

Donor Site Morbidity of Supraclavicular Artery Island Flap: Egyptian Oncology Center Experience

AMIR M. ZAID, M.D.*; AMIRA A.M.M. ATTIA, M.D.**; WAEL M. SAID AHMED, M.D.**;
ISLAM H. METWALLY, M.D.*; SHADY AWNY, M.D.* and MOHAMED T. HAFEZ, M.D.*

The Department of Surgical Oncology, Oncology Center, Mansoura University (OCMU) and Oral & Maxillofacial Surgery Department**, Faculty of Dentistry, Mansoura University*

Abstract

Background: The supraclavicular artery island flap (SCAIF) has been used successfully for head and neck reconstructive purpose especially in oral tumor ablative surgery, providing acceptable outcomes.

Aim of Study: To assess morbidity of shoulder after harvesting of SCAIF applied for reconstruction of oral defects after cancer surgery.

Patients and Methods: Prospective analytical descriptive case series study including 33 patients with tumors involving oral mucosa diagnosed and managed by wider local excision of tumor, neck dissection (ND) and immediate reconstruction of the resultant defects with pedicled SCAIF. The follow-up was at least 6 months after surgery. Donor site postoperative complications and late morbidity were assessed.

Results: Our study included 33 patients (17 males and 16 females); their mean age was 54.3. Postoperative donor site complications occurred in six patients (18.2%); three major complications managed surgically and three minor complications managed conservatively. Our results of donor site complication can be classified according to Clavien-Dindo system as two for grade II; three for grade IIIa, and one for grade IIIb. Late morbidity included Referred sensation and shoulder pain which occurred in 21.2% and 15.2%. Arm movement was nearly normal in most of cases (93.9%), it was affected in only 2 cases only.

Conclusions: SCAIF is a safe technically simple thin pliable fascio cutaneous regional flap. It should be considered as a reliable option for reconstruction of oral defect after cancer surgery. Donor site complications after SCAIF harvesting are minimal with little insignificant effect on arm movement and shoulder function.

Key Words: *Supraclavicular artery island flap – Oral cancer – Reconstruction – Donor site morbidity.*

Introduction

SURGERY for the head and neck tumors often necessitates flap reconstruction of either mucosal or

skin surfaces or both to maintain integrity of oral cavity, restore form and keep acceptable functional outcomes [1,2].

Application of free flaps extended the available options for head and neck reconstruction. Radial forearm free flap (RFFF) and anterolateral thigh (ALT) had been broadly applied for soft tissue reconstruction while the fibular free flap (FFF) is considered standard for bony reconstruction. Although, these flaps are versatile, reliable and providing well vascularized tissue especially after radiotherapy (RT) or chemo-radiotherapy (CHRT), they had multiple disadvantages as the need for dedicated expertise which may not be available in all centers, longer operation times, higher medical costs, not suitable for fragile patients and extensive perioperative monitoring with flap loss rates ranges from 2% to 15% of cases [1].

Despite the advancement and evolution of free flaps procedures, there has been a significant shift in the paradigm of reconstruction towards loco-regional pedicled flaps. These pedicled flaps remain a mainstay when microsurgical procedures are not suitable or failed or not available and also, when local flaps fit oral defects better [3].

Regional flaps usually need less operative time. Latissimus dorsi myocutaneous flap (LDMCF) and Pectoralis major myocutaneous flap (PMMCF), either myofascial or myo-fasciocutaneous are common options for head and neck reconstruction, but their bulky nature sometimes restricts their application [2]. They usually require segmental mandibulectomy to accommodate them as inset of these flaps medial to the mandible is difficult with possible risk of pedicle compression. These flaps mandate widespread muscle dissection leading to increased donor site morbidity. Also their harvesting

Correspondence to: Dr. Amir M. Zaid,
[E-Mail: ameirsdzaid@gmail.com](mailto:ameirsdzaid@gmail.com)

needs position changing thus increasing the surgical time [7]. The trapezius flap has a limited arc of rotation and cannot be used for closure of defects that cross anteriorly the midline of the head and neck [8].

Pedicled flaps are usually preferred in advanced cancer patients are debilitated and malnourished. SCAIF is a regional fasciocutaneous flap with skin island harvested from shoulder and supraclavicular area. Multiple centers expressed their success of using SCAIF in reconstruction of head and neck post-oncologic defects in multiple sites of reconstruction including oral cavity, trachea, pharynx, and cutaneous defects [1,4-6].

