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Acta chir plast. 2020, 62(1–2):3.

Dear readers,

It is my honour and pleasure to have a few introductory words in this issue of Acta Chirurgiae Plasticae.

In the last couple of months, we have been experiencing difficult and, in a certain sense, also strange times. The pandemic has affected and changed us. More than ever before, we appreciate the value of our own health. And we are investing. In preventive measures, in urgent medical care, in public awareness, in the security of our future. And we are also restricting. We are postponing tasks that we have planned, we are avoiding social contact in public, all cultural and sport events have disappeared. Education has been maintained through homework and self-study. A lot of our everyday needs have suddenly become unreachable. And again, we are restricting. But this time, with a different purpose. Times like this give us an opportunity to slow down a little and take time to think. And again, we are investing. In our own family that have often suffered because of our absence. In our physical and mental well-being. In education. Or at least, we should.

I strongly believe that in the end, we will get through all this with success and life will lead us further on the unpredictable journey.

I am very glad that during this strange time of restrictions, investments, invested restrictions and restricted investments, it was possible to create another issue of Acta chirurgiae plasticae. This time, pieced together from articles focused on maxillofacial surgery.

Oral and maxillofacial surgery is distinct from any other specializations. It has been rooted in general medicine. In time, it has become a dental speciality and today, it is one of the recognized specializations, with the two fields contributing in its total coverage. Maxillofacial surgery still stays unique as it is the only specialization that links together both general and dental medicine in terms of education and training. A good maxillofacial surgeon must become a combination of a dentist, a dentoalveolar surgeon, a general surgeon, a traumatologist, an orthopaedist, a vascular surgeon, an otolaryngologist, a surgical oncologist, a plastic and a reconstructive surgeon. Therein lies the difficulty and the beauty of maxillofacial surgery.

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AN OVERVIEW AND OUR APPROACH IN THE TREATMENT OF MALIGNANT CUTANEOUS TUMOURS OF THE HAND

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ABSTRACT

Introduction. Diagnosis of malignant cutaneous tumours of the hand is often difficult because of the different anatomic structures present in this region and yet clinicians must be able to distinguish typical benign entities from life-threatening or limb-threatening malignant diseases. Due to the hand's complex structures located in a small area, surgeons must evaluate constantly the balance of inadequate surgery against functional and cosmetic aspects. Thus, a multidisciplinary approach is recommended for a correct diagnosis and treatment design.

Materials and methods. Between 2006 and 2017, 354 consecutive patients with basal and squamous cell carcinomas, and melanoma of the hand were retrospectively analysed at the Department of Plastic and Reconstructive Surgery at the University of Palermo, treatment was surgical for all of them; also radio- and chemotherapy were necessary based on the histological diagnosis.

Results. The most common tumour was basal cell carcinoma (BCCs), followed by squamous cell carcinoma (SCCs). Melanoma was the most frequent lesion diagnosed in the digits. Radical excision was the main treatment of choice. In 29 cases (11 with SCC, 18 with melanoma) axillary lymphadenectomy was performed, because of lymph nodes metastases. In the follow up, the spread of cancer to distant organs caused the death in three cases. Recurrence rate was higher in case of infiltrative SCCs and BCCs.

Conclusions. The major references provide only limited information on malignant soft-tissue tumours of the hand. Our retrospective study aims to present the most commonly observed malignant soft-tissue tumours of the hand, analysing their causes, their objective and instrumental evaluation, and their treatments.

KEYWORDS

Hand tumour, soft-tissue lesion, surgical excision

INTRODUCTION

Cutaneous tumours represent the most frequent primary malignancies of the hand. Typically, they present as painless lesions on areas of high exposure as the dorsum of the hand and upper extremity[1]. The patient's history and the physical examination represent essential factors in the process of formulating a diagnosis. Characteristics such as the change in size, rapid- or slow-growth, pain, localization, transillumination, firmness and motility are significant when performing an immediate diagnosis in most cases. Occasionally, a systemic workup is necessary in order for diagnostic differentiation, including plain radiographs to distinguish the soft-tissue or bony tissue origin, MRI to define the tissue invasion, CT scan to obtain bony details such as cortical disruption, signs which point to a malignant diagnosis[2-3]. Surgical removal of the lesions with appropriate margin resections represents the gold standard of treatment, essential for histological analysis and malignancy staging.

MATERIALS AND METHODS

A total of 354 consecutive patients (211 men, 143 women) with malignant cutaneous tumours of the hand were operated and retrospectively analysed at the Department of Plastic and Reconstructive Surgery, University of Palermo, between 2006 and 2017. Mean age was 69.5 (45–94), no significant difference in age at presentation between sexes was observed. 149 (42%) were BCCs, 124 (35%) SCCs, 81 (22%) melanomas. Treatment was surgical for all of them. In 29 cases (11 with SCC, 18 with melanoma) homolateral axillary lymphadenectomy was performed because of metastasis; also radio- and chemotherapy were necessary based on the histological diagnosis. Patients with BCC and SCC were followed up at the institute two times a year for a mean of 3.4 years. In case of infiltrative SCC lymph nodes ultrasound examination was required. Patients with melanoma underwent multidisciplinary program of follow-ups, which included both dermatologic and oncologic visits. The frequency of the visits and instrumental examinations (ultrasounds,

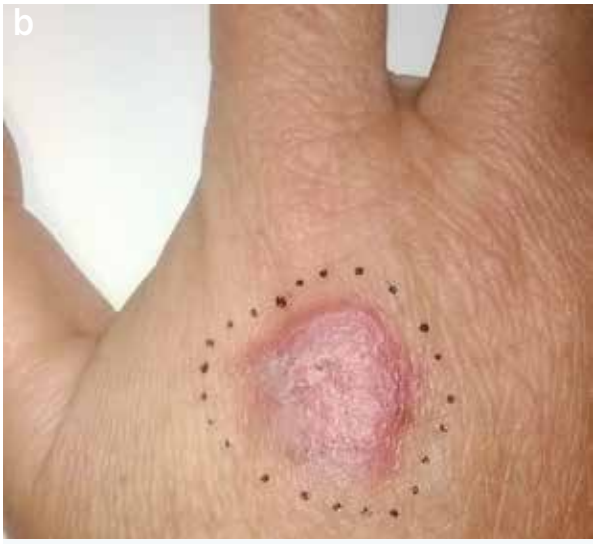


Figure 1a. Nodular BCC arising from the index finger
Figure 1b. BCC, morphoeic type

MRI and CT scan) was correlated to the staging and ranged between two and six times a year, for a mean of eight years.

RESULTS

The dorsum of the hand, first and second web spaces accounted for more than 90% of squamous and basal cell carcinoma, which is likely related to ultraviolet radiation exposure; the major incidence of malignant tumours on the left hands could be related to the increased ultraviolet radiation exposure on the window-side of the body while driving[4]. Palmar or peri/subungual lesions were infrequent, except for malignant melanoma. The most common BCC subtype was superficial (37.7%), followed by nodular (29.5%), infiltrative (19.3%), and morphoeic (13.2%). According to the histological analysis the most common incomplete excision was in infiltrative BBCs (32%), then the nodular and mixed aggressive (15%), superficial ones (12%) and other various histological types (41%). The recurrence rate, after a mean of 3.1 years, was 4%, which essentially included the infiltrative variant. We accomplished radical excision and full-thickness skin graft for most of the SCCs; in 17 cases the tumour infiltrated the bone, thus we performed finger amputation (see Figure 2g). According to the grading, 35% were well differentiated, 28% moderately differentiated, 18% poorly differentiated and 19% undifferentiated. In eleven cases ultrasound lymph nodes examination demonstrated axillary metastases, which required lymphadenectomy. In one case, the patient died of distant organ metastases two years after the surgery. The rate of recurrence at primary lesion site was 11% mean after 3.8 years from the operation.

The majority of malignant melanomas were nodular (40.6 %), acral lentiginous (34.3%), followed by the superficial spreading (25%) subtype. Surgery with radical excision was the treatment of choice for all lesions. In four of these patients the clinic examination, after being confirmed by ultrasounds, revealed the simultaneous presence of axillary lymph nodes metastases. In 14 cases, micrometastasis to sentinel lymph node biopsy was detected. In total, we performed 18 axillary lymphadenectomies, in which four cases underwent adjuvant therapy. In two of these, after a mean of 5.6 years since the operation, distant organ cutaneous metastases occurred (see Figure 3f–g).

DISCUSSION

Basal cell carcinoma

Basal cell carcinoma (BCC) arises from keratinocytes of the basal epithelium. The clinical aspect is similar to squamous cell tumours, but generally they are more slow-growing and, therefore, sometimes first assessed months after the patient notices the growth. Several distinct variants of BCC exist: superficial, infiltrative, morphoeic and nodular, which is the most common (Figure 1a). This type is characterized early by pink atrophic skin with telangiectasias, which eventually develops into ulcerated lesions with raised pearly borders. BCC rarely metastasizes, but it can be locally aggressive. Although nonsurgical treatments are available, like topical immunomodulators such as imiquimod, 5-fluorouracil, cryotherapy, photodynamic therapy and deep shaving, surgical excision provides healing with lower recurrence rate, thus is the preferable treatment[5]. Excision with a 4 mm margin for lesions less than 2 cm in diameter is considered adequate, permitting the healing on 95% of patients. For tumours wider than 2 cm, and for larger and morphoeic types (Figure 1b), Mohs' surgery is recommended, which produces cure rates of 99%[6]. In total we treated 149 cases of BCC, performing radical excision with local flap reconstruction for smaller lesions, while using full-thickness skin graft for larger carcinomas.

