Twenty-five years of experience with the submental flap in facial reconstruction: Evolution and technical refinements following 311 cases in Europe and Africa

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Twenty-five years of experience with the submental flap in facial reconstruction: Evolution and technical refinements following 311 cases in Europe and Africa

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Abstract

Background: The submental flap is a pedicled island flap with excellent colour match for facial reconstruction. The flap can be raised with muscle, submandibular gland or bone and can be transposed to reach defects up to two thirds of the face. We report the primary author's experience of 25 years using the submental flap from its original description to most recent technical evolutions in both Europe and Africa.

Methods: This is a retrospective study including all patients with facial defects reconstructed using a submental flap between 1991 and 2016. This study included the use of all four variations of the submental flap: "platysmal', "digastric", "extended" and "super extended". We report technical adaptations and complications encountered.

Results: We performed 311 facial reconstructions using submental flaps: 32 "platysmal", 133 "digastric", 91 "extended" and 45 "super extended" variations. In conjunction with these reconstructions, we performed 10 osteocutanous submental flaps and 2 free flaps. We report 2 cases of total flap necrosis (0.6%) and 28 minor complications including: 23 cases of distal skin necrosis (7%), 1 reversible mandibular facial nerve palsy (0.3%) and 3 hematomas (1%).

Conclusions: The submental flap has proven to be a reliable flap for head and neck reconstruction. The four technical modifications described employ varying amounts of soft tissue to replace tissue lost and can include vascularized bone from the mandibular margin. This flap exemplifies Gillies' principle of "replacing like with like" and should be discussed as an alternative to free tissue transfer in facial reconstruction, especially in settings where resources are limited.

Keywords

Reconstructive Surgical Procedure; Facial reconstruction; Noma; Submental Flap; Pedicled Flap

Introduction

The submental island flap is a pedicled flap with predictable vascular anatomy. It has an excellent colour and texture match to the face and a well-concealed donor site beneath the mandible. Since the original description by Martin[1] in 1990, approximately 600 cases of facial reconstruction using submental flaps have been reported[2] in the literature, with high patient satisfaction and a reported success rate of over 97%. Utilizing the technique of YV lengthening of the pedicle or the retrograde harvest of the facial artery allows reconstruction of defects up to two thirds of the face without the need for microsurgery[3-5]. Multiple submental flap variants have now been described and include the harvesting of skin, muscle, submandibular gland and or bone to allow the flap to conform to the majority of complex composite facial defects[6,7].

The purpose of this article is to report experience of 25 years of submental flap reconstruction, analyzing 311 consecutive cases performed by, or in the presence of, the senior author in Europe or Africa. We aim to describe key technical modifications from an anatomical point of view and to analyze the advantages and disadvantages of each one according to the location and size of the defect, technical skill of the operator and operative conditions.

Anatomy

Blood supply to the skin beneath the chin is provided by the submental artery (SMA), a constant branch of the facial artery (Figure 1). The SMA runs deeply between the horizontal ramus of the mandible and the submandibular gland. It continues until the anterior belly of the digastric muscle where it gives off small branches to the gland, a horizontal branch to the mandible and additional branches to the mylohyoid muscle, the anterior belly of the digastric muscle and cutaneous perforating vessels through the platysma. The artery ends close to the mandibular symphysis in a subdermal plexus that anastomosis with the contralateral

submental artery[8]. The submental vein drains into the facial vein and ultimately into the internal jugular vein through a variable branch, commonly located inside the lower pole of the parotid gland[9-11].

Surgical Techniques and Indications

Evolution of submental flap technique

Our flap harvesting technique has evolved as our experience in reconstructive and humanitarian surgery has grown. In the original description, the submental flap was harvested just below platysma without any additional muscle[1,6] ("platysmal" version, Figure 2A). This technique requires meticulous dissection to preserve all cutaneous perforating vessels of the ipsilateral submental pedicle. In 2000, we harvested the flap to include the anterior belly of the digastric muscle as suggested by to Faltaous[12], facilitating preservation of perforating branches to the skin and anastomosing branches with the contralateral side ("digastric" version, Figure 2B). In 2009, we proposed to harvest the entire mylohyoid muscle, the 2 anterior digastric bellies and if necessary the contralateral submandibular gland with the flap, based on previous work[13] by Patel *et al.* This variation was named the "extended" version (Figure 2C), and allowed recruitment of additional soft tissues for complex composite defects, especially in the management of Noma in resource-limited settings. Finally, in 2011, we described the "super extended" version (Figure 2D) to extend the size of the cutaneous paddle up to the contralateral ear lobe. This flap includes the entire contralateral submental pedicle with its perforating branches supplying the distal skin paddle.

Skin Paddle design

An elliptical skin paddle design has always been used for each flap variant. The anterior incision is drawn along the inferior aspect of the mandible from one angle to the other, without exceeding the angle of reflection of the submental skin, thus avoiding a visible scar. In the area of intersection between the facial artery and the mandible, the anterior incision

should be strictly posterior to the mandibular basilar edge and stay close to the posterior aspect of the platysma to avoid injured the marginal branch of the facial nerve. The posterior incision is drawn as a straight line connecting one mandibular angle to another. The minimum skin paddle dimensions were 5 x 5 cm, centered on the parasymphyseal perforating vessels. The maximum skin paddle dimensions were 22 x 9 cm utilizing the "super extended" version of the flap.