The SCAIF is fasciocutaneous flap yielding skin island with colour and texture similar to facial skin. Also, it is hairless thin with lighter flap making it very appropriate for intraoral mucosal reconstruction. It has better rotational arc than PMMCF or Deltopectoral flap as its pivot is located closer to the head and neck [2,9]. The simplicity of harvest, little donor site morbidity, and lack of need for microsurgical experience are all advantages of SCAIF. As a result, SCAIF is regarded as a viable alternative for head and neck reconstruction. In addition, donor site morbidity is minimal [4-6].

Complications of the donor site as hematoma, seroma and wound dehiscence, are commonly reported. Infection is uncommon and mainly occurs incases with mucosal reconstruction [10]. Furthermore, numerous authors have reported complaints of shoulder tightness but no functional limitations, with little influence on shoulder function or quality of life [1,11].

We began using the SCAIF in cases of oral cancers that their post-oncological resection defects cannot be closed primary or by local intraoral flaps as buccal pad of fat, tongue flaps, buccinator flaps. We aimed in our study to express our experience of applying SCAIF in reconstruction of defects after oncologic surgery of oral tumors with attention and focus on the evaluation the postoperative complications and latemorbidity of donor site (shoulder) after SCAIF harvesting.

Patients and Methods

This study was conducted in Oncology Centre, Mansoura University. This study is prospective analytical descriptive case series study including 33 patients with tumors involving oral mucosa diagnosed and managed “between July 2017 till July 2021” by wider local excision of tumor, ND

and immediate reconstruction of the resultant defects with pedicled SCAIF. The follow-up was at least 6 months after surgery. This study was approved by our institutional board.

Our study included all patients diagnosed as primary malignant oral tumors whom their management mandates wider local excision of oral cancer reaching pathologically free safety margin (R0 resection). The resultant mucosal defects were reconstructed by SCAIF. We excluded all patients who refuse to undergo surgery; contraindicated to major surgery and American Society of Anaesthesiology (ASA) score 4 or bad physical Status scoring 4; with small defects after wider local excision which can be closed primary or with local intraoral flaps or defects >12cm in their transverse dimension. Also Patients with metastatic disease (M1), patients with heavy ipsilateral nodal disease especially if involving supraclavicular area are also excluded. Our study excluded patients with a history of shoulder scars or surgery. Bone infiltration or recurrent tumors or previous ND (provided that angiography showed intact supraclavicular artery) were not contraindication for the flap. We excluded patients whom underwent follow-up less than 6 months.

All patients will be subjected to the following investigations for diagnosis of tumors, assessment of tumor respectability, searching for nodal spread including CT Scanning; MRI, neck US and X-ray (orthodontogram); Pathological diagnosis: Wedge or incisional biopsy of primary tumor. Distant metastasis should be excluded by chest X-ray, pelvi-abdominal US while pan-CT scanning was needed in suspected secondaries. CT-angiography was not performed routinely but it was demanded in patients with previous ND or surgery. Written informed consent was obtained after full explanation of the procedure, the possible complications and outcomes.

Surgery:

After marking of incision, clavicle, sternocleido-mastoid (SCM), external jugular vein (EJV), trapezius muscle, pedicle site and the flap dimension; the procedure was performed under general anaesthesia with nasal endotracheal intubation. Nasogastric feeding tube was inserted. The patient was positioned in semi setting supine with head extension. Head, neck, axilla, and shoulder are exposed and arms where situated beside chest (Fig. 1).

R0 Resection of tumor was done with use of frozen section for margins of soft tissue & Block

ND (if indicated). After tumor resection, assessment of defect was done. Skin island of appropriate size was designed according to defect parameters. Doppler US was not routinely applied to detect the flap pedicle however it was spared for patients with past history of ND or neck surgery.

All flaps were harvested from distal to proximal in subfascial plane by the same team following the standard technique as described by several authors [13,35,36] (Fig. 2).

The reachability of the flap to defect into oral cavity was ensured before de-epithelialization of the rest of skin. De-epithelialization was done before tunnelling of flap into oral mucosal defect. Trimming the distal tip of flap until healthy bleeding tissue is noted before flap inseting. Tunnelling of flap into oral cavity was done. SCAIF flaps were tunneled superficial to SCM muscle and inserted

into oral cavity passing either medial to mandible to cover tongue, floor of mouth, or gingival defect; or passing lateral to mandible to cover buccal defects. Skin island was sutured to surrounding mucosa.