Squamous cell carcinoma

Squamous cell carcinoma (SCC) is the second most common skin cancer in humans and the first on the hand, accounting for 75–90% of all hand tumours (Figure 2a), followed in frequency by basal cell carcinoma. It is also the most common malignant lesion of the nailbed, often misdiagnosed as a chronic infection or a traumatic injury[7]. Clinical presentation ranges from erythematous plaques to huge polypoid tumours. Other subtypes include verrucous, ulcerative, Marjolin, and subungual carcinomas. About 20% of the squamous cell carcinomas demonstrate a correlation with

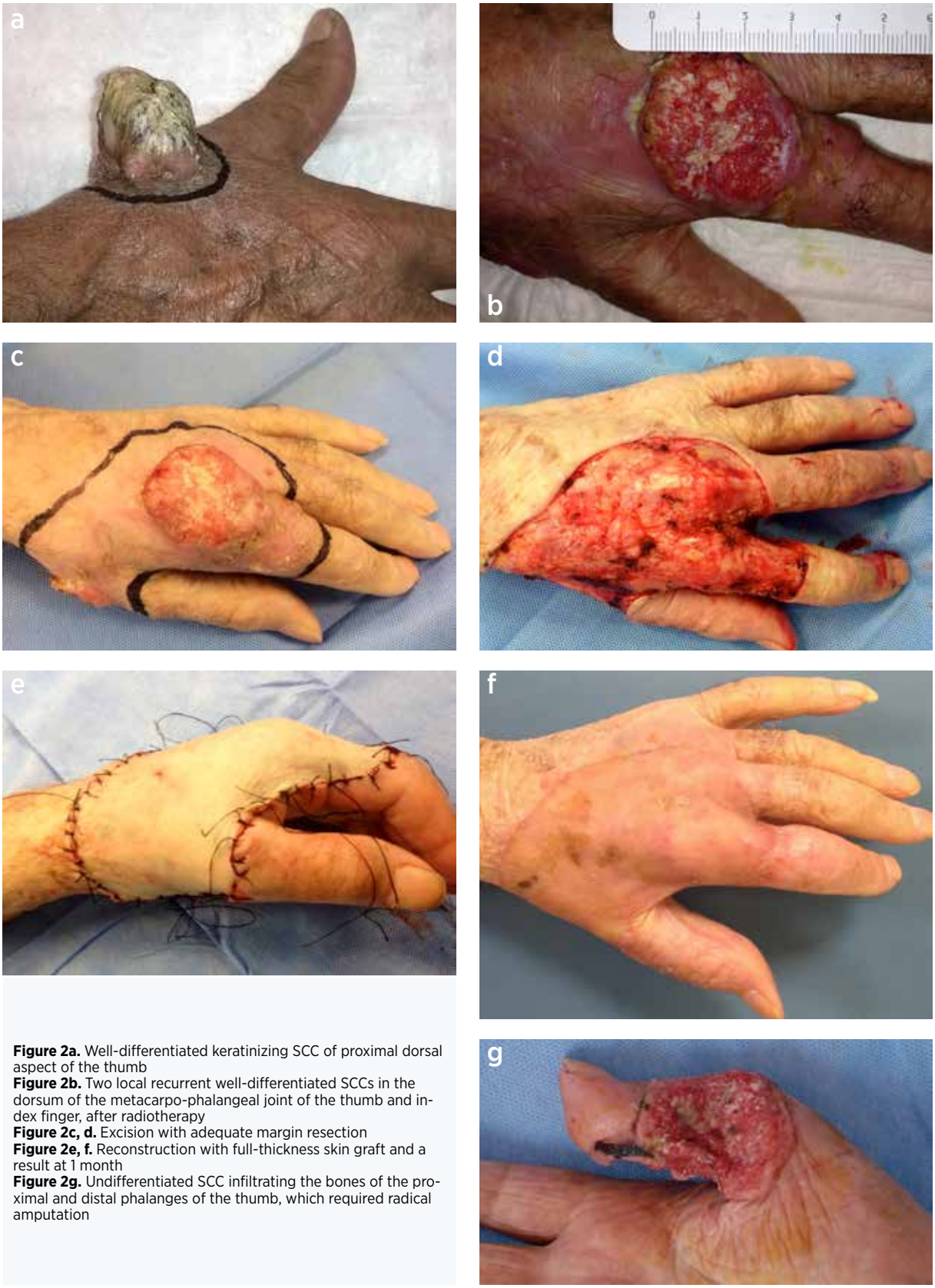


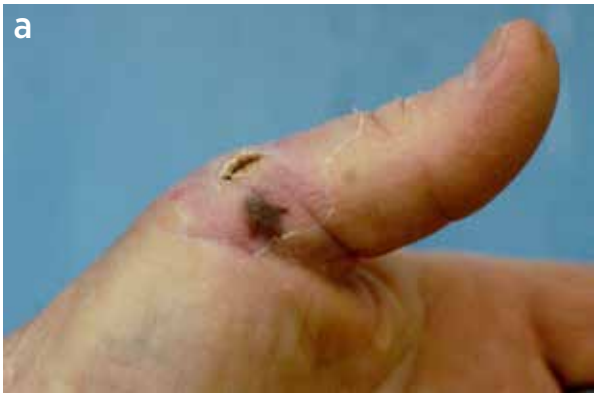
Figure 2a. Well-differentiated keratinizing SCC of proximal dorsal aspect of the thumb
Figure 2b. Two local recurrent well-differentiated SCCs in the dorsum of the metacarpo-phalangeal joint of the thumb and index finger, after radiotherapy
Figure 2c, d. Excision with adequate margin resection
Figure 2e, f. Reconstruction with full-thickness skin graft and a result at 1 month
Figure 2g. Undifferentiated SCC infiltrating the bones of the proximal and distal phalanges of the thumb, which required radical amputation

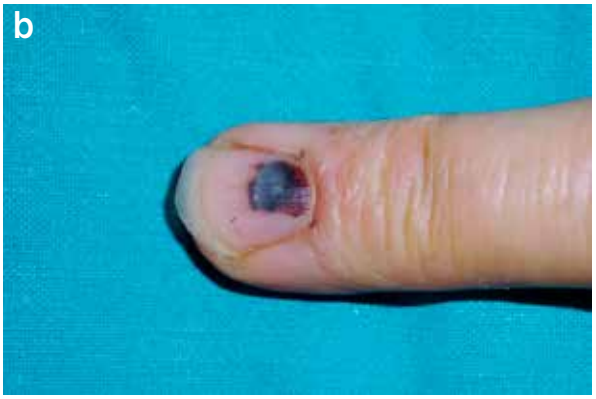
premalignant conditions such as actinic keratosis or Bowen's disease. Like other skin tumours, squamous cell carcinoma is more common in areas of intense ultraviolet light or sun exposure such the dorsal surface of the hand. Risk factors include advancing age, outdoor vacation and sunnier geographic areas. An Australian study has suggested a driver's window-side of the body is more likely to develop cancers due to increased ultraviolet exposure[4]. The presence of a tumour in the web spaces or on the dorsum of the proximal phalanx is more significantly correlated to an increased rate of metastasis, about 0.5-5.9% [8] spreading to axillary lymph nodes, due to the thinner skin and the greater density and size of lymphatic trunks. This increases the importance of early diagnosis and treatment. Also, they demonstrate a major propensity for local recurrence due to a more conservative surgical approach in these areas. The primary treatment is surgical excision, including the subcutaneous fat, with 4 mm margins for tumours that are less than 2 cm in diameter, or 6-10 mm margins for those 2 cm in diameter or larger, or with other clinical high-risk prognostic characteristics[8-9] (Figure 2a, b, c). Margins of excised specimens are marked for orientation in cases where the histological analysis requires re-intervention. Split, full-thickness skin grafts (Figure 2d, e, f) and local, perforator, free flaps are the options of reconstruction for post-resection defects for which primary closure is not possible. The different clinical aspect of SCCs can often be mis-diagnosed. In this case shaving or biopsy can be considered for large and pigmented lesions, or atrophic plaques. The recurrence rates after surgical excision range from 7% to 28%; poorly differentiated cells, lesions with a vertical depth greater than 4 mm, perineural invasion, and rapid growth recurrence, all have poor prognostic factors. Generally, regional lymphadenectomy is not recommended in cases of clinical node-negative disease, but only in cases of palpable nodes. In patients with advanced SCC, selective lymphadenectomy using preoperative radiolymphoscintigraphy and intraoperative vital dye injections to identify the sentinel lymph node, represents a safer option, which may help in staging cases and avoiding complications of the complete axillary node dissection. Current evidence does not promote the sentinel lymph node biopsy as routine use for low-risk tumours given the low rate of lymph node metastasis.[10]

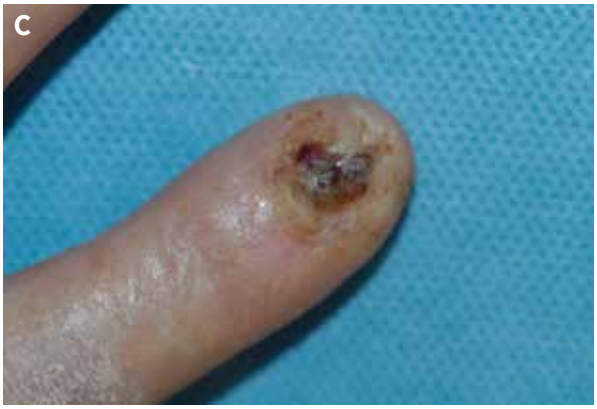
In frail and elderly patients who cannot undergo the operation, radiotherapy using the brachytherapy technique could be a well-established alternative in terms of local tumour control, cosmesis and hand function[7]. We operated on 124 patients with SCCs, diverse in clinical presentation, ranging from small erythematous plaques to huge polypoid tumours.

