did not mention any particular complication caused by this design. For the whole series, however, they noted flap-related complications in 63%, including flap necrosis, suture-line dehiscence, fistula formation, infection, and hematoma. On the other hand, WILSON et al.[23] found the pectoralis major flap to be extremely reliable, having only eight failures in 112 flaps (7.1%). In their

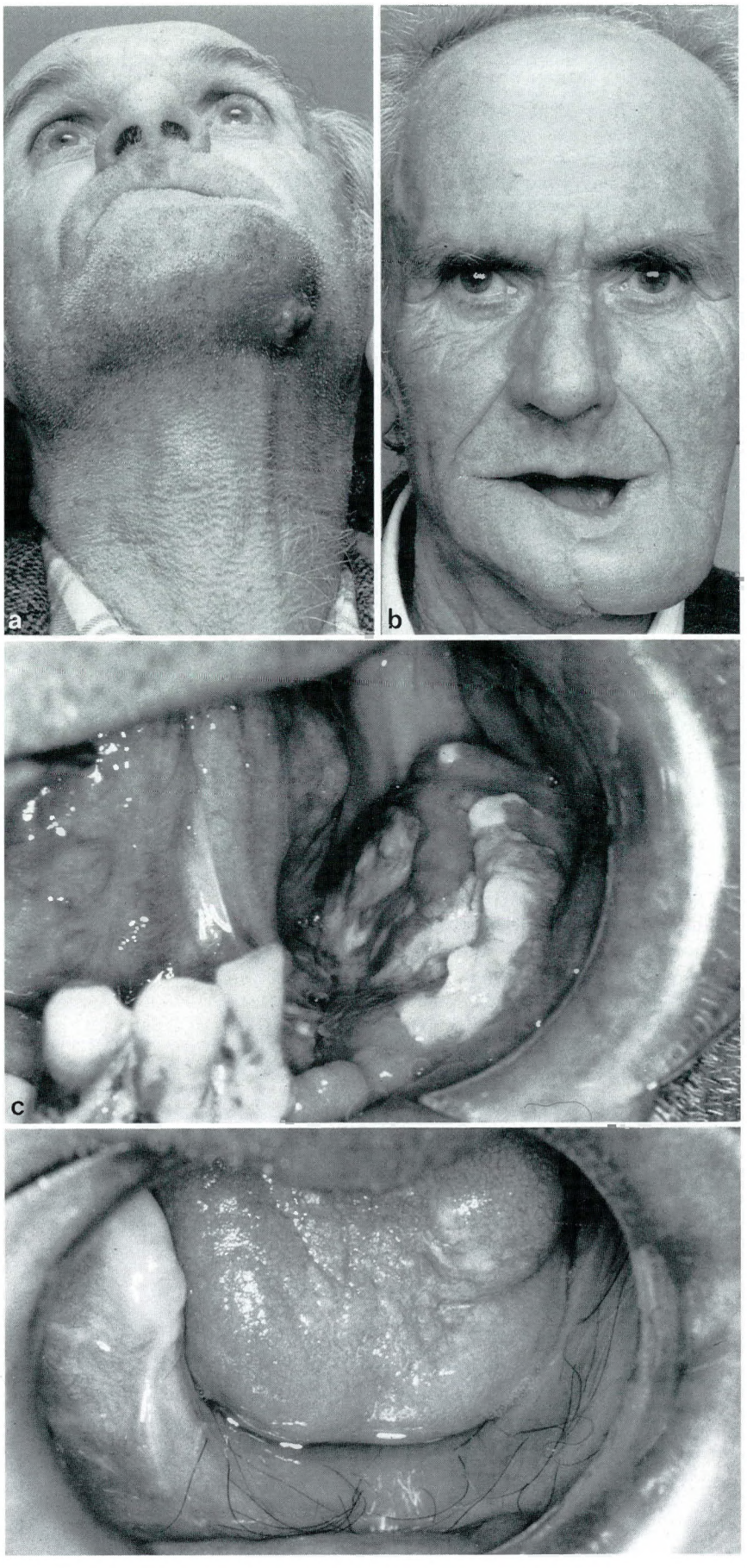


Fig. 4. a and b) Preoperative and 6 months postoperative view of 65-year-old patient with squamous cell carcinoma, illustrating skin invasion and extraoral reconstruction. c and d) Pre- and postoperative intraoral views of same patient.

duced, causing discomfort in only one patient.