After haemostasis and two suction drains (for neck & shoulder) and neck incision was closed. However, if there was a risk for flap compression under neck skin after tunnelling, the flap itself may be used to occupy the longitudinal limb of ND incision to avoid flap compression. Then, wide undermining of donor site skin flaps is usually required before closure. In all cases, donor site defects (up to 12cm width) were closed primarily [12]. However, proximal part of SCAIF flap may be used to cover the medial part of donor site to avoid pedicle compression. All donor site defects were closed primarily in a 2-layer suture or skin stapler instead of cutaneous suturing (Fig. 4).



Fig. (1): Marking of supraclavicular flap.



Fig. (2): SCAIF after harvesting.

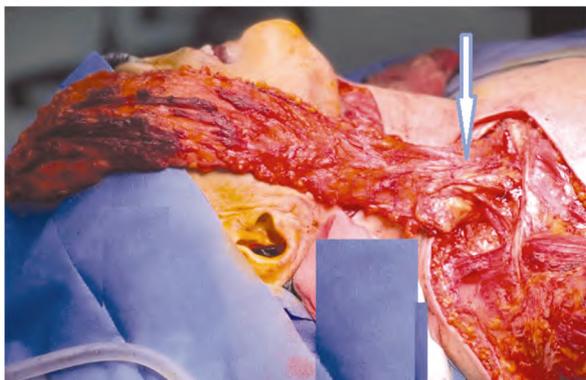


Fig. (3): Test for reachability of SCAIF, arrow points to pedicle.



Fig. (4): Closure of donor site after SCAIF harvesting.

Light dressing was applied for 2 days with concern to avoid pedicle compression. Patients were instructed for early mobilization and shoulder movement.

Follow-up:

Follow-up for all patients for an average of 6 months at least, for donor site complications or shoulder mobility, tightness, pain, referred sensation and causes for reoperations. The data included demographical data, past history, smoking and alcoholism, adjuvant therapy, postoperative donor site complications (major = required surgical interference, minor = managed conservatively) and donor-site pain, tightness and shoulder movement [12].

Statistical analysis:

Analysis of data of our patients were using SPSS version 22 (Inc, Chicago, IL). Continuous variables are presented as mean when symmetrical or median when asymmetrical. Categorical variables are presented as proportions. Univariate analysis was done using Chi-Square test, Fisher's exact test (if cell count less than 5), Mann-Whitney test and student *t*-test. *p*-value <0.05 was considered significant.

Results

Our study included 33 patients (17 males; 16 females); their mean age ± SD was 54.3 ± 15.5 years. The study included 13 smoker patients (39.1 %) and only 2 patients (6.1 %) drink alcohol. Neoadjuvant chemotherapy was given for about fifth of the patients (21.2%), while radiation therapy used in 5 cases before surgery. About two fifths of our patients (39.4%) were comorbid.

Tumors were located at multiple oralsubsites; however, most were either buccal (39.4%) or tongue (30.3%). The defect induced by surgical resection was mainly mucosal only (57.6%), however bone was resected in 33.4% (n=11). Apart from two who underwent inferior maxillectomy; nine out of the 11 patients required mandibulectomy (segmental in 4 & marginal in 5 patients). Only 2 patients needed elective tracheostomy for fear of post operative oedema and risk of airway obstruction. All patients underwent lymphadenectomy, but LND was done bilaterally in 4 (12.1%) patients, (Table 1).

The histopathological paraffin section pathology showed microscopic margin infiltration in 2 (6.1%) patients. Squamous cell carcinoma (SCC) was the

most common pathological type and 18 (54.5%) patients were node positive. Staging tumor, node size (Table 2).

Table (1): Intraoperative finding of studied patients.