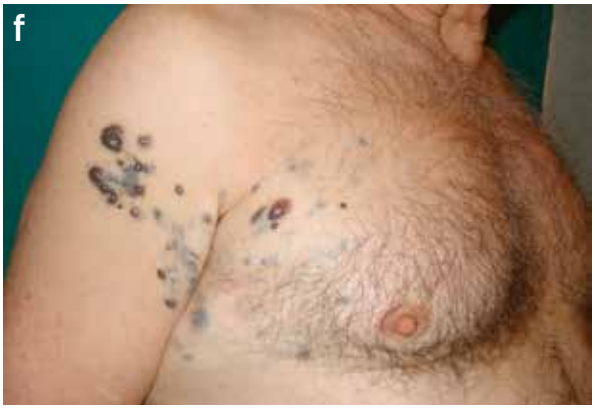
Melanoma

Melanoma is the skin cancer with the lowest incidence among the malignant tumours of the hand, but responsible for the majority of all skin cancer related deaths. Its incidence continues to rise, but it is partly due to increased awareness and screening. In the early stage of development, the tumour usually appears as a slow-growing pigmented lesion (melanoma in situ) (Figure 3a). The acral lentiginous melanoma, a rare type of melanoma arising on the oral mucosa, soles, and palms, can involve the nail unit; in particular the nail matrix (subungual melanoma), the nail plate (ungual melanoma) and the skin lateral to the nail plate (periungual melanoma). Subungual melanoma often starts as a pigment band visible along the length of the nail plate (melanonychia), which can escape early detection (Figure 3b). It becomes wider, more irregular in pigmentation, involving the adjacent nail fold, developing an ulcerated bleeding nodule, or causing nail dystrophy (Figure 3c). Correlation with ultraviolet exposure is not evident such for trunk or extremities; actually, trauma is more likely to play a role, accounting for the greater incidence in the thumb. The nodule's shape is often associated with the advanced stage, with vertical growth, invasion of subcutaneous tissue, and regional and distant metastasis (Figure 3d). The rate of metastasis increases with the Breslow thickness of the tumour. Other peculiar characteristic of the primary melanoma as prognostic factors in the staging system by the American Joint Committee on Cancer (AJCC)[11] is ulceration, which increases the risk of regional lymph nodes and distant metastases. Treatment consists of a full-thickness biopsy to confirm the diagnosis. The aim of the oncologic excision is to remove the entire primary lesion, thus, according to the histopathological and biochemical markers, to perform a wide surgical excision with peripheral margins established by the tumour's thickness. For melanomas in situ a margin of 5 mm is recommended; for lesions of up to 2 mm in thickness, an excision of 1 cm is proposed and 2 cm for tumours with a thickness greater than 2 mm[11]. All excisions must include the subcutaneous fat up to the muscular fascia to ensure the complete removal both of the tumour and sub-clinical malignant cells in the cutaneous lymphatics. The reconstruction depends on two main factors: location and size of the melanoma. For dorsal or volar aspect of the hand, wide excision with primary closure, or skin graft or local flap for larger defects, are common. For the fingers it is not possible to perform the excisions with large margins, especially for subungual lesions. In this case, to maintain function and cosmesis, minimal invasive approach as amputation at a level one joint proximal to the melanoma is recommended, in particular for invasive lesions (Figure 3e, f, g). Studies have demonstrated no differences in terms of survival and recurrence rate in case of radical amputation of the digit[12]. Treatment of invasive melanoma of the thumb seems further complicated. In case of a loss of its length, many reconstructive strategies were reported, including pollicisation, free toe to thumb transfer, reverse forearm flaps. Sentinel lymph node biopsy is a surgical diagnostic procedure indicated to detect micrometastasis at regional, clinically negative, lymph nodes, in patients with melanomas of 0.8 mm in thickness and larger or in melanomas < 0.8 mm in thickness with ulceration. Axillary lymphadenectomy should be performed in melanoma patients with palpable lymph nodes[11]. Localized in-transit disease should be removed surgically. Although surgery remains the primary treatment for melanoma, recent advances in adjuvant therapy may offer further survival benefits to patients with multiple in-transit metastases and distant metastases are best treated with systemic adjuvant therapy or isolated lymphatic perfusion. Among our 81 patients, the majority of malignant melanomas were stage T3 at initial presentation (25 cases) (2.01 to 4.00 mm thick), and average surgical margins were well below the minimum recommended for each T stage, based on the 2010 British Association of Dermatologists guidelines[13].









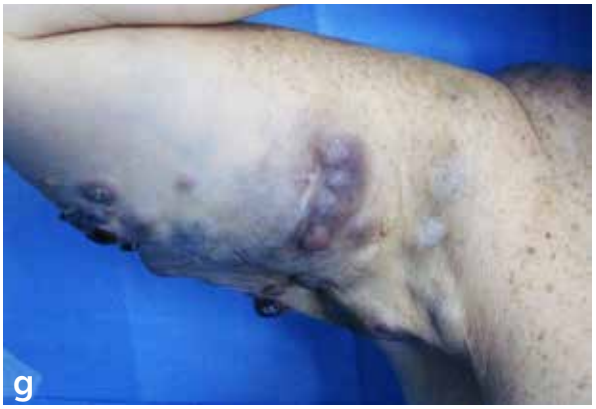


Figure 3a. Superficial spreading melanoma of the thumb, 6 months after caustic burn occurred dorsally at metacarpophalangeal joint
Figure 3b. Subungual melanoma with the typical melanonychia
Figure 3c. Subungual melanoma with related nail dystrophy
Figure 3d. Nodular melanoma with palpable axillary lymph nodes in a 74 year-old woman
Figure 3e. Amputation at the distal interphalangeal joint for a subungual melanoma
Figure 3f, g. Distant cutaneous metastases in a patient with a history of a subungual melanoma

CONCLUSION

Hand tumours are common entities and most of them are benign[14]. Familiarity with the most frequent lesions allows clinicians to accurately diagnose these disorders, but it is important to stay vigilant to avoid missing the rare malignant diseases. Some features can suggest the malignant nature of a lesion, including rapid growth, pain at rest, size greater than 5 cm, constitutional symptoms, and radiographic signs of invasion into local tissues[15]. Surgery with radical excision alone is the preferred strategy of treatment for malignant tumours, which can be accompanied by radiotherapy or chemotherapy on an adjuvant or neoadjuvant basis, depending on the particular tumour[15]. Conservative surgery in case of subungual melanoma demonstrates no significant differences in prognosis[12]. In our experience three patients died from distant metastases (two for melanoma, one for SCCs); thus, our disease-free survival rate is not statistically significant. Actually, according to the literature, patients with malignant tumours of the hand seem to survive more than those with musculoskeletal tumours arising in other parts of the body[15]. The reason is not entirely known. Probably the earlier appearance of symptoms because of the restricted anatomic area determines the diagnosis of the tumour in an earlier, more favourable stage that is associated with improved survival.

Disclosure

None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this manuscript. This work has not been commissioned or published elsewhere, except for congress abstracts and guidelines. All procedures performed in this study involving human participants were in accordance with ethical standards of the institutional and/or national research committee and with the Helsinki declaration and its later amendments or comparable ethical standards.

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ENHANCED RECOVERY PROTOCOL FOLLOWING AUTOLOGOUS FREE TISSUE BREAST RECONSTRUCTION

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SUMMARY

Background. Enhanced recovery after surgery (ERAS) aims to achieve earlier recovery, reduced hospital length of stay (LOS) and improved outcomes. Following the introduction of our ERAS protocol, we sought to review our ERAS experience. Our aims were to evaluate the LOS, post-operative complications, discharge analgesia, patient satisfaction and our ERAS protocol compared to the literature.
Methods. This was a retrospective review of all our prospectively managed database between January 2016 and December 2016. Patient demographics, LOS, discharge analgesia and complications were collected. Patient satisfaction was determined using a 10-point Likert scale questionnaire.
Results. A total of 70 patients underwent breast reconstruction using free deep inferior epigastric artery (DIEP) flaps. The mean age at surgery was 51 years (range 23–71). The mean LOS was 4.89 days (range 4–10). 61 patients (87%) were discharged within 5 days. 65 patients (93%) were discharged home on no controlled opioids. Major and minor complications were encountered in 3 patients (4%) and 5 (7%) patients respectively. There were no cases of complete or partial flap failure. 30-day patient satisfaction was high (>9/10) across all domains but patients complained of nausea & vomiting.
Conclusion. The adoption of our enhanced recovery protocol for autologous breast reconstruction has resulted in a mean LOS and opioid use reduction similar to contemporary literature. However, we have seen that there are further refinements that can be made to our ERAS protocol and there is still a need to develop a stronger evidence base to support our practices. This is in parallel with ongoing education and audit cycles to foster a culture of ERAS that can safely optimise patient outcomes.

KEYWORDS

Breast reconstruction, enhanced recovery, length of stay, free tissue flaps, mammoplasty

INTRODUCTION

Enhanced Recovery after Surgery (ERAS) is also known as fast-track surgery. It is based around the concept of taking a multidisciplinary approach towards pre-operative optimisation, with standardised protocols to minimise peri-operative variation and achieve the highest quality of post-operative rehabilitation [1–3]. ERAS was first pioneered in Denmark in the 1990s to optimize recovery after colorectal surgery [4–6]. This has since rapidly developed into a world-wide concept that is used across a number of surgical specialties from colorectal, orthopaedics, urology, vascular surgery to gynaecology [7–10]. Within the specialty of plastic surgery, free tissue breast reconstruction has emerged as an area where ERAS enhances the care and recovery of patients. The common objective endpoints use to demonstrate a successful ERAS pathways relate to inpatient post-operative opioid use, morbidity and hospital length of stay (LOS) [1,11–13].

After an audit of LOS following free deep inferior epigastric perforator (DIEP) breast reconstruction at North Bristol National Health Service (NHS) trust in 2014, it was quantified that the mean LOS for patients following surgery was 7 days; LOS was determined as the number of days from hospital admission to discharge home. Whilst this was similar to the literature[14], there were reports that ERAS principles were being implemented for breast reconstruction[15]. The senior author felt that further improvements could be made and the local ERAS protocol for breast reconstruction was formally introduced in February 2015.

The aims of this study are to: 1) evaluate our ERAS experience in comparison to that of contemporary literature, 2) evaluate the LOS, number and proportion of patients discharged without prescription of opioids, major and minor complication rates, and readmission rates, 3) evaluate the feedback of patients who were rehabilitated on the ERAS protocol.

MATERIALS AND METHODS

Study design

A retrospective review of the, prospectively maintained, Bristol free breast reconstruction database for patients treat-

Post-operative care of patients following free tissue transfer Breast Reconstruction Anti-embolisms stockings prescribed and in-situ preoperatively. Enoxaparin 40mg to be administered at 22:00 on the evening of surgery (administered to the thigh). Intermittent pneumatic calf compression to be used until patient is mobile. Soft sports bra should be available on admission. Decaffeinated tea and coffee for hospital stay only.						
	Day 0	**Day 1**	**Day 2**	**Day 3**	**Day 4** **Discharge home**	**Day 5** **Discharge home**
Flap observations	½ hourly	Hourly	2 hourly	4 hourly	4 hourly	4 hourly
Observations	½ hourly	Hourly	2 hourly	4 hourly	6 hourly	6 hourly
Urine output	0.5-1 ml/kg/hr	0.5-1 ml/kg/hr	TWOC			Stay only if not fully mobile or drains still in situ
Oxygen	Mask	Nasal specs	Wean	Stop		
IV fluids	Continue	Continue fluids only with instructions	Stop	Lines out		
Analgesia	Continue PCA, make sure patient is pain free	Stop PCA. Start oral analgesia	Oral analgesia	Oral analgesia	Oral analgesia	
Eat and drink	Drink freely. Reintroduce light diet within six hours post-surgery as tolerated	Encourage to eat and drink freely as tolerated.	Eat and drink freely. Check patient's bowel function.	Eat and drink freely. Prescribe laxatives if bowels not opened.	Eat and drink freely. Continue laxatives if bowels not opened.	
Mobilise	Bed Rest	Sit up 45-60 degrees after Consultant/Registrar review	Sit out and mobilise ASAP after Consultant/Registrar review	Mobilise	Stairs	
Bloods	Only if significant blood loss in theatre, otherwise book for next morning	Hb, U&E Transfuse if Hb <70*, Hb 70-100 start ferrous sulphate	Recheck Hb only if transfused			
Drains	Check hourly	Empty and record daily	Empty and record daily	Drain out if serous, less than 30mls/24hrs and fully mobile		

If Hb 70-100mg/dl, start ferrous sulphate 200mg three times daily for one month.
If Hb less than 70mg/dl, patient will need blood transfusion after discussion with consultant.