Discussion

The extent of the maxillofacial areas which can be covered by a myocutaneous pectoralis major flap without overstretching the pedicle was already discussed in the original publication of ARIYAN[1]. In all our cases, sufficient mobilization of the flap was obtained. Since the initial publication of ARIYAN[1], several reports about pectoralis major myocutaneous flaps providing two cutaneous linings have been published. The modifications presented can be classified into three subgroups: 1) the delayed myocutaneous flap after skin grafting of the undersurface of the muscle, 2) division of the myocutaneous unit into two flaps and 3) division of the cutaneous layer only. Because it is generally preferable to try to achieve adequate reconstruction in one procedure, the first option should be avoided.

When the muscle is divided, it must be done according to the intramuscular vessel distribution[11]. This can be done with the pectoralis major muscle, classified as a muscle flap with one dominant vascular pedicle and secondary segmental vascular pedicles[13]. Based upon this principle, MORAIN & GEURKINK[14] described a pectoralis major flap in which the skin and the underlying muscle were split over 90% of their length. They pedicled the muscle flap medially on the perforating intercostal vessels, creating vertically positioned skin islands, allowing coverage of only facial defects and the lower neck. TOBIN et al.[19] followed the same principle in describing the splitting of the pectoralis major muscle which created two horizontally situated skin paddles carried on segmental branches of a single flap. The flap was split longitudinally, thus creating a sternocostal myocutaneous segment supplied by the acromiothoracic vessels, and an external myocutaneous segment supplied by the lateral thoracic vessels.

When the subcutaneous layer is divided without splitting the muscle, the principles of flap vascularization have to be respected, because the skin is supported by intact underlying subcutaneous tissue and muscle, vascularizing the skin islands over the perforating musculocutaneous arteries[11,13]. VASCONEZ et al.[21] mentioned that two skin paddles can easily be provided, and BILLER et al.[6] reported four bilobed flaps in a series of 42 cases. Several authors contend that the superficial localization of the two skin units may influence their viability. ESPINOSA et al.[9] described vertically positioned skin paddles, separated by a distance of 2.5 cm, preserving the nipple-areola complex. WEAVER et al.[22] described two skin islands positioned side by side on the chest wall, separated from each other up to the