Variable	Value
<i>Tumor site:</i>	
Floor	5 (15.2%)
Buccal	13 (39.4%)
Tongue	10 (30.3%)
Alveolar	4 (12.1%)
Cheek	1 (3%)
<i>Defect nature:</i>	
Mucosa	19 (57.6%)
Mucosa & bone	6 (18.2%)
Mucosa & skin	3 (9.1%)
Mucosa, bone & skin	5 (15.2%)
<i>Bony resection:</i>	
No	24 (72.7%)
Yes	11 (27.3%)
<i>LND:</i>	
Unilateral	29 (87.9%)
Bilateral	4 (12.1%)
<i>Level LND:</i>	
Supraomohyoid	7 (21.1%)
MBND	26 (78.8%)
<i>Tracheostomy:</i>	
No	31 (93.9%)
Yes	2 (6.1%)

Table (2): Histopathological features of studied patients.

Variable	Value
<i>Tumour type:</i>	
SCC	28 (84.8%)
Adenoid cystic carcinoma	3 (9.1%)
Mucoepidermoid carcinoma	1 (3%)
Squamous cell papilloma	1 (3%)
<i>Stage:</i>	
I	1 (3%)
II	12 (36.4%)
III	16 (48.5%)
IV	4 (12.1%)
<i>T:</i>	
1	1 (3%)
2	13 (39.4%)
3	14 (42.4%)
4	5 (15.2%)
<i>N:</i>	
0	15 (45.5%)
1	9 (27.3%)
2	7 (21.2%)
3	2 (6.1%)

Postoperative donor site complications occurred in six patients (18.2%); three major complication managed surgically and three minor complications managed conservatively. Three cases complicated by donor site gap; re-surgery was required in form of closure of wound gap in two patient while the last case managed by local dressing. Also hematoma occurred in one case and surgical evacuation under local anathesia was demanded. The last two complicated case suffered from seroma and infection. Our results of donor site complication can be classified according to Clavien-Dindo system as 2 for grade II; three for grade IIIa, and one for grade IIIb.

Late morbidity included shoulder pain, tightness. Five patients (15.2%) complained of mild shoulder pain but fortunately they were adapted as this mild pain caused little discomfort to them. Also shoulder tightness occurred in only 4 (12.1%) patients, three of them were previously complicated by wound gap. Seven (21.2%) patients documented persistent referred sensation but this did not causing any trouble for them even may be desirable sequelae especially in oral reconstruction. We assessed the arm mobility by testing the abduction movement 1 month postoperative (grade I means abduction less than 90; grade II means abduction between 90 up to 135; grade III between 135 up to 180; grade IV above 180). This test revealed that grade IV in most of patients (n=22; 72.7%); the grade III in 7 patients while grade II in just 2 patients but improved dramatically during follow-up. Grade I was not reported in any case (Table 3).

Table (3): Postoperative donor site complications and late morbidity of studied patients.

Donor site		
<i>Complications:</i>	6 (18.2%)	Clavin-dindo
• Wound gap	3	IIIb; IIIa; II
• Haematoma	1	IIIa
• Seroma	1	IIIa
• Infection	1	II
Shoulder pain	5 (15.1%)	
Shoulder tightness	4 (12.1%)	
Referred sensation	7 (21.2%)	

Analysis of factors which can be contribute to postoperative complications by comparison of complicated and non-complicated groups revealed that age, sex, comorbidity, harvesting time, flap width, blood loss. But complication (specially wound dehiscence or gapping and re-suturing with subsequent fibrosis) may affect arm mobility however it did not reach statistical significant (*p*-value=0.055) (Table 4).

Table (4): Complication (specially wound dehiscence or gapping and re-suturing with subsequent fibrosis) may affect arm mobility however it did not reach statistical significant

Donor site comp	Non complicated (n=27)	Complicated (n=6)	<i>p</i> -value
<i>Sex:</i>			
Male	13	4	0.66
Female	14	2	
<i>Smoking:</i>			
No	17	3	0.66
Yes	10	3	
<i>Comorbidity:</i>			
No	15	2	0.63
Yes	10	3	
Harvesting time	60 (45-85)	70 (65-70)	0.14
Flap width	8 (6-12)	9 (6-11)	0.58
Blood loss	430±160	410±220	
<i>Arm mobility:</i>			
2	1	1	0.055
3	4	3	
4	22	2	

Discussion

The Supraclavicular artery Island flap (SCAIF) is a perforator pedicled fasciocutaneous flap with an axial pattern, based on the supraclavicular artery [11,13]. The surgeons' skill allowed flap harvesting and primary tumor resection to be completed without changes in body position with preservation of the muscles and motor nerves of the shoulder and arm. Thus, SCAIF harvesting had minimal effect on the function of the donor site. However, accessory nerve should be preserved (if not infiltrated) to avoid shoulder affection [14].