Table 1. The Enhanced recovery after surgery (ERAS) protocol for breast reconstruction implemented in February 2015. ASAP – As soon as possible, Hb – Haemoglobin, hr – hour, IV – Intravenous, kg – kilogram, ml – millilitres, PCA – Patient controlled analgesia, TDS – Three times daily, TWOC – Trial without urinary catheter, U&E – Urea & electrolytes

ed between January 2016 and December 2016 was undertaken. All consecutive patients were included for the analysis with no exclusions. All patients underwent immediate or delayed free DIEP reconstruction that was either unilateral or bilateral. Patients that had concurrent therapeutic or risk reducing mastectomies were also included in the analysis.

Enhanced Recovery Protocol

The North Bristol NHS Trust ERAS protocol was developed by a multidisciplinary team of anaesthetists, nursing staff, surgeons, physiotherapists and pharmacists. The protocol was implemented at Southmead Hospital in February 2015 to bring together the care provided across the different disciplines. Pre-operatively, patients were counselled of what to expect during their ERAS journey and they also met with post reconstruction free DIEP patients. The patients were expected to have a body mass index of 30kg/m^2 or less but they also had preoperative abdominal exercise classes with the aim to strengthen their core musculature in an effort to reduce the post-operative abdominal weakness. Computed tomography angiography (CTA) was undertaken to characterize patients' abdominal perforators; this also determined whether recurrent disease was present prior to surgery. The ERAS protocol standardised the care across multiple strands of nursing, surgical, physiotherapy, analgesia and nutritional care. Immediate post-operative analgesia was oxycodone administered through a patient controlled analgesic device (PCA). This was stepped down to oral analgesia within the first 24 hours following surgery. Regular flap monitoring was undertaken half hourly and then reduced in frequency to every four hours as the risk of flap failure subsided. Intravenous fluids were used intraoperatively and continued overnight but stopped on day 1 post operatively to encourage resumption of normal oral intake. The urine output was monitored to ensure normovolaemia; aiming for 0.5–1ml/kg/hr. Anti-emetics were prescribed, according to the anaesthetist's choice, to reduce opioid induced nausea and vomiting. Normal intake of food and fluids was commenced within 18 hours of surgery but also supplemented through the use of high energy and protein drinks. Sports bras were worn from the first post-operative day to support the reconstructed breasts. Mobilisation was actively encouraged day 2 post-operatively. Bowel movements and blood testing were also managed according to the ERAS protocol. When patients were ready, they were discharged to their own home. The protocol is attached in Table 1.

The surgical technique

Surgery was undertaken at a single centre by two reconstructive breast surgeons (EP and SMW). All patients underwent preoperative assessment with a full blood count, renal and liver function tests. On the day of surgery, the breast, chest wall and the locations of DIEP perforators were marked pre-operatively using a hand-held Doppler with reference to the pre-operative CTA. At induction, intravenous flucloxacillin or teicoplanin and gentamicin (for patients who were penicillin allergic) were administered. The non-operative areas of the patient were kept warm with forced air warming to maintain their core body temperature above 36°C. Breast reconstruction was undertaken using tissue harvested from a free DIEP flap. The superficial epigastric venous system was also routinely prepared for emergency use in the event of venous congestion[16]. The recipient vessels were the internal mammary artery and vein, after resection of a portion of cartilage from the third rib [17]. Both the artery and vein anastomoses were hand sewn end to end; no venous couplers were used. After DIEP inset, the remaining abdominal skin, fat, and fascia superficial to the external oblique were dissected to facilitate closure. A single-shot transverse abdominus plane (TAP) block was undertaken unguided for immediate post-operative analgesia. Sublay mesh (BARD Medical, Crawley United Kingdom) was inserted to reinforce the abdominal wall prior to closure of the abdomen in layers. Closed suction drains were placed prior with one in the breast and two in the abdominal wall. The post-operative ERAS recovery protocol was then implemented on release from theatre until discharge home.

Post discharge questionnaire

A patient satisfaction questionnaire was developed for patients to assess the quality and their satisfaction with the ERAS service. Prior to 'roll-out' the questions were analysed by the North Bristol NHS trust research team to ensure that there was no bias in wording. Patients were all aware preoperatively that a questionnaire of their experience would be sent between 30 to 60 days following discharge. This was to ensure capture of any post-operative complications. Patients were then given between 90 to 120 days following discharge to return completed questionnaires. The questions were scored on the Likert scale of 0 – 10 with 0 representing the worst possible care and 10 representing the best possible care. The questions were:

1. At your pre-assessment appointment did the information given by the nurse practitioner prepare you for your stay in hospital?

2. What was your experience of the care you receive on the ward?

3. On the day of your discharge did you feel ready to go home?

Non-return of questionnaires was deemed as not wishing to participate in the survey. All data from the database and returned questionnaires were collated and analysed using Microsoft Excel 2010.

RESULTS

A total of 70 patients underwent free DIEP reconstruction between January 2016 and December 2016. 28 patients underwent immediate reconstruction (40%) and 42 underwent delayed reconstruction (60%). Of these patients, three patients in the immediate group had bilateral risk reducing mastectomies with immediate reconstruction. Two patients in the delayed reconstruction group had previously undergone bilateral risk reducing mastectomies before deciding to have free DIEP reconstruction. 60 patients underwent unilateral free DIEP reconstruction (86%) and 10 patients underwent bilateral free DIEP reconstruction (14%); five of the bilateral reconstruction patients had risk reducing mastectomies. The mean and median ages at surgery were both 51 years (range of 23 to 71). No patients underwent any concurrent oophorectomies.

The mean LOS was 4.89 days with a median of 5 days (range 3–10 days). 61 patients (87%) were discharged within five days; 26 patients (37%) were discharged within 4 days. Nine patients (13%) were discharged after five days, with only two patients staying longer than seven days (3%). When the

	Q1.	Q2	Q3
Mean	9.2	9.1	9.5
Median	10	9.5	10
Range	6 to 10	5 to 10	7 to 10

Table 2. The scores awarded by patients following their ERAS breast reconstruction. Q1 - At your pre-assessment appointment did the information given by the nurse practitioner prepare you for your stay in hospital? Q2 - What was your experience with the care you receive on the ward? Q3 - On the day of your discharge did you feel ready to go home?

patients were stratified, the immediate group had a mean and median LOS of 5.21 and 5 days respectively; prolonged stays were due to abdominal haematoma, return to theatre and nausea/vomiting. The delayed group had a mean and median LOS of 4.67 and 4 days respectively; four patients had a prolonged stay due to nausea/vomiting, high drain output, pneumonia and postural hypotension. The unilateral group had a mean and median LOS of 4.93 and 5 days respectively. The bilateral group had a mean and median LOS of 5 days for both.

Sixty-five patients (93%) were discharged home on either: no medication, 'over the counter' analgesia or the patient's own regular analgesia that they were taking preoperatively. Only six patients (8.5%) were discharged home on short a one-week course of paracetamol and the prescription opioid tramadol; three in the immediate group (11%) and three in the delayed group (7%). Of the patients that had a prolonged stay, none required prescription opioid on discharge.

Major complications were encountered in three patients (4%); two of the patients were from the immediate group and one was from the delayed group. Two patients returned to theatre for re-exploration of the DIEP flap; one each from the immediate and delayed groups. Of these two patients, one required a cephalic turndown for venous congestion and the other required the successful salvage of the arterial anastomosis. The third patient developed an abdominal haematoma requiring evacuation. There were no cases of complete or partial flap failure during the study period. One death occurred four months following discharge, due to acute progression of metastatic disease that was not detected at the time of the CT scan; this was not a complication of surgery or ERAS protocol.

Minor complications were encountered in five cases (7%); two within the immediate group (7%) and three within the delayed group (7%). Two patients (one each from the immediate and delayed groups) required blood transfusions. One patient, in the delayed group, developed a post-operative chest infection requiring a course of antibiotics. Two patients, one each from the immediate and delayed groups, had wound infections requiring treatment with antibiotics.

There were 69 questionnaires sent out; 1 questionnaire was not sent out due to death from disease progression. There were 34 returns, giving a 49% response rate. The results in Table 2 indicated that the responding patients were very satisfied with their care with mean and median scores greater than 9 out of 10 for all three domains.

The patients were very satisfied with the preoperative counselling particularly the opportunities to meet other patients who underwent ERAS and also to undertake abdominal exercise classes. Patients were very satisfied with the quality of inpatient care but nausea, vomiting, and constipation were common problems. Comments relating to discharge included many positive comments of patients feeling ready to go home and discharge running like clockwork. However, one patient mentioned feeling inadequate when they did not reach ERAS milestones.

DISCUSSION

At the turn of the last decade, the LOS following free breast reconstruction for the majority of patients was reported to range around 7 days [14,18,19] and uptake of ERAS principles within the field of Plastic Surgery was previously felt to be slow[1]. Since then, there has been a rapid boom in the adoption of ERAS for breast reconstruction across a range of techniques including: implant based [20], pedicled flaps [12,15], and free autologous flaps [1,11,13,21–23]. In 2014 we felt that our previously LOS was prolonged at seven days, this led to the implementation of our local ERAS protocol to successfully reduce the mean LOS to 4.89 days. This is broadly similar to other studies with a mean LOS ranging between 3.9–6.2 days [11,13,21,23] and our median LOS of 5 days is consistent with that of current UK practice[24]. Whilst we encountered two cases of unplanned return to theatre, for venous and arterial failure, there were no cases of partial or total flap failure. This is credit to the monitoring protocol and staff diligence in detecting and facilitating salvage of the free DIEP reconstructions. Our 2.8% rate of unplanned return to theatre were lower than other studies that had rates of between 5–10% [1,13,25]. Flap failure was lower than other studies which had combined total and partial flap failure rates of between 2–5.8% [1,11,13,25]. We had one case (1.4%) of haematoma at the abdominal donor site which was similar to the 1.4–2.2 % reported by others [11,25]. Pneumonia was seen in one of our patients (1.4%) and this was also similar to Bonde et al [11]. We had a low readmission rate with only one patient (1.4%) returning to their local hospital for treatment,; this is at the lower end of the range compared to other studies that had a 2–14% readmission rate [1,13]. The low rates of complications confirm the safety of our surgical and ERAS protocol.