Harvesting the "super extended" submental flap

The "super extended" submental flap is raised in a retrograde direction, beginning with the posterior skin incision and the dissection of the contralateral submental pedicle. The skin and platysma are incised and the ipsilateral submandibular gland is identified[14] (**key point 1**). On this side, it is mandatory to preserve the facial vein for the drainage of the flap, which can be thin and very superficial (**key point 2**). Utilizing scissors to carefully dissect out the facial vein directly below the platysma is preferable at this point. The lower pole of the submandibular gland is dissected free and the anterior belly of the digastric muscle identified bilaterally. The muscles are then divided as close as possible to the hyoid bone. The contralateral submandibular gland is then dissected from its lower to its upper edge until the contralateral submental pedicle is visualized. If the gland is to be included in the flap, the direct vessels coming from the SMA are preserved, otherwise they are electrocoagulated. The contralateral submental pedicle is dissected and ligated at its origin. All cutaneous perforating branches are preserved to improve distal vascularization of the skin paddle. The contralateral SMA vascular system is supplied by the parasymphyseal cutaneous linking vessels between the two SMA perforasomes, and sometimes by direct vessels between the distal branches of the ipsi- and contralateral submental pedicles. The mylohyoid muscle is located at the level of its insertion onto the hyoid bone. The layer between the mylohyoid and geniohyoid muscles is identified prior to division of the muscle insertions onto the hyoid bone. (**key point 3**). The

upper edge of the flap is then incised, preserving the mandibular branch of the facial nerve, with dissection proceeding in a retrograde direction. The mylohyoid and digastric muscles are then divided on the mandible. The ipsilateral pedicle is dissected only if a long arc of rotation is required. In case of bow stringing of the facial vein, lengthening of the vein can be achieved according to the YV lengthening procedure[3].

YV Lengthening of the facial vein

The communicating branch between the facial vein and the internal jugular vein is dissected, and the facial vein is divided proximally to this communicating branch. Consequently, the venous drainage of the flap is directed toward the internal jugular vein and allows up to 5 cm distal mobilization of the submental flap.

Harvesting the osteocutaneous submental flap

An osteocutaneous variant of the "extended" or "super extended" version is possible to harvest (Figure 3). A 1.5 cm segment of mandibular bone can be harvested from the free edge of its horizontal portion on the contralateral side according to the pedicle origin. The harvest can be extended from the symphysis until the angle of the mandible. The mandibular attachment of the contralateral hemi-myloid muscle must be preserved to protect the thin perforator vessels destined for the bone.

Closure of the submental flap donor site

A 5 cm wide midline subplatysmal undermining is performed to the sternal manubrium to mobilize the cervical skin and advance the posterior edge of the donor site. An intradermal inverted "high tension" 2-0 absorbable suture fixed solidly the skin near to the sternal manubrium to the hyoid bone. The closure is then performed by inverted 3-0 absorbable sutured and separated 3-0 nonabsorbable sutures on suction drainage.

Choosing a variant of the submental flap

We utilized four different technical variations of the flap depending on the extent of the defect, the operative conditions and our experience (Table 1). When faced with a small defect in a Western population commonly secondary to skin malignancy, the pros and cons of "extended" and "super extended" variations should be considered. In such cases, the "digastric" version (Figure 2B) according to Faltaous[12,15] or even more reliably, Patel's variation, which includes the ipsilateral anterior belly of the digastric muscle and the ipsilateral hemi-mylohoid muscle in the flap is preferable[13]. The "platysmal" version (Figure 2A) is also a good option as it is the thinnest flap, however this variant is technically the most challenging and risky to harvest[1], specifically preserving satisfactory venous drainage. In fact the submental pedicle run deep to the anterior belly of the digastric muscle in 70 percent[12] of patients, providing some anastomotic vessels. In Noma surgery, patients are often in a very poor health[16] and have large composite defects where an over correction with a bulky flap is often required[17]. In cases of Noma we recommend the "extended" (Figure 2C) or "super extended" versions (Figure 2D). Using these two flap versions all perforating vessels, through the mylohyoid muscle to the skin, from SMA are preserved. Utilising these variations allows extension of the cutaneous skin paddle to the contralateral ear lobe.

Illustrative Case reports 474 words

European Experience

Case 1

A 55-year-old male was referred to us with an infiltrative basal-cell carcinoma over the zygomatic arch (Figure 4). Despite initial resection and radiotherapy the patient developed a recurrence that involved the underlying bone. In stage one, an en-bloc excision of skin, soft tissue and 3.5 cm of zygomatic arch was performed, with clear margins. In the second stage, an osteocutaneous "platysmal" submental flap was performed according to the original

technique[6]. The curvature of the bony segment harvested from the mandible conformed to the zygomatic defect very well.