Wide undermining of edges is usually needed. Although shoulder drain is not necessary, [5] because the dead space is closed tightly, we recommend putting suction drain to decrease the risk of seroma formation and early detection of haematoma thus decreasing the risk of pedicle compression and risk of wound infection or dehiscence [15].

According to many authors, flap length should not exceed 22cm and width should not exceed 8cm in order to avoid skin necrosis and achieve primary closure [3,5,16]. This width had been extended by Vinh et al., up to 10 can be closed primarily after significant undermining, however this may result in a wider scar and skin grafts was needed if the width was more than 10cm [17]. This matches with other authors as Hunt & Buchmann [4]. But according to our experience primary closure of donor site can be achieved in flaps with width up to 12 cm after good undermining of edges. Our results

matched the results of both Chen et al.; Granzow et al., B and González-García et al., who recommended skin grafting may be applied for coverage of donor site if flaps width > 12cm. we also recommend using the proximal part of SCAIF flap to cover the medial part of donor site to avoid compression of flap pedicle. Though a scar may be noticeable when the patient is shirtless or wearing a tank top and fortunately, shoulder function was not compromised [12,18,19].

In our study, six cases (18.2%) suffered from complication (three major & three minors). Our results matched many authors in literature as Spiegel et al., 2018 and Nthumba et al., 2012. Among our complicated cases, three presented with wound gap, one with haematoma, one with seroma and the last one with infection. Surgical reclosure was done for 2 cases of wound gap. Also surgical evacuation was needed in the case of haematoma in a cardiac patient on anticoagulant therapy was done under local anaesthesia. While the rest of cases managed conservatively.

Donor site complications varies from seroma, haematoma, infection or shoulder cellulitis, wound dehiscence or gapping, limited shoulder movement or stiffness and shoulder pain. Donor site complications are divided into major and minor according to management. Major complications required surgical interference while minor complications treated conservatively. In limited series, donor site problems have been documented in up to 18% of patients [21]. This is in agreement with earlier study, which shows a 17% serious complication rate, [20] which mandates surgical intervention for treatment and minor complication rate which managed conservatively without the need for surgical intervention ranging between 22% to 33.3% [22,23].

A minor concern connected to flap harvesting with intact sensory neural innervation is referred sensation to the shoulder area. Although it is a mild annoyance, it may induce anxiety in certain patients. However, this sensation may be beneficial when SCAIF is used for oropharyngeal restoration, but it is more irritating when it is used for skin reconstruction. Division of cervical branches (branches from the cervical rootlets (C3, C4) experienced no referred pain. So, division of sensory branches of cervical plexus is recommended in reconstruction of cutaneous defects [5,24]. In our study, seven cases (21.2%) experienced referred sensation with especially cold drinks; all of them not report any anxiety about this complaint. Karabulut [2] reported that referred non-irritating sensation occurred in (29.4%) experienced in 5 of 17

patients with no patients reporting pain or discomfort. However, referred sensation was documented in one patient among 45 patient in study of Kokot et al., [1].

In Shenoy et al., [25] Donor site gapping of SCAIF in 2 patients required skin grafting. While Chiu et al., [5] found 2 cases of shoulder cellulitis and one case of wound dehiscence managed by local wound care over weeks. This may be due to not using routine drain placement below the flap. In cohort study by on 12 patients reconstructed by SCAIF, Spiegel et al., 2019 [26] reported four minor complications (33.3%) and single (8.3%) major complication of the donor site.

In our series, most of patients regained normal full range of movement. We tested shoulder abduction movement according to abduction angle (angle between arm and trunk). Grade I means that abduction angles less than 90; grade II means that abduction angle between 90 up to 135; grade III means that abduction angle less between 135 up to 180; while grade IV means that abduction angle more than 180. Nearly all (31 patients = 94%) of our patients were grade 3 (7 patients = 72.7%) and 4 (24 patients = 21.2%) while the remaining two patients (6%) were grade 2. This can be explained simply by fasciocutaneous flap nature (the muscles and motor nerves of shoulder are not involved), hence the normal range of shoulder movement is nearly maintained.