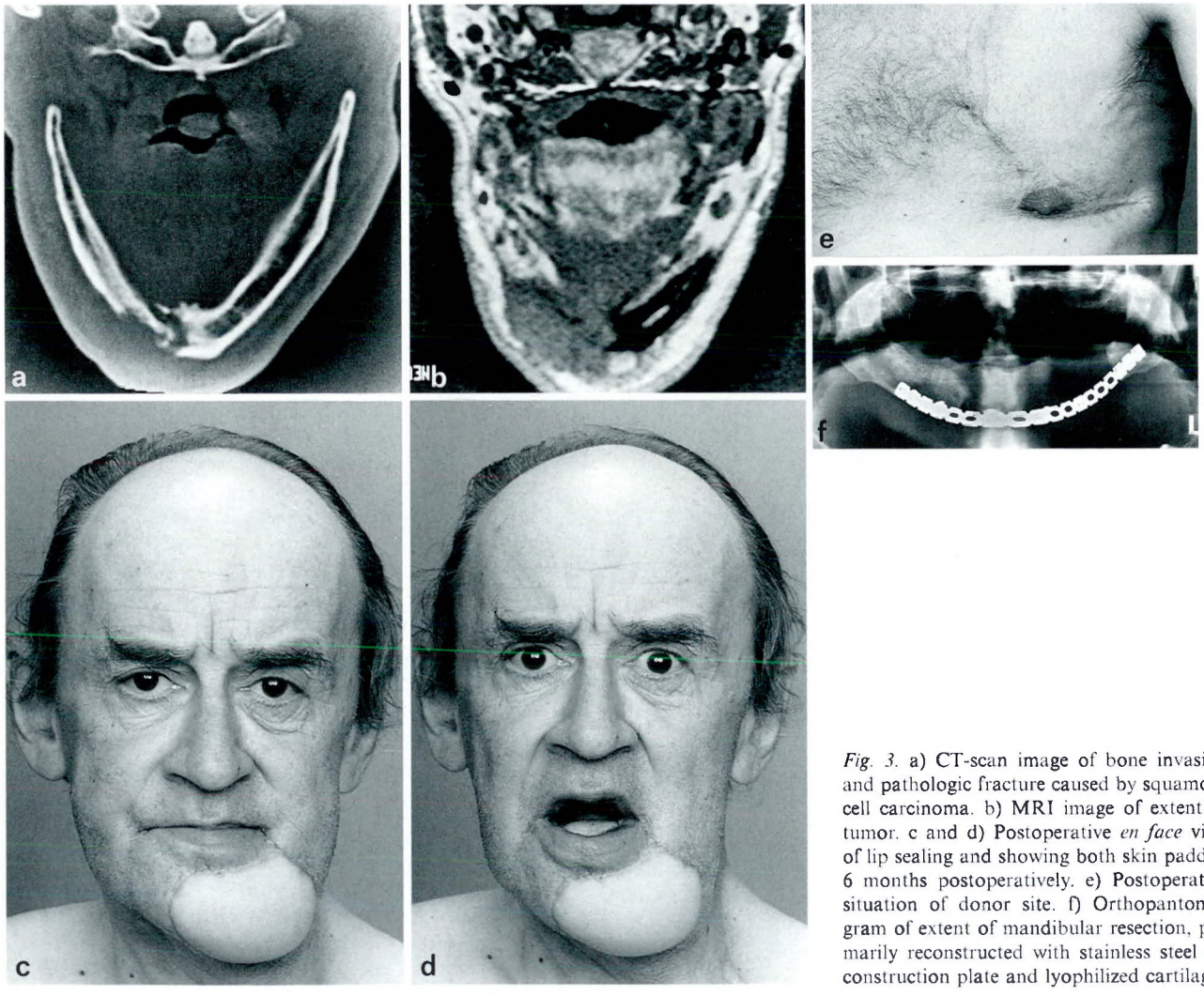


Fig. 3. a) CT-scan image of bone invasion and pathologic fracture caused by squamous cell carcinoma. b) MRI image of extent of tumor. c and d) Postoperative *en face* view of lip sealing and showing both skin paddles 6 months postoperatively. e) Postoperative situation of donor site. f) Orthopantomogram of extent of mandibular resection, primarily reconstructed with stainless steel reconstruction plate and lyophilized cartilage.

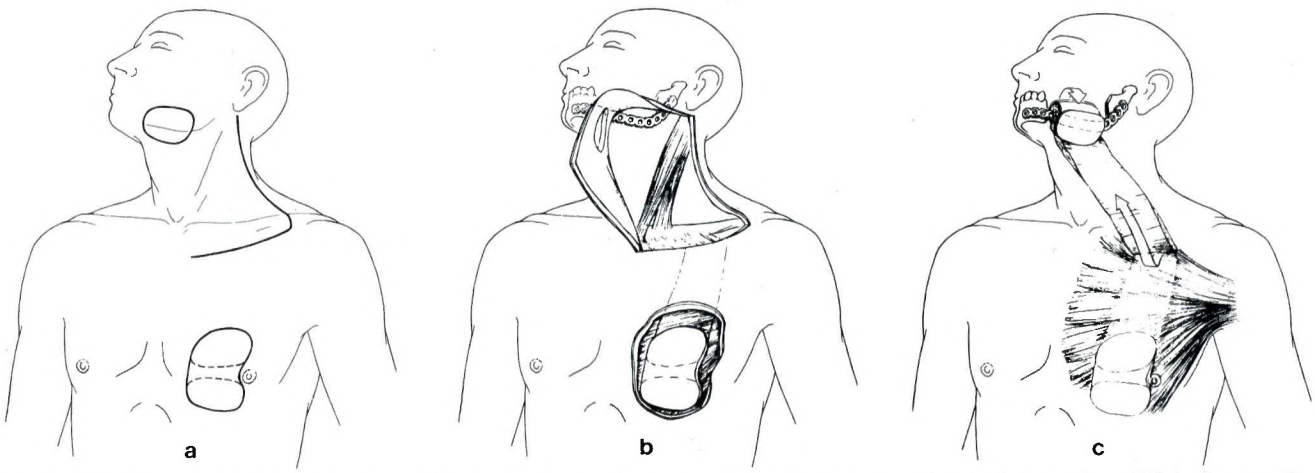


Fig. 1. a) Drawing of planned incision for extraoral resection, hockey-stick incision for neck dissection, and donor site of bilobed pectoralis major flap. b) Overview of bilobed pectoralis major flap, subcutaneous tunnel, reflected skin flap, and reconstruction plate restoring continuity of mandible. c) Illustration of flap positioned in recipient site with proximal skin island covering oral defect, and distal one covering extraoral defect.