Case 2

A 63-year-old male was referred to us with a recurrent melanoma of the cheek (Breslow thickness over 3 mm) (See **Figure, Supplemental Digital Content 1,** which shows a Per-operative view and one-year post-operative view, INSERT HYPER LINK). Following excision of the entire aesthetic unit of the cheek with appropriate margins, reconstruction was achieved using a "platysmal" submental flap. No secondary corrective procedure was required.

Humanitarian Experience in Africa

Case 3

A 12-year-old Nigerian child was referred to us with an extensive soft tissue defect involving the left oral commissure, left upper one-third of the lip and cheek following Noma (Figure 5). We performed a single-stage reconstruction using a "digastric" submental flap variant. The inner lining of the cheek was achieved using turn over flaps from local scar tissues. The left nostril was mobilized and re-inserted over the submental flap at the right position and the left upper lip was completely dissected and advanced to reach the commissure.

Case 4

An 8-year-old child was referred to us in Nigeria with a left commissure and partial cheek defect following Noma (Figure 6, see Noma lesion before spontaneous healing in figure, **Supplemental Digital Content 2, INSERT HYPER LINK**). We performed a commissuroplasty by advancement of the two lips. The Inner lining of the cheek was reconstructed using local turn over flaps from scar tissues. The outer lining was reconstructed

with a “extended” submental flap variant including the contralateral submandibular gland to provide required bulk.

Case 5

A 31-year old Ethiopian man was referred to us with an extensive defect of the right commissure with loss of one third of the upper and lower lips following Noma (Figure 7). We performed a single stage reconstruction with a Webster flap for the upper lip and a commissuroplasty. The Inner lining of the cheek was recreated using turn-over flaps from scar tissues. The outer lining was reconstructed using a “extended” submental flap.

Case 6

A 32-year-old Congolese woman was referred to us with a total bilabial amputation following barbarian mutilation (Figure 8) (See Figure, **Supplemental Digital Content 3**, which shows One-year post-operative result following total bilabial reconstruction using the “super extended” submental flap variation with secondary division and skin grafting of the vermillion, INSERT HYPER LINK) (See video, **Supplemental Digital Content 4,** which demonstrates the post-operative result, INSERT HYPER LINK) (Video Graphic 1). On the same mission we reconstructed six patients suffering from total or subtotal amputation of the both lips. We reconstructed the lips with a “bucket-handle” submental flap. The Inner lining was provided by turn-over flaps from scar tissues. The outer lining was reconstructed using a ”super extended” submental flap variation. The flap was divided after 3 weeks in order to recreate the mouth opening. Additional skin grafts were performed in order to reconstruct the vermillion.

Results

Three hundred and eleven patients underwent submental flaps between 1991 and 2016 (Table 2). Among these patients, 32 received a “platysmal” variation of the flap, 133 a “digastric” variation, 91 an “extended” variation and 45 a “super extended” variation.

Among these 311 cases, we performed 10 osteocutanous submental flaps (2 "platysmal", 4 "extended" and 4 "super extended"), 2 free-flaps ("platysmal" variation) and 15 "super extended" flaps with a skin paddle over 20 centimeters in length. We report 2 total flap failures (0.6%) due to technical intraoperative errors: a complete section of the facial vein and a complete section of the submental pedicle. Regarding the 10 osteocutaneous flaps performed worldwide, 2 were performed in France to reconstruct defects of the zygomatic arch and the maxilla following Basal Cell Carcinoma excision. The other 8 cases were performed in Africa. Six were performed for maxillary bone loss (4 patients) or destruction of the orbital rim (2 patients) secondary to Noma. Two osteocutaneous flaps were used in Africa to reconstruct the mandible following ameloblastoma resection.

We report 28 minor complications with no impact on final result: distal skin necrosis less than 4 cm (7%), 3 hematomas (1%) at the donor site rapidly resolving and 1 mandibular neuropraxia (0.3%). The low incidence of mandibular nerve injury in this case series should be considered with the knowledge that many of our patients operated in Africa had mandibular neuropathy secondary to Noma. We report one case of wound dehiscence due to lack of "high tension" sutures between the deep skin layer and the hyoid bone. We report hypertrophic scarring in less than 5% of cases (12 patients), and only in African patients. Corticosteroid injections always improved this problem (see Figure, **Supplemental Digital Content 5,** which shows Hypertrophic scar of the submental flap donor site in an African patient, before and after injections of corticosteroids, INSERT HYPER LINK). In the twenty patients with submental flap reconstruction including the contralateral submandibular gland, we reported only 1 salivary fistula which went on to resolve spontaneously after 3 months. The low rate of complication in African patients must be put into perspective by the low level of patient reporting and the reduced follow-up of 6 months or 1 year post operatively for the majority of patients.