In present era of head and neck reconstruction, the micro-vascular free flap lies on the top of reconstructive ladder. The RFFF, ALT and FFF are considered the work horse for intra-oral defects reconstruction. Although the reliability, versatility, and ability to yield abundant distant tissue with acceptable thickness & texture; their application mandates higher expertise, and longer operative times. Donor site morbidity of RFFF includes need of skin graft to close donor area, tendon injuries, reduced strength of grip power, and sensory disturbances [27]. Donor-site complication rate was higher in FRFF than in SCAIF [19,28].

The trapezius muscle flap is not considered mainly for oral cavity reconstruction because of its high complication rate (up to 57%) and bulkiness [29]. Although the PMMCF is an excellent option in salvage procedures, its volume and donor site appearance impose limits, particularly in women (breast distortion), who have a functional deficit due to muscle loss [25,30]. The internal mammary artery perforator flap, which is generated from the deltopectoral flap, has a small pedicle and frequent-

ly requires costal cartilage removal to reach a greater distance, which can result in pneumothorax and intercostal neuralgia [31-33]. Temporalis flaps are associated with a high risk of trismus and, unless an implant is employed, leave a large donor site defect. They also frequently cause difficulties in a radiated field [34].

Chiu et al., [5] concluded that bad consequences were primarily caused by the patient's poor health, comorbidities, radiation, and smoking history. They were all treated with caution. These results matched with ours although it does not reach statistical significance. In addition, the salvage group had a considerably higher rate of wound dehiscence than the original surgery group (13.0% and 3.6%, respectively) [29,35]. We recommend routine use suction drains one for neck and one for shoulder. As there is extensive flap undermining thus increasing chance of seroma formation. So, suction drains prevent and help in reducing wound complications.

Shoulder function after SCAIF harvest for reconstruction of head and neck defect secondary to oncological resection is very good and causes insignificant compromise. Overall parameters show good function and range of motion, less pain and resumption of daily activities. Spiegel et al., concluded that SCAIF has mild effects on shoulder mobility [26].

Limitations:

Small sample size, lack of long term follow-up.

Conclusion:

Supraclavicular artery island flap is a safe reliable technically simple thin pliable fascio cutaneous regional flap. It can be considered as important successful reconstructive option for patients with oral cancer. Donor-site complications after SCAIF are minimal with little insignificant effect on arm movement and shoulder function.

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مضاعفات موقع التبرع بالرفرف المعتمد على شريان ما فوق الترقوة : تجربة لمركز أورام مصرى

لقد تم استخدام رفراف المعتمد على شريان ما فوق الترقوة فى إعادة بناء تجويف الفم بعد استئصال الأورام الخبيثة بنجاح كبير فى عديد من الدراسات السابقة وحيث قمنا بإجراء دراسة وصفية تحليلية لتقييم مضاعفات ومشاكل الكتف باعتباره المكان المتبرع للرفرف. وشملت ثلاثة وثلاثين مريضاً يعانون من أورام خبيثة نابعة من التجويف الفمى التى تم تشخيصها وعلاجها عن طريق الاستئصال الجذرى وتشريح الرقبة من الغدد الليمفاوية وإعادة البناء الفورى للعيوب الناتجة بالفم باستخدام الرفرف المتبع وتمت متابعة المرضى بعد الجراحة لمدة ستة أشهر على الأقل مع تقييم مضاعفات ما بعد الجراحة ومشاكل ووظائف الكتف. أظهرت النتائج حدوث بعض المضاعفات لموقع التبرع بالرفرف بعد الجراحة فى ستة مرضى فقط (١٨%) التى شملت ثلاثة مضاعفات كبرى تم علاجها بالتدخل الجراحى وثلاثة أخرى صغر يتم علاجها بدون جراحة. ورغم وجود معاناة بسيطة من الألم فى خمسة مرضى والاحساس المشار للكتف فى سبعة مرضى كانت حركة الذراع شبه طبيعية فى معظم الحالات ما عدا حالتين فقط.

لذلك يعتبر هذا الرفرف الجدى الرقيق المرن خياراً بسيطاً وأمناً تقنياً ما أنه حلاً موثقاً به لإعادة بناء عيوب الفم رغم بعض المضاعفات البسيطة والضئيلة المتعلقة بالكتف (مكان التبرع بالرفرف) مع الحفاظ على حركة ووظائف الكتف بشكل جيد ومرضى.