As pain is a predictor of the quality of post-operative recovery and patient satisfaction [26], the low rates of our patients requiring prescription opioid analgesia on discharge (7%) reinforce the benefits of successful ERAS implementation. Analgesia on discharge is possibly a good indicator of whether patients are ready for discharge. The effects of successful ERAS implementation have been reported to continue into the outpatient setting with lower median total opioid use and potentially reducing opioid misuse[30]. Particularly as evidence indicates that patients discharged with prescription opioids were more likely to become long term users compared to those with no opioid prescriptions [27–29]

Our mailed questionnaire response rates of 49% was considered adequate [31] and the responses communicated very good overall satisfaction of care. Whilst the questionnaires raised many positive comments, they also highlighted improvements that could be made to our ERAS protocol. The common theme raised was the issue of early postoperative opioid induced nausea and vomiting. On comparison of our protocol to those with shorter lengths of stay, the key contributing factor is likely our ongoing use of PCA compared

the omission of PCA usage in other studies[11,23,32]. Some have felt that opioid use delays recovery and is a major obstacle to early discharge[32], this is an aspect that we will seek to review in future refinements of our protocol; though we are mindful that PCA usage is established in the UK with 63% of anaesthetists prescribing PCA for free autologous breast reconstruction[24]. The Transversus Abdominis Plane (TAP) block has been used to augment the multi-modal analgesia of patients with reports of lower morphine usage, less nausea & vomiting and thus a shorter LOS[18,23,32]. Some authors have used liposomal bupivacaine[1,32], due to the reported prolonged release over 96 hours and benefits up to 72 hours post-operatively[32]. Though the clinical effects of non-liposomal bupivacaine have been felt to be equivalent to liposomal bupivacaine [23]; particularly if administered with dexamethasone[22]. Despite numerous reports, a Cochrane library systematic review indicated that there was limited evidence that use of perioperative TAP block reduces opioid consumption and pain scores after abdominal surgery compared with no intervention or placebo[33]. Within the setting of nausea, vomiting and sedation there was insufficient evidence that TAP blocks led to a difference[34]; we also did not observe such effects following TAP blocks.

The rapid uptake of ERAS principles has led to a wealth of studies that are highly variable in their parameters leading many to question whether the parameters are based on evidence or expert opinion [23,24]. Whilst the co-authors of Astanehe were involved in drafting the evidence based ERAS society recommendations, it is worth noting that even they were not able to fully apply all aspects of the ERAS society recommendations; meeting 11 out of the 18 criteria [23,35]; we managed to meet 10 of the criteria. A recent survey of UK breast reconstruction practice has also demonstrated wide variability in clinical practice across hospitals and even within hospitals[24]. Part of the reason behind the clinical variability may arise from conflicting evidence within the literature. For general anaesthesia, total intravenous anaesthesia has been recommended but others have recommended sevoflurane as it may have protective effects on the endothelium and vasculature[24,35,36]. Another aspect, that has been exemplified earlier by TAP blocks, is the absence of high-quality evidence[24]. The majority of the ERAS society recommendations were based on moderate evidence with only three aspects (body mass index <30, multi-modal analgesia and direct closure using sutures) being based on high quality evidence[35]. Another aspect of the variance is related to the compliance and whether outcomes are actually attributable to ERAS[9], from the literature only three studies quantified compliance rates[25,30,37]. Redwood et al saw overall compliance rates of 57%[37]. Sharif-Askey et al saw the highest compliance with the pre- and intra-operative aspects at 94% for pre-operative counselling, 90% for operative carbohydrate drink, 100% and 99% for pre-and intra-operative pain management respectively. Post-operatively this fell dramatically down to 44% for cessation of intravenous fluids and 68% for starting early oral fluid intake; though post-operative compliance of less than 50% is not uncommon [38-40]. Rendon et al also reported high compliance rates of 93% pre-op, 91% intra-op, 96% post-op but it was unclear if partial fulfilment of the parameters counted as 'compliance'[30].

The barriers to ERAS implementation are multi-faceted, as ERAS is multi-disciplinary it requires engagement from all team members to fulfil all aspects from pre-admission through to post-discharge care[38]. Whilst deviation by patient or surgeon preference only contributed to 2% of non-compliance for Redwood et al, 10% of the non-compliance were from errors in ordering or executing the pathway. Resistance or dis-engagement with ERAS parameters needs to be settled before implementation, with all members of the team educated in its application to ensure a positive culture exists to facilitate ERAS implementation [38,41]. Recent work by Pearsall et al distilled common enablers such as open communication, changing nursing culture, maintaining the ERAS protocol through continuing education of patients, new staff and existing staff [41]. As ERAS protocols become embedded within the culture of the hospital, we can better asses their true effects once an acceptable level compliance becomes the norm.

As we all strive to further optimise our ERAS protocols and achieve ever shorter LOS, is there a limit to what can be achieved? Once the analgesic, mobilisation, dietary and drain factors are accounted for, the remaining critical aspect is monitoring of the free flap. We monitor flaps with decreasing frequency until discharge, but some authors argue that the monitoring can be much shortened. For Astanehe et al and Carruthers et al, all cases of microvascular problems were encountered within the first 24hrs[23,42] and Bonde et al stopped flap monitoring after 48hrs[11]. A limited cohort of free autologous reconstructions have been discharged within 23 hours of admission by Martinez et al [43]. Whilst Martinez et al previously encountered late vascular compromise after three days, they instituted changes such as anticoagulation and elective anastomosis of the superficial epigastric venous system to ensure robust reconstructions[43]. We recognise our study limitations such as the retrospective nature and absence of pre-ERAs group to compare outcomes and the uncertainty of compliance rates. Despite this, we feel that the best comparison is against current literature. Our study has highlighted multiple areas to critically self-appraise and optimise particularly in the area of multi-modal analgesia and nausea. These themes are relevant to all clinicians involved in free autologous breast reconstruction and we are optimistic that future research can address the issues of underpowered studies to unify the variation that exists across ERAS protocols.

CONCLUSION

Our ERAS protocol for autologous free tissue breast reconstruction has seen lower complication rates, shorter lengths of stay and low rates of opioid analgesics prescribed at discharge. ERAS is being embraced globally and there are many who continue to push the possibilities of what can be achieved. However, we have seen that there is still a need to develop a stronger evidence base to support our practices. This is in parallel with ongoing education and audit cycles to foster a culture of ERAS that can safely optimise patient outcomes.

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tool. The procedures used, comply with the principles of the Helsinki Declaration.

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RED BREAST SYNDROME (RBS) ASSOCIATED TO THE USE OF POLYGLYCOILIC MESH IN BREAST RECONSTRUCTION. CASE REPORT

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SUMMARY

Some patients undergoing breast reconstruction with acellular dermal matrices (ADMs) develop postoperative erythema overlying their ADM grafts named red breast syndrome (RBS). To the best of our knowledge this entity has never been related to the use of a synthetic mesh.
We present a case of a 61-year-old patient who underwent bilateral nipple-sparing prophylactic mastectomy because of BRCA-1 gene mutation. The patient was reconstructed with a direct-to-implant approach, and the implants were covered with a polyglycolic acid mesh. Twenty days after the reconstruction, she presented with a blanching erythema of both reconstructed breasts without signs of infection on the area covered by the mesh. The patient denied symptoms like fever or tenderness and presented with no clinical signs of infection. Her laboratory tests were within normal range. We decided to watch and wait. The patient continued strict controls in the outpatient setting. Gradually, the erythema begun to disappear and it resolved spontaneously.
RBS has only been described with the use of ADMs, but since in this case the mesh was made of polyglycolic acid, we suggest RBS should be considered either with the use of biological or synthetic meshes. The importance of its differential diagnosis resides in distinguishing it from an infection.

KEYWORDS

Red breast syndrome; breast reconstruction; polyglycolic acid mesh; polyglactin mesh; mastectomy; breast cancer

INTRODUCTION

Some patients undergoing implant-based breast reconstruction (IBBR) with acellular dermal matrices (ADMs) develop a postoperative erythema overlying their ADM grafts named red breast syndrome (RBS). The entity was first described in 2010 in a correspondence between Nahabedian[1] and Newman et al.[2]. RBS is characterized by a blanching erythema, which is non-infectious and self-limited, and it is alleged to be due to an immunological response to the ADM (either related to the sterilization process, process of eliminating immunogens from the cadaveric dermis, or other) and its incorporation to the surrounding tissue. The incidence of RBS is yet unknown, and the long-term sequelae of RBS remain to be seen[3].

To the best of our knowledge, this entity has never been related to the use of a synthetic mesh. Herein we report the first case in the medical literature of RBS associated to the use of a polyglycolic acid mesh.