Discussion

Flap refinements according to the topography of the defect

We have developed several technical refinements in order to increase the arc of rotation of the submental flap to reach the whole face. We initially used the flap as a free flap for forehead defects[6,8]. After our publication of the YV advancement procedure[3], we were able to transpose the flap up to the mid forehead without using microsurgery. Thanks to the communicating branch between the facial and external jugular veins, we can lengthen the venous pedicle. The dissection of the facial artery until this origin is always sufficient for a very distal transposition. This variation allows the flap to reach the entire oral cavity. We have also used the submental flap as a "bucket handle flap", distally based, for reconstruction of both upper and lower lips (Case 6). In this situation, the facial artery and vein were dissected proximal and distal to the submental flap, and the proximal vessels were ligated and divided (preserving the mandibular branches of the facial nerve) so that the flap was solely supplied by reverse blood flow from the distal vessels. We have no experience of submental flap for use in nasal reconstruction. However, in this indication, the flap should be transposed as a reverse flow pedicled flap[18,19] or as a free flap[20].

Flap variations according to the nature of the defect

We commonly use the submental flap for soft tissue coverage following head and neck cancer or Noma. We have also used this flap as a filler, following complete de-epithelialization[21], to treat hemi-facial microsomia in Romberg's disease. We described the osteocutaneous version of the submental flap in our original description[6] in 1993. Bony blood supply to the mandible is ensured by direct and muscular branches coming from the submental pedicle[7,10]. We performed the first case of "platysmal" osteocutaneous submental flap in 1996 to reconstruct the zygomatic arch (case 1). We subsequently performed 6 cases of the osseocutaneous submental flap in Africa between 2001 and 2016. In three cases of severe

centrofacial Noma the maxilla was reconstructed with 3 to 9 cm of mandibular bone. In two other cases the bony orbital rim and floor were reconstructed with the same procedure. We performed our first mandibular reconstruction in 2015, following ameloblastoma excision. We transposed a 9.5 cm x 1.5 cm segment of split mandible to the contralateral side. In our experience the osteocutaneous variant of the submental flap is particularly adapted to reconstruct bony defects of the maxilla, the zygoma, the orbital rim and the mandible of up to 10 cm. In 2002 the "extended" submental flap was developed in response to a patient in Africa with a major soft tissue defect following Noma. This variation included the submandibular gland and provided invaluable bulk. Since this date we have performed more than 25 submental flaps that included the gland. Only one patient reported a salivary fistula, healing spontaneously after 3-months. We recommend routine ligation of Wharton's duct to avoid this complication.

Teaching of flap harvesting

Teaching reconstructive procedures to local plastic surgeons has always been an important goal of our humanitarian missions in Africa. We propose the "super extended"[11] and "extended" versions[22], best suited for this purpose. In this situation the main operator can help their assistant to dissect the contralateral side of the flap with very few risks. Indeed, the musculocutaneous perforators inside the mylohoid and digastric muscles are sufficient to perfuse the entire skin paddle up to the angle of the mandible. Patel's "super extended" flap variation[13] seems particularly adapted to the resident education. However, in Patel's variation, the mylohoyoid and digastrics are raised only on the ipsilateral side. In the "extended" and the "super extended" variations, both sides of the mylohyoid and both anterior bellies of the digastric muscle are raised. Furthermore, in the "super extended" flap, the contralateral pedicle is also dissected. In such cases we can teach the resident how to dissect the flap on the contralateral side without compromising the result of the reconstruction due to technical error.

Complications

The biggest complications encountered in this series were iatrogenic division of the submental pedicle (1 case) and facial vein (1 case) leading to flap failure. With the extended and super extended variations, the dissection of the contralateral pedicle is not required thereby minimizing the potential for this complication. However, we still recommend careful incision of the contralateral, posterior edge of the skin paddle to avoid any damage to the facial vein which can sometimes be smaller and more superficial than expected. In the literature[2] a high percentage of mandibular branch of facial nerve injuries are reported. In our experience, careful dissection at the mandibular angle, immediately below the platysma muscle, is sufficient to avoid this complication. We have reported only one case of temporary mandibular neuropraxia, resolving within 3-months. However, in the retrograde variation, the risk of nerve injury appears to increase, especially when increased arc of rotation is required[23].

Conclusion

The submental flap is a versatile and reliable option for head and neck reconstruction[24,25] in both developed and resource-limited settings. It is suitable for reconstruction of up to two-thirds of the face. The “platysmal”, “digastric”, “extended” and “super extended” flap modifications can contribute varying amounts of soft tissue bulk for complex defects with the additional option of vascularized bone if required. This flap fully respects Gillies’ principle of "replacing like with like" and should be considered as an alternative to free tissue transfer in certain facial reconstructions. However, a thorough knowledge of the cervical anatomy is necessary to avoid pitfalls in flap dissection.

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Legends

Figure 1

Anatomy of the submental area - skin and platysma have been removed.