aneous layer are incised without undermining the latter, thus respecting the perforating musculocutaneous vessels that vascularize the skin. The raising of the pectoralis major muscle is started via the lateroinferior part of the skin incision. Care is taken to identify the muscular fascia deep to the vascular axis. After mobilization of the musculocutaneous portion and with the vascular bundle visible through the fascia, the muscular pedicle overlying the vascular axis is dissected cranially until its infraclavicular portion is reached (Fig. 1b). The flap is transported via a subcutaneous tunnel in the chest until the inferior border of the hockey-stick incision, situated below the clavicle, is reached. In the posttraumatic patients, an additional incision at the base of the neck is needed to ensure careful transport of the flap. The flap is positioned superficially to the clavicle and is first brought into the intraoral defect, underneath the AO reconstruction plate, restoring mandibular continuity. From there, the distal part of the flap is positioned over the plate to cover the extraoral defect (Fig. 1c). After the correct position of the flap both intra- and extraorally is secured, a small area of skin approximately 2 cm in width, separating both skin paddles, is excised. The flap is sutured in place both intra- and extraorally and secured with suspension sutures to prevent traction on the lip. The donor site is closed primarily after insertion of two vacuum drains. In all cases, antibiotic coverage with cephamandol and ornidazol was used for approximately 10 days. All patients underwent physiotherapy postoperatively.

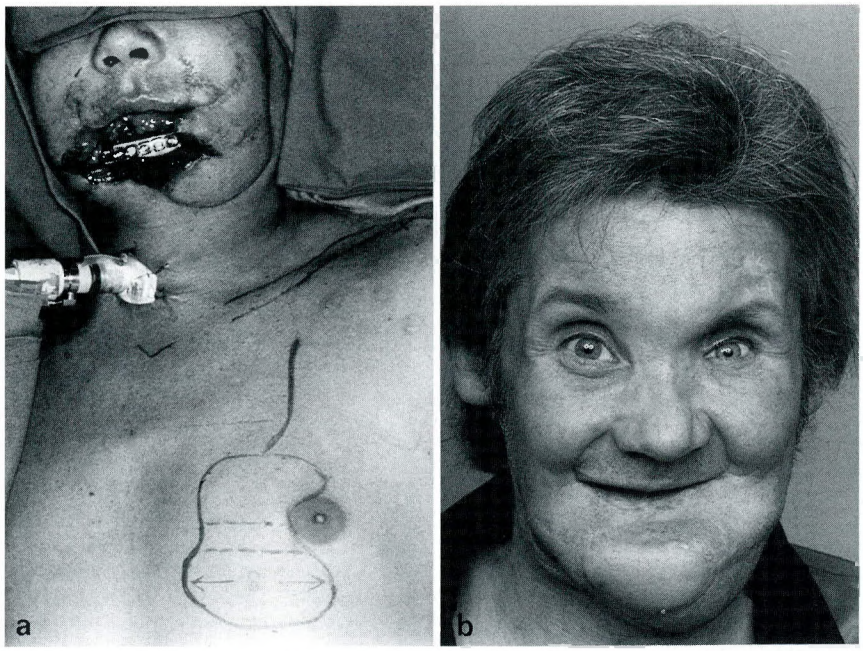


Fig. 2. a) Drawing of donor area of bilobed pectoralis major flap for delayed reconstruction after gunshot wound. Reconstruction plate and lyophilized cartilage, latter supporting remaining tissues of floor of mouth, were inserted primarily. b) Illustration of facial situation, 6 months postoperatively.