CASE REPORT

We present a 61-year-old patient, with a *BRCA-1* gene mutation diagnosed after her sister's breast cancer diagno-

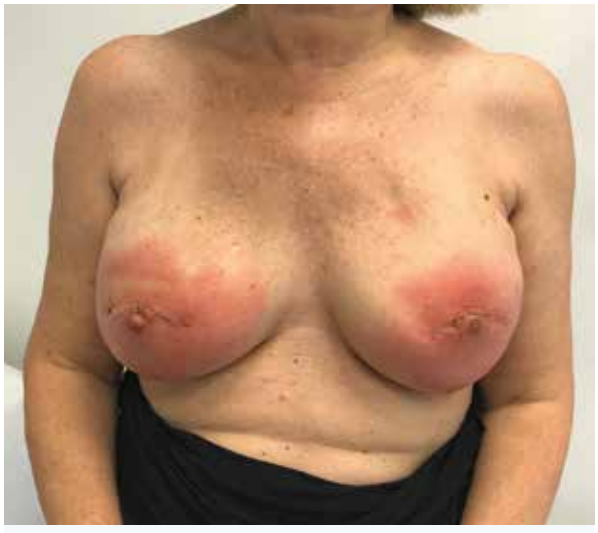

Figure 1. Patient at postoperative day no. 25. Both breasts presenting with blanching erythema and no other clinical signs of infection

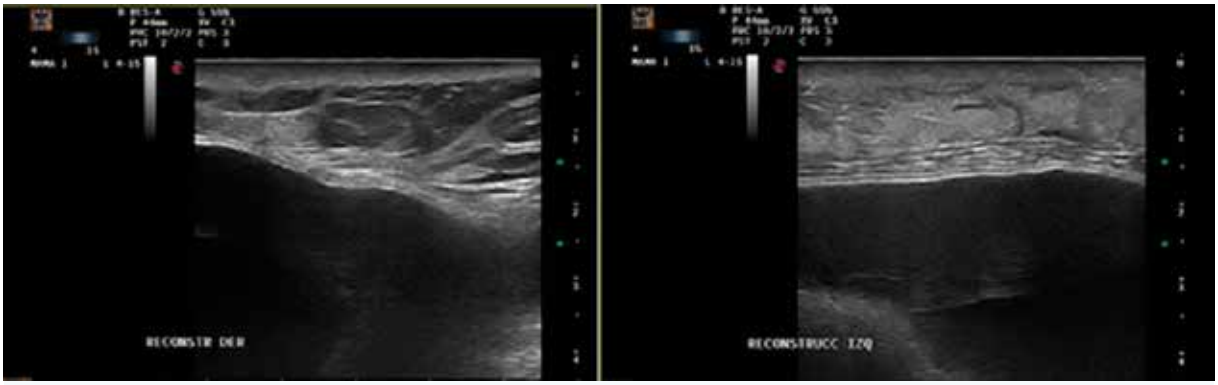

Figure 2. Ultrasound images showing no evidence of seroma or abscess on the right and left sides

sis. She underwent a prophylactic bilateral nipple-sparing mastectomy reconstructed with 390cc Mentor® anatomical textured implants (Mentor Corp., Leyden, the Netherlands) placed in submuscular position with the aid of a polyglycolic acid mesh (Safil® Mesh, Braun Surgical, Barcelona, Spain).

The patient received an intramuscular deposit steroid injection prior to leaving the hospital, 24 hours after the procedure. She also received perioperative IV antibiotics, and oral antibiotics (cephalexin 1g twice daily) were continued until drain removal on the 7th postoperative day when the daily output was less than 30 cc. Twenty days after the procedure, the patient developed a right-sided blanching erythema starting at the inframammary fold (IMF) which extended towards the nipple areola complex (NAC). Three days later she developed an erythema on her left breast that followed the same pattern starting at the IMF and rapidly progressing towards the NAC (Figure 1). The patient denied having fever or sweats, she had no pain or tenderness on either breast. Laboratory tests showed normal white blood cell count (7386/mm^3) and the ultrasound revealed no fluid collections (Figure 2).

Given the fact that the patient presented with no clinical signs of infection, normal white blood cell count and an ultrasound negative for collections we decided to watch and wait. The compromise of both breasts and the pattern of the erythema also was suggestive of an allergic reaction to the synthetic mesh. The patient continued strict controls in the outpatient setting. Gradually the erythema begun to disappear and resolved spontaneously. (Figure 3.)

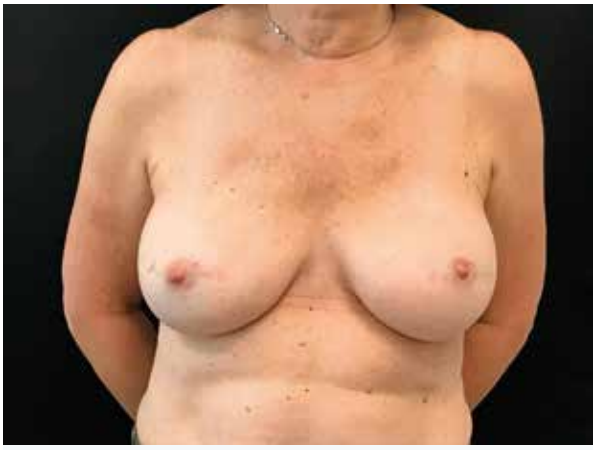

Figure 3. Resolution of the erythema with no sequelae

DISCUSSION

RBS, as a clinical entity, is characterized by erythema and the absence of infectious manifestations such as fever, tenderness or pain, increased local temperature, abscess or response to antibiotics. The erythema appears days to weeks after the reconstruction using ADM, located over the areas where the ADM has been placed (generally involving the lower pole of the breast). It blanches with pressure and resolves spontaneously without intervention. This reaction is supposed to be immunologic in origin, due to the sterilization method or the presence of biological antigens in the ADM[3]. Neither of these factors are usually present in a polyglycolic acid mesh, which might explain the absence of related reports to a synthetic mesh so far.

ADMs work as biocompatible scaffolds for cellular ingrowth that allows its incorporation to the surrounding tissue providing more elasticity to the tissue. ADMs were introduced in 1995 for treatment of full thickness burn injuries[4] and were first used by Breuing and Warren in 2005 to reestablish the continuity of the pectoralis major in IBBR and reduce rippling[5]. ADMs are used to provide load support and improve the aesthetic result by pulling the muscle down to cover the incision, allowing for effective lower pole expansion and achieving a better definition of the IMF[6]. Other meshes, both biological and synthetic, have been also used for IBBR with similar purposes[7,8,9,10]. In Argentina and many other countries, given the high cost of ADMs, synthetic meshes are often used, being a popular alternative in IBBR[11,12]. Polyglycolic meshes were first described for breast reconstructive purposes by the first author in 2007[13,14]. Since then, we have used this absorbable mesh in more than 800 patients.

After revision of the available literature, we have not found a description of RBS associated with any synthetic mesh. This case in point, the mesh we used was Safil® mesh which is a polyglycolic acid mesh, when we generally use polyglactin 910 Vicryl® knitted mesh (Ethicon, Sommerville, NJ, USA) suggesting that there is a difference between those

two brands despite it being the similar type of thread. We conjecture that this mesh may have a different immune response in the body, the same way aseptic ADMs have been shown to have more incidence of RBS than sterile ADMs[15].

Even though, in the case presented, no antibiotics were used due to the clear absence of infectious manifestations, the risk of not treating a true infection in the breast outweighs the morbidity of unnecessary use of antibiotics, thus the recommendation is still empiric antibiotic coverage if there is any clinical doubt[3].

To date, the diagnosis of RBS remains a diagnosis of exclusion, and further casuistry of RBS associated to polyglycolic meshes is needed to determine its link. RBS is considered an idiopathic erythema and the exact etiology remains unknown. Ganske et al have studied the origin of RBS through punch biopsies demonstrating eosinophilic infiltration as seen in delayed-type (type IV) allergic reactions and showed a response to steroids and chemotherapy[16]. These facts may suggest an immune response to the presence of the mesh.

Our patient received intramuscular steroids prior to hospital discharge, this possibly influenced the timing of the erythema to 20 days after the procedure. However, we did not treat the RBS with steroids at time of appearance of the erythema. If there is any doubt of infection, steroids would exacerbate the condition.

In conclusion, to the best of our knowledge, this is the first case of RBS associated to the use of a polyglycolic mesh in IBBR. New cases that may arise are awaited to aid in the investigation of probable causes and to determine the best treatment.

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Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.
Informed consent: The patient gave her informed consent in writing prior to inclusion in the study.

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ACCIDENTAL FINDING OF SYNCHRONOUS BILATERAL DUCTAL CARCINOMA IN SITU IN A YOUNG MAN REFERRED TO MASTECTOMY DUE TO GYNEKOMASTIA – AND WHAT IF LIPOSUCTION HAVE BEEN USED? CASE REPORT

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SUMMARY

Breast male cancer is a rare condition. We report a case of a synchronous bilateral ductal carcinoma in situ (DCIS) which developed in a 26-year-old man with long-standing gynecomastia. He underwent bilateral subcutaneous mastectomy. Histology revealed bilateral pure DCIS. There was no identifiable causative factor for the development of bilateral DCIS, and there was no family history of the disease. No other treatment was required, and after 18 months there were no signs of local recurrence. This case highlights the importance of staying vigilant regarding the presence of malignancy in normally benign conditions. Liposuction has become a very useful technique for gynecomastia correction, however, there is a risk of dissemination of an unknown malignant tumor. In atypical cases, en bloc surgical excision should be performed.

KEYWORDS

Bilateral ductal carcinoma in situ; breast; gynecomastia; liposuction; mastectomy

INTRODUCTION

Breast cancer in males is a rare condition with an incidence of 0.5–0.7% of all cases of breast carcinoma.[1-3] Approximately 5% (range 2.3–17%) of male breast cancer (MBC) cases are ductal carcinomas in situ (DCIS). Presenting symptoms are similar to female tumors, and the two most characteristic clinical symptoms include a slowly growing subareolar mass and nipple discharge.[3] The origin of the majority of female DCIS is the terminal duct lobular unit (TDLU).[1,4] However, the male breast lacks this anatomical structure. Hittmair showed that low grade forms of DCIS do not require the TDLU as site of origin.[4] Therefore, DCIS in males is likely to arise from the epithelium of larger ducts.[4,5] The vast majority of male breast cancers are invasive ductal carcinomas. Invasive lobular carcinoma is rare (1%), presumably due to the lack of lobular development in the male breast.[3]

The most prevalent risk factor for male breast cancer is related with higher age and most have been attributed to testicular malfunction and increased estrogen.[1,2] Other proposed risk factors include family history, breast cancer genes mutations (BRCA2 > BRCA1), Cowden and Klinefelter syndromes, alcohol consumption, and liver disease.

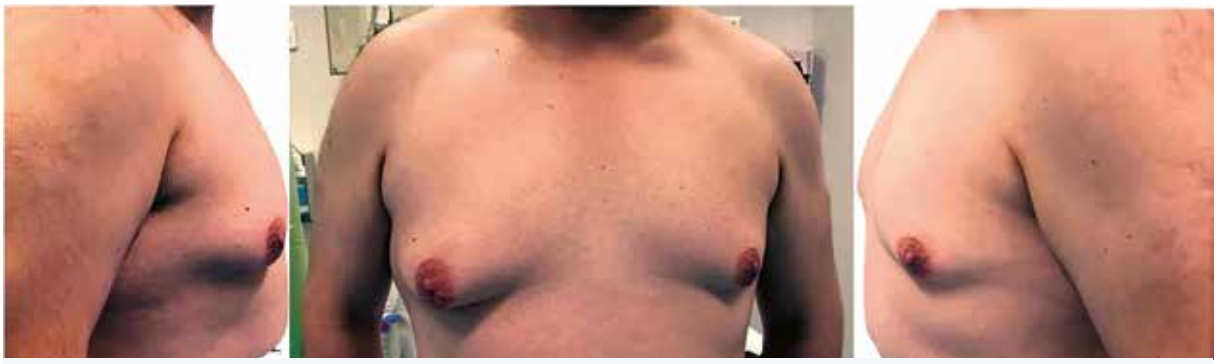

Figure 1. Preoperative: Bilateral asymptomatic gynecomastia

Gynecomastia, defined as excessive breast tissue development, is a common condition in male adolescents. There is no proven direct link between gynecomastia and male breast cancer.[2] Association between gynecomastia and DCIS has rarely been reported in adults and very few cases have been described in teenagers.[1-3] Here we report a case of a bilateral DCIS, accidentally found in a 26-year-old obese man treated for gynecomastia.