1. Perforating branches of the submental pedicle to the skin anastomosing with the contralateral side

2. Branches of the submental pedicle to the anterior belly of the digastric muscle

3. Branches of the submental pedicle to the horizontal branch of the mandible

4. Branches of the submental pedicle to the mylohyoid muscle

5. Branches of the submental pedicle to the submandibular gland

Figure 2

Surgical anatomy of the four variants of the submental flap

A. "Plastysmal" variation

B. "Digastric" variation including the anterior belly of the ipsilateral digastric muscle

C. "Extended" variation including both anterior bellies of the digastric muscles and the mylohyiod muscle

D. "Super extended" variation with the submandibular gland, both anterior bellies of the digastric muscle, the mylohyiod muscle and the contralateral submental pedicle to its origin

Figure 3

Osteocutaneous submental flap harvesting

Figure 4

A 55-year-old male was referred to us with an infiltrative basal-cell carcinoma over the zygomatic arch. Despite initial resection and radiotherapy the patient developed a recurrence that involved the underlying bone. Reconstruction was performed in one stage using the "platysmal" variant of the osseocutaneous submental flap

A. Pre-operative view

B. One-year post-operative view

C. One-year post-operative CT scan; the red arrow indicates the bony shaft harvested with the submental flap and used for the zygomatic arch reconstruction

Figure 5

A 12-year-old Nigerian child with a soft tissue defect involving the left oral commissure, left upper one-third of the lip and cheek defect following Noma. We performed a single-stage reconstruction using a "digastric" submental flap variant. The inner lining of the cheek was achieved using turn over flaps from local scar tissues. The left nostril was mobilized and re-inserted over the submental flap at the right position and the left upper lip was completely dissected and advanced to reach the commissure.

A. Pre-operative photography

B. One-year post-operative photography

Figure 6

An 8-year-old Nigerian child with a soft tissue defect of the left oral commissure and partial cheek defect following Noma (see Noma lesion before spontaneous healing in figure, **Supplemental Digital Content 1**, INSERT HYPER LINK) We performed the reconstruction in a one-stage procedure with a commissuroplasty by advancement of the two lips and a "extended" submental flap variant including the submandibular gland.

A. Pre-operative view

B. One-year post-operative view

Figure 7

A 31-year old Ethiopian man with an extensive defect of the right commissure with a complete loss of the external third of the two lips after Noma. We performed, in a single stage procedure, a Webster flap for the upper lip, commissuroplasty and a "extended" submental flap.

A. Pre-operative view

B. One-year post-operative view

Figure 8

32-year-old woman with a total bilabial amputation after barbarian mutilation. We reconstructed both lips with a "bucket-handle" "super extended" submental flap variation. The flap was divided after 3 weeks in order to recreate the mouth opening and skin grafts were performed to reconstruct the vermillion. Pre-operative view

See Supplemental Digital Content 3, INSERT HYPER LINK and Supplemental Digital Content 4, INSERT HYPER LINK, which shows One-year post-operative view and motion recovery at 2 years.

Table 1

Pros and cons of the 4 different submental flap versions.

Table 2

Patient and flap data.

Figure, Supplemental Digital Content 1, A 63-year-old male with a melanoma recurrence of the cheek (Breslow thickness over 3 mm). Following excision of the entire cheek with appropriate margins, reconstruction of the entire cheek aesthetic unit was achieved using a "platysmal" submental flap. Per-operative view and one-year post-operative view, INSERT HYPER LINK.

Figure, Supplemental Digital Content 2, Noma lesion prior to spontaneous healing in an 8-year-old child, INSERT HYPER LINK.

Figure, Supplemental Digital Content 3, One-year post-operative result following total bilabial reconstruction using the "super extended" submental flap variation with secondary division and skin grafting of the vermillion, INSERT HYPER LINK.

Video Graphic 1. See Video, Supplemental Digital Content 4, which demonstrates a post-operative result following total bilabial reconstruction using the "super extended" submental flap variation with secondary division and skin grafting of the vermillion, INSERT HYPER LINK.

Figure, Supplemental Digital Content 5, Hypertrophic scar of the submental flap donor site in an African patient, before and after injections of corticosteroids, INSERT HYPER LINK.

Submental flap version	Harvest	Reliability	Cutaneous Paddle Maximum dimension (cm)	Thickness	Simplicity of harvest
Platysmal	Skin, platysma	-	18	-	-
Digastric	Skin, platysma, anterior belly of the ipsilateral digastric muscle	+	18	-	-
Extended	Skin, platysma anterior belly of bilateral digastric muscles, mylohyoid muscle	+++	18	+++	+++
Super-extended	Skin, platysma anterior belly of bilateral digastric muscles, mylohyoid muscle, contralateral submental artery and vein	+++	22	+++	++

Table 1.