Results

In all cases, healing of the intraoral skin paddle was uneventful; fistulas did not develop. In one posttraumatic and one cancer patient, partial dehiscence of the extraorally situated skin island occurred. In one patient who had preoperative radiotherapy (70 Gy), major dehiscence developed, although the skin overlying the musculovascular pedicle remained intact, and the extraoral skin paddle itself did not become necrotic. This is the only case in which the reconstruction plate became exposed. However, neither the extraoral (distal) nor the intraoral (proximal) skin paddle became necrotic. In all cases, ample soft-tissue coverage was provided both intra- and extraorally. Late dehiscence caused by shrinking of the flap did not develop. There were no vascular problems compromising the bilobed flap. Primary closure of the donor area was obtained in all cases. Hematoma of the donor area, necessitating exploration and drainage, occurred once. Apart from the intraoral hair growth and the lack of color match, the aesthetic results were adequate (Figs. 2–4). Rotation of the head to the contralateral side was somewhat re-

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The bilobed myocutaneous pectoralis major flap in closure of combined intra- and extraoral defects

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Abstract. Oral carcinomas may eventually invade the perioral soft tissues. In such cases, tumor resection creates through and through defects. Similar defects are seen in patients with gunshot wounds. The versatility of the bilobed myocutaneous pectoralis major flap in closure of these defects is emphasized. The results in nine patients treated by this method are discussed.

Key words: oral cancer; reconstructive surgery; myocutaneous pectoralis flap.

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Reconstructive surgery in the orofacial region has been considerably facilitated by the introduction of the myocutaneous flap. The myocutaneous pectoralis major flap was described in 1968 by HUEBSTON & MCCONCHIE[10] for reconstruction of the chest wall, although the idea of using the pectoral muscle for reconstruction had already been mentioned, in 1897, by RYDIGIER[16]. ARIYAN et al.[1-3] reintroduced this flap for reconstruction in the head and neck area. Since then, it has been considered by many surgeons to be the standard method for reconstruction in this area[4,6,12]. Closing of combined intra- and extraoral defects with a pectoralis major flap was already reported in 1979 by ARIYAN[1], who also mentioned the division of the skin into two parts. The closure of combined defects has always been considered to be difficult because it was thought to require multiple staged procedures to introduce sufficient soft tissues with two cutaneous surfaces. Other authors have already mentioned the use of the bilobed, bipaddled, or divided pectoralis major flap[4-9,12,14,15,17-23]. This report emphasizes the versatility of this method, especially in patients with advanced cancer of the orofacial area.

Material and methods

Between 1989 and 1992, the bilobed pectoralis major flap was used for primary reconstruction in seven patients with advanced carcinomas of the orofacial region and for delayed reconstruction in two patients with major gunshot wounds causing extensive bone and soft-tissue loss. In both gunshot cases, the defect was the result of attempted suicide, extending from the chin area to the base of the skull. The group of tumor patients comprised five men and two women aged between 46 and 79 years (average, 57 years). All patients had squamous cell carcinoma. In all cases, the tumor, originating from the floor of the mouth, had perforated the mandible and invaded the skin. In five cases, the tumor extended over the midline of the anterior floor of the mouth. Two of the patients had received preoperative radiotherapy (50 Gy). In one patient, the tumor involved was a recurrent squamous cell carcinoma situated in the anterior floor of the mouth, invading the symphysis and skin of the chin, after radiotherapy (70 Gy) applied elsewhere. All patients underwent uni- or bilateral, functional or radical neck dissection in conjunction with the intraoral and mandibular resection. In all cases, there was a combined intra- and extraoral defect in the cheek and the floor of the mouth. In all cases, the mandibular continuity was restored with a stainless steel reconstruction plate (AO-ASIF), and the combined soft-tissue defect was closed with a bilobed pectoralis major flap. One patient underwent this procedure a second time on the contralateral side, after the development of a second carcinoma.

Surgical method

The axis of the neurovascular bundle, comprising the acromiothoracic artery and vein together with the lateral pectoral nerve, is drawn on the chest wall, as described by ARIYAN & CUONO[3]. The skin islands are designed over the vascular pedicle, ensuring that the arch of rotation of the flap is sufficient to reach the recipient site; this ensures that the skin islands are situated medially and caudally to the nipple-areola complex (Fig. 1a). Although the plication area is indicated, both skin islands will be separated only when the flap has been positioned correctly in the recipient site. The skin and underlying subcut-