CASE REPORT

A 26-year-old man presented with a long-standing stable bilateral gynecomastia. He was a smoker (half a pack per day) and had a history of morbid obesity. He was advised to lose weight and stop smoking, and his weight was reduced by 20 kg to 85 kg (body mass index 29.2), but despite the loss of weight, bilateral gynecomastia had become more prominent. There was no family history of cancer. Physical examination revealed asymmetrical bilateral breast growth (right breast being larger – Figure 1), consisting of adipose tissue associated to glandular tissue under the areola, without palpable masses. Testicular ultrasound was normal. Sex hormones, thyroid and hepatic functions were also normal. Breast ultrasound showed bilateral breast enlargement without nodules or suspicious lesions. No axillary, supraclavicular, or cervical lymphadenopathy were clinically obvious. He had fully developed secondary sexual characteristics, including normal-size and descended testicles.

Because of the psychosocial impact on his quality of life, he underwent bilateral subcutaneous mastectomy and simultaneous mastopexy by a circumareolar incision. No concomitant liposuction was used. Two suction drains were placed (each for side) and they were removed after 24 hours. The postoperative period was uneventful. Macroscopic examination showed central fibrosis surrounded by adipose tissue. Histologic examination revealed multifocal intraductal proliferation with a solid cribriform pattern and calcification, without necrosis, accounting for a low-grade intraductal breast carcinoma. After DCIS detection, total evaluation of the specimen was done to rule out invasive cancer. DCIS was present in 30 of 111 examined fragments at the right breast, and in 26 of 71 fragments at the left breast. The luminal cells were diffuse and strongly positive for estrogen receptor. CK 5 and P63 were positive only in the myoepithelial cells surrounding the ducts (Figure 2). Resection margins were histologically tumor free.

The case was discussed at our institution's tumor board meeting. Close surveillance and follow-up every 6 months were recommended with physical examination and chest x-ray, and genetic counseling. No adjuvant treatment was needed. Peripheral blood karyotype was normal, ruling out Klinefelter syndrome. A complete analysis of BRCA-1 and BRCA-2 genes showed no mutation, and there was no P53 or PTEN mutation. However, a rare variant in the ATM gene was detected – ATM c.1229T>C (p.Val410Ala).

He remains well and under regular follow up, with no evidence of recurrent disease at 18 months follow-up (Figure 3).

DISCUSSION

There is no proven link between gynecomastia and cancer.[2] Indeed, pubertal gynecomastia is considered to be a phase of normal development and spontaneously regresses in teenagers within 1–2 years. Although not evident in our

Figure 2. Histology. Low-grade DCIS, cribriform, H&E staining. Note the presence of a duct filled by cells with the characteristics of low--grade DCIS next to a normal duct. Absence of necrosis and mitosis, H&E staining.
Low-grade DCIS. Uniform staining of neoplastic cells for estrogen receptors.
Low-grade DCIS. Myoepithelial cells positive for cytokeratin 5 Note negativity for this marker inside the duct.
Low-grade DCIS. Myoepithelial cells positive for P63

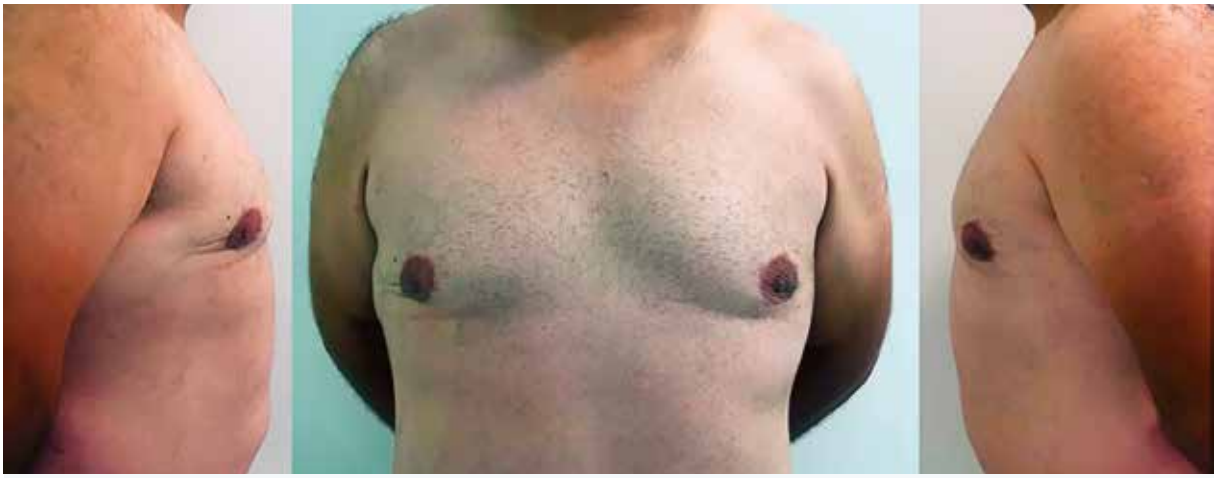

Figure 3. Postoperative result after 1 year

patient, risk factors for the development of DCIS include hyperprolactinemia [1] and exogenous estrogens.

Genetic risk factors include a family history of breast cancer, BRCA-2 mutation, and Klinefelter syndrome, whereas Cowden and Li-Fraumeni syndromes have not been associated with MBC.[2] Our patient's genomic and karyotypic thorough analysis was negative for any genetic contribution, despite detection of a rare variant in the ATM gene, which has a conflicting interpretation of pathogenicity.[6] Some studies indicated that there is a significant prevalence of ATM mutations in breast and ovarian cancer families suggesting increased susceptibility to breast cancer of ATM mutations.[7]

Obesity is a risk factor for adult male breast cancer, doubling the risk of an individual to develop MBC. [2] In our patient, obesity could have contributed to the development of gynecomastia. Indeed, in overweight teenage boys, an increased conversion of testosterone to estrogen within the peripheral adipose tissue could be involved in its development (androgens are aromatized to estradiole and androstenedione to estrone). This could have exacerbated the already existing estrogen excess and, therefore, his predisposition to breast cancer.

The management of male patients with DCIS has not been extensively studied; therefore, no firm guidelines for treatment exist, but the recommended treatment in the literature is modified radical mastectomy without axillary dissection.[1,2,5] Because the majority of these lesions are subareolar, nipple excision may be required. Radiation therapy, tamoxifen, or chemotherapy are not required in men after total mastectomy for DCIS.

Senger et al [8] performed a review of 452 patients that included two cases of pseudogynecomastia (0.4%), in addition to a literature review where a total of 15 incidental findings were identified: ductal carcinoma in situ (12 cases), atypical ductal hyperplasia (two cases) and infiltrating ductal carcinoma (one case). Because no significant pathological findings were detected in a cohort of 452 cases with 2178 slides, and because of associated costs on routine histopathological tissue examinations, he proposed that not all tissue samples obtained by mastectomy for gynecomastia necessitate histopathological evaluation. The decision to proceed to histopathological evaluation should include major and minor risk factor assessments, such as evidence of Klinefelter syndrome, a pathological process with an acute onset or rapid progression, a palpable irregular mass, bloody nipple discharge or other clinical presentations that have been reported to be associated with malignant or premalignant lesions, such as retroareolar pain and swelling. Given the rarity, guidelines for MBC screening by mammogram and/or magnetic resonance imaging are ill-defined.

Qureshi et al [5] suggested that in the preoperative planning of gynecomastia surgery for breast diameters >6 cm, though effective, excisional techniques subject patients to large, visible scars.

In addition, ultrasound-assisted liposuction has emerged as a safe and effective method for the treatment of gynecomastia with minimal external scarring. Ultrasound-assisted liposuction has several advantages over suction-assisted lipectomy in the treatment of gynecomastia, including the selective emulsification of fat leaving higher density structures, such as fibroconnective tissue, relatively undamaged. At higher energy settings, ultrasound-assisted liposuction is effective in removal of the denser, fibrotic parenchymal tissue that suction-assisted lipectomy is inefficient in removing. It also affects the dermis, allowing for skin retraction in the postoperative healing period, and reduces physical demand for large-volume liposuction, allowing the surgeon improved attention to precise contouring.

However, liposuction without histopathological evaluation of the liposuctioned tissue may be problematic. Voulliaume [9] reported two patients with an unusual complication: the liposuction of a malignant tumor. In one patient, liposuction was used for gynecomastia correction, which was in fact a breast cancer. Three years after liposuction, the patient developed an invasive and infiltrative cancer, with metastatic axillary lymph nodes, and pectoralis muscle invasion just above the clavicle. The second patient was treated by liposuction for an ankle "lipoma", but it proved to be a liposarcoma after recurrence with deep invasion (internal malleolus and Achilles tendon), requiring enlarged resection and flap coverage. He advocated that in order to avoid liposuction and dissemination of a malignant tumor, preoperative investigations have to search clinical peculiarities evoking the diagnosis. An unilateral "gynecomastia",

irregular, hard or painless mass, patients with > 40-years, family history of breast cancer, must incite the surgeon to perform a classical excision, just as a recurrent "lipoma", deeply located, voluminous or rapidly growing, situated on the limbs or in the humeroscapular area. Doubtful cases must be rejected for liposuction, and treated by a surgical excision with strict safety margins and complete anatomopathologic examination of the lesion.

In our case, fortunately we decided to perform bilateral mastectomy and after diagnosis of bilateral ductal carcinoma no other treatment was required.

Liposuction has become a very useful technique for gynecomasty correction, however, the risk of dissemination of an unknown malignant tumor should be present. In atypical cases, surgical excision should be performed.

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

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Conflict of interest: All named authors hereby declare that they have no conflicts of interest to disclose.