Number of patients	Country	Year	Submental Flap Variant	Indications	Localization	Complications
26	France	**1991 - 2000**	"Platysmal" *1 osseocutaneous flap* *2 free flaps*	BCC, SCC, MCC, Melanoma, DFSP, Sarcoma, Parotid tumor, Noma, Gun shot, Trauma	Lower, middle and upper third of the face	2 haematomas, 2 distal necrosis (2 to 3 cm), 1 temporary facial palsy
10	France	**2000 - 2007**	"Digastric"	BCC, SCC, Melanoma	Lower, middle and upper third of the face	None
16	Nigeria	**1999 - 2000**	"Platysmal"	Noma, Ameloblastoma	Lower and middle third of the face	3 distal necrosis (2 to 4 cm)
123	Nigeria, Niger, Ethiopia	**2001 - 2009**	"Digastric"	Noma, Ameloblastoma	Lower and middle third of the face	1 complete necrosis (technical fault), 7 distal necrosis (2 to 4 cm)
91	Nigeria, Ethiopia, Congo, Burkina Fasso, Ivory Coast	**2009 - 2013**	"Turbo" *5 osseocutaneous flaps*	Noma, Ameloblastoma	Lower and middle third of the face	1 complete necrosis (technical fault), 8 distal necrosis (1 to 4 cm), 3 hematomas
30	Congo, Niger, Ethiopia, Ivory Coast	**2011 - 2016**	"Combo" *4 osteocutaneous flaps*	Noma, Ameloblastoma	Lower and middle third of the face	None
15	Niger, Ethiopia, Ivory Coast	**2011 - 2016**	Extended "Combo"	Noma, Ameloblastoma	Lower and middle third of the face	3 distal necrosis (2 to 3 cm)

BCC: basal cell carcinoma; SCC: squamous cell carcinoma; MCC: Merkel cell carcinoma; DFSP: dermatofibrosarcoma protuberans

Table 2.

Figure 1

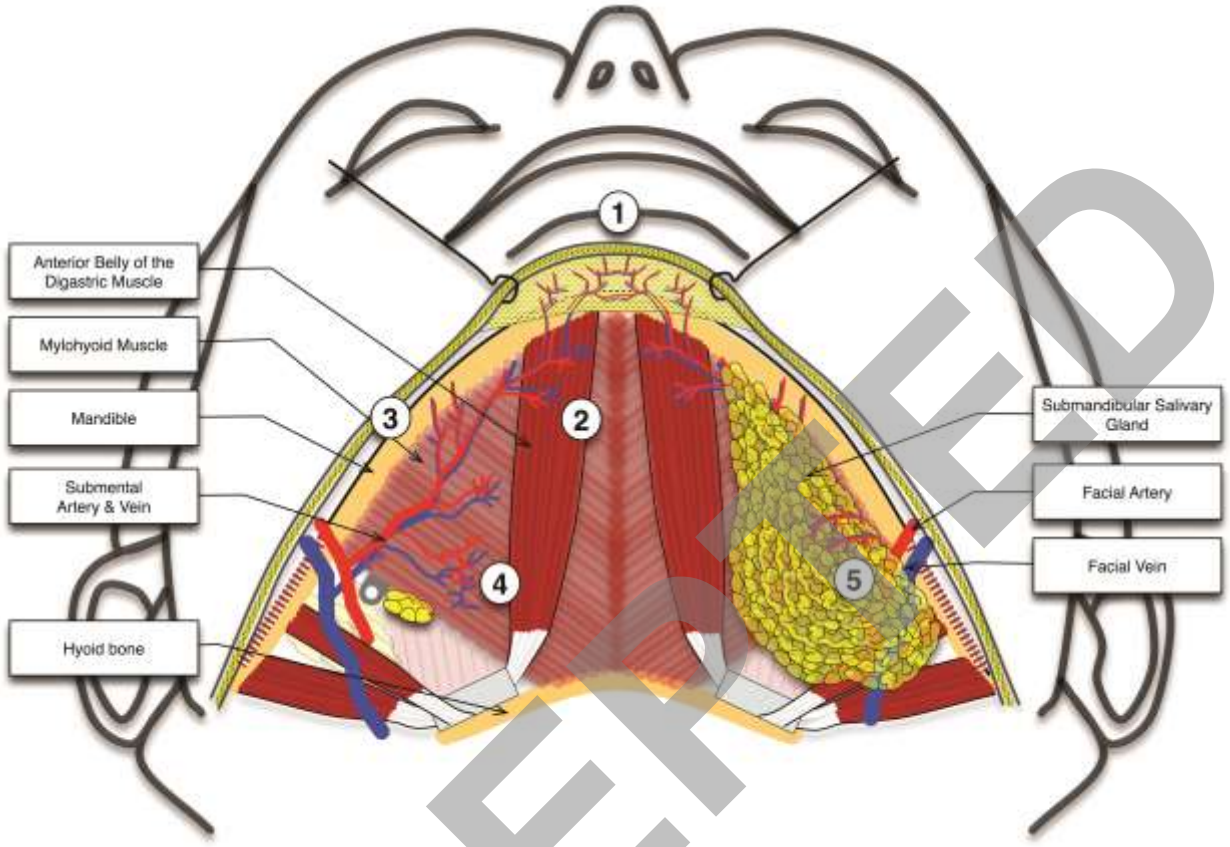

Figure 2

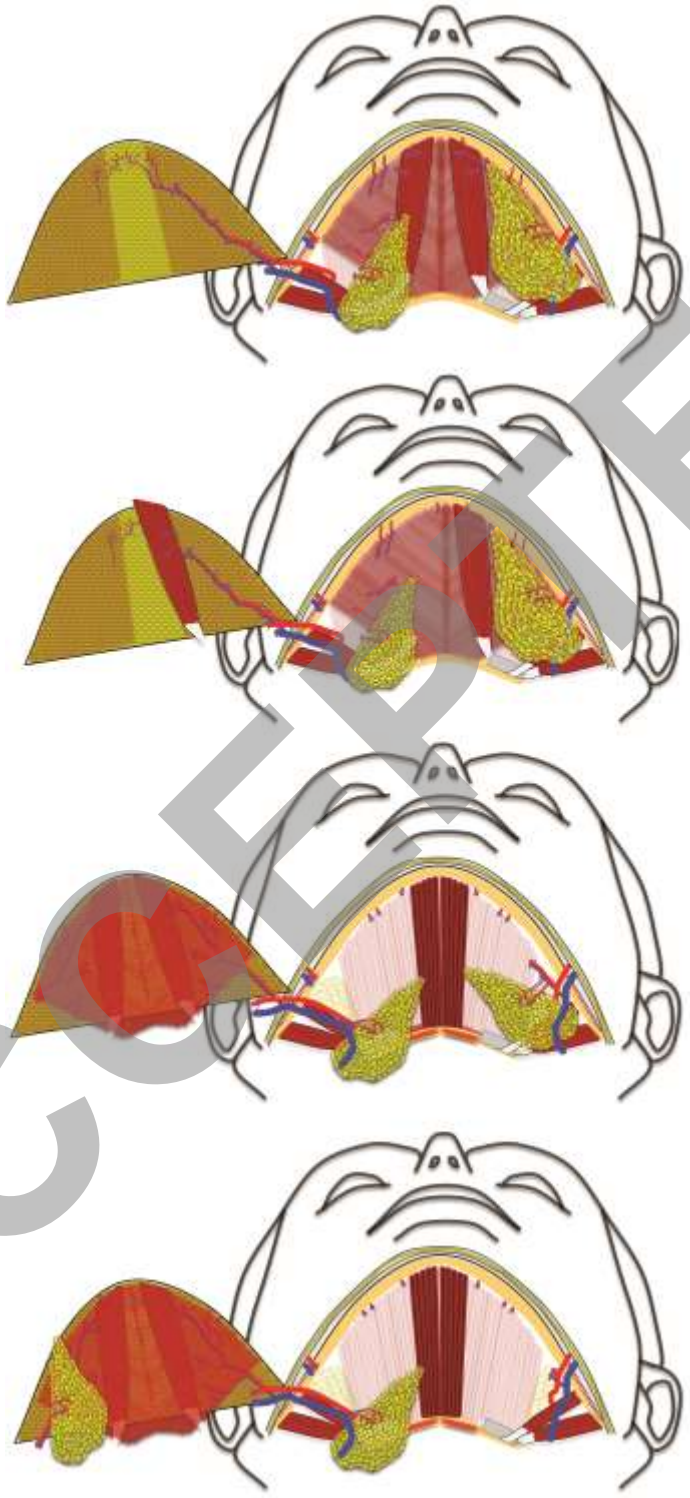

Figure 3

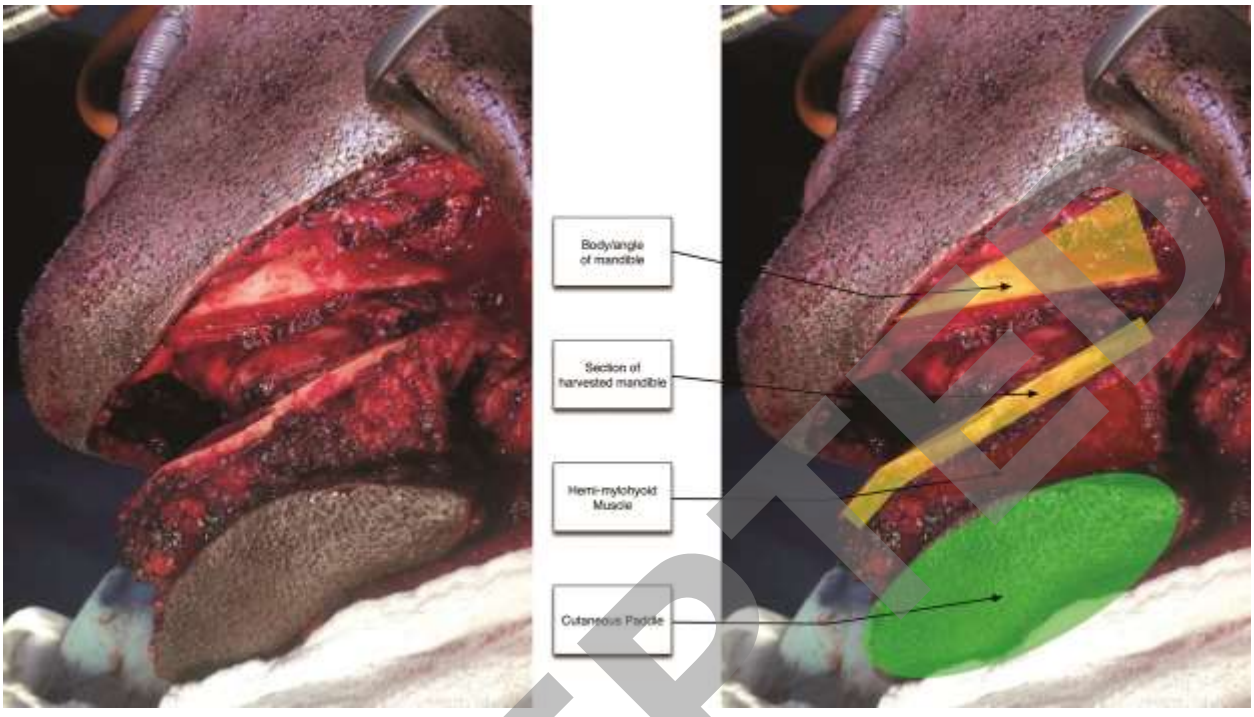

Figure 4

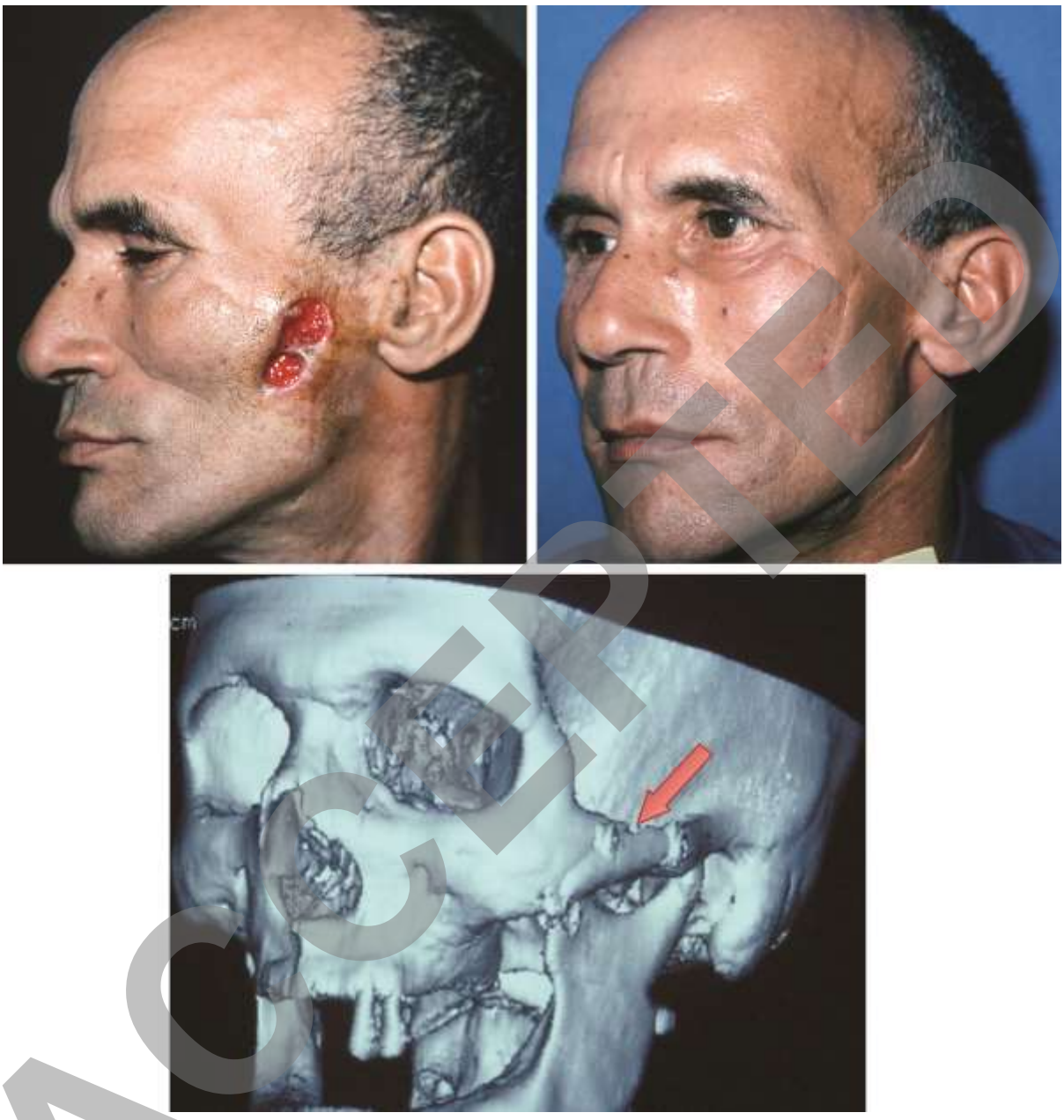

Figure 5

Figure 6

Figure 7

Figure 8

SDC1

SDC2

SDC3

SDC 5

Video.graphic1