Author Contribution: Study design: Ricardo Horta; Data acquisition: Ricardo Horta, Fernando Schmitt, Helena Gervásio; Data analysis and interpretation: Ricardo Horta, Nuno Pereira; Manuscript preparation: Ricardo Horta, Nuno Pereira; Manuscript editing: Ricardo Horta; Manuscript review: Ricardo Horta, Fernando Schmitt, Helena Gervásio.

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SKIN SUBSTITUTES IN RECONSTRUCTION SURGERY: THE PRESENT AND FUTURE PERSPECTIVES¨

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SUMMARY

The progress in critical and intensive care burn management in the 21st century has significantly reduced mortality in patients with critical burn injuries. This progress has moved the focus of burns care from simple survival to the quality of life after the burn trauma, in particular to healing of defects caused by full-thickness burns, subsequent maturation, characteristics and appearance of the scars. The benefits of the application of skin substitutes include elimination of excessive scarring, hypertrophic and keloid scar formation and subsequent contracture development. The authors of this article present the strategy of use, application and development of dermal scaffolds as well as the current trends in the use of dermal scaffolds in the treatment of full-thickness burns.

KEYWORDS

Dermal scaffold; hypertrophic scar; acellular dermis; dermal defect

INTRODUCTION

The progress in critical and intensive care in the field of burn management in the 21st century has significantly reduced mortality in patients with critical burn injuries. This progress has shifted the focus of burn care from simple survival to the quality of life after the burn trauma, in particular to healing of defects caused by full-thickness burns, subsequent maturation, characteristics and appearance of the scars. The application of autologous skin grafts in case of skin loss injuries is a well-established method of defect healing, it is however not entirely satisfactory where the subsequent scar properties are concerned. A simple application of skin grafts cannot fully replace the lost skin. The aim of the development of skin substitutes is substitution of the dermis responsible for mechanical elasticity and pliability. The benefits of application of skin substitutes include elimination of excessive scarring, hypertrophic and keloid scars formation and resulting contractures, representing up to 67 % of morbidity in surviving patients after a critical injury[1]. Formation of aesthetically and functionally inferior scars leads to functional as well as psychological and social consequences limiting the patient's quality of life after a burn injury.

Skin substitutes are three-dimensional biomatrices designed to mimic the dermis. In principle, they are scaffolds demonstrably improving and directing the healing of acute defects caused by full-thickness burns, they also optimise the properties of the resulting scar including its flexibility and elasticity[2,3,4].

EVALUATION OF THE TOPIC

Dermal (or skin) substitutes are designed to mimic the properties of the extracellular matrix, allowing the formation of neodermis through gradual cellularization. Subsequently, it assumes the role of the skin in restoration of anatomical and physiological functions. The properties of the dermal matrix reduce the duration of the defect healing, contractility, elasticity of the resulting scar, as well as the formation of hypertrophic and keloid scars[5]. Biocompatibility of the dermal scaffold depends on its acceptance by and integration into the surrounding tissues, immunocompatibility, and biodegradation. The biocompatibility clinically demonstrates as capillary growth into the scaffold and subsequent fibroblast infiltration and collagen production resulting in the formation of neodermis[6]. The proliferation of capillaries into the scaffold depends, among others, on its pore size. Although the scaffold is termed "permanent", the resulting structure of the neodermis is in effect determined by the invading cellular colonies of fibroblasts and collagen. A controlled gradual biodegradation of the dermal scaffold resulting in formation of non-toxic low-molecular weight metabolites without any inflammatory reaction or foreign body reaction is desirable[7]. The susceptibility of the dermal scaffold to vascularisation is its crucial characteristic, given both by the aforementioned pore size and by the used material. The speed of vascularisation determines also the speed of the subsequent application of the autologous dermal-epidermal graft on the new epidermis, which can be either

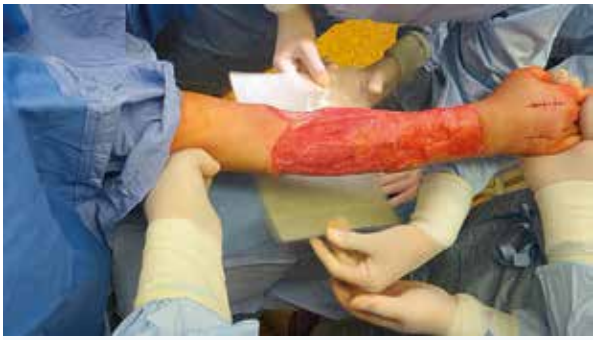

Figure 1. The process of Integra® application in a full-thickness burn on the forearm

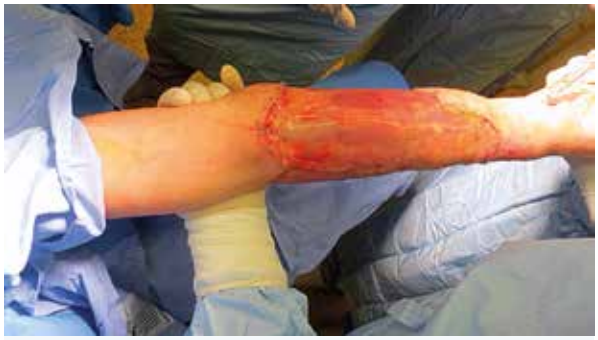

Figure 2. Integra® fixation using titanium clips

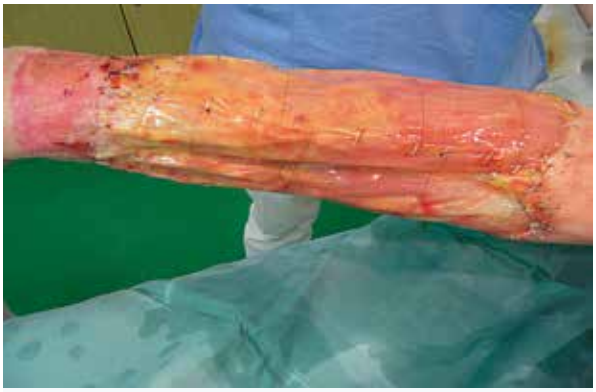

Figure 3. One month after Integra® application; changes of colour resulting from neovascularisation can be observed

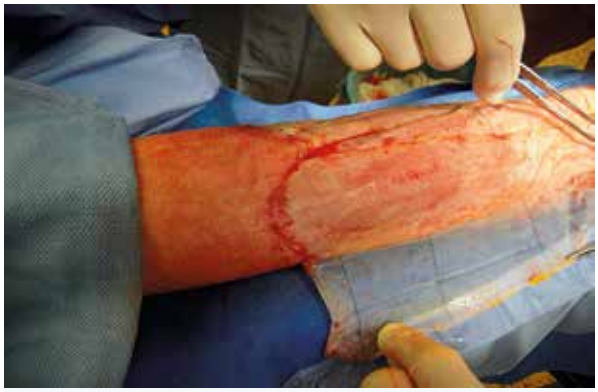

Figure 4. Removal of the outer silicone layer 21 days after Integra® application

transplanted at a later time (e.g. Integra® skin substitute), or immediately with the application of the scaffold (such as in the Matriderm® dermal substitute)[7,8]. Biopolymers, mainly collagen, are most commonly used for production of skin substitutes. Besides collagen, hyaluronic acid, polylactones, elastin, chondroitin-sulphate, etc. can be used for this purpose. The final resistance of the formed neoepidermis to friction is another important characteristic of dermal substitutes, as are the financial affordability and simplicity of storage of the matrix prior to application[9].

Acellular dermal allografts are produced by de-epithelisation of cadaverous skin. The skin is subject to processes such as decellularization or removal of the infectious and antigenic elements[10]. The result is a freeze-dried matrix that can be simply stored for many months. One of the most widely used acellular dermal matrices is Alloderm® (LifeCell, Branchburg, N.J.). Alloderm® is used as a dermal substitute in both partial and full thickness burns and allows subsequent application of dermo-epidermal graft[11]. Alloderm® was successfully used also in other applications, such as the replacement of soft tissues in prosthesis covering, lip augmentation, covering of defects of abdominal wall or vaginal prolapse[12,13]. DermaMatrix® (Synthes, West Chester, Pa.) offers a possible alternative to Alloderm®. In a comparative study on an animal model, DermaMatrix® preserved its original structure and consistency three months after implantation while Alloderm® showed marks of structural deterioration.

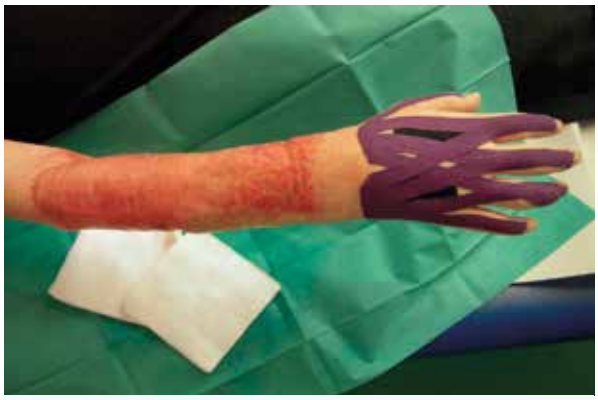

Figure 5. The fully healed skin defect two weeks after autotransplantation of a dermo-epidermal graft (8 weeks after primary Integra® application)

12 months after implantation, only a thin layer was found after DermaMatrix® application while a thick-walled dense capsule surrounded by inflammatory reaction was observed after Alloderm® use. Although the results of this animal study favoured DermaMatrix®, no firm conclusions can be drawn as clinical data are not available[14,15].

Acellular xenodermal matrices contain cross-linked bonds, which makes them slightly less favourable than

allografts in clinical practice. Products from this group include porcine skin derivatives Permacol® (Tissue Science Laboratories, Hampshire, UK), and EZ-Derm® (Mölnlycke Health Care AB, Gothenburg, Sweden). The clinical use of Permacol® has been already abandoned, the results of EZ-Derm® use are, according to the available studies, not convincing[15,16,17].

Xenodermal matrices without chemically induced cross-linked bonds can be used also for soft tissue defects of other origin than burn injury[18]. The OASIS Wound matrix® (Healthpoint, Fort Worth, Tex.) is a dermal matrix derived from the submucosal part of the porcine intestine and consists predominantly of glycosaminoglycans, collagen, fibronectin and growth factors (FGF2, TGF2). One of the biggest advantages of this matrix is its storage convenience (up to 2 years at room temperature), which facilitates its immediate use[19]. The principal application of this matrix is treatment of ulcerations. A randomised controlled trial with 120 patients proved a higher percentage of treatment of lower limb venous defects using compression therapy combined with OASIS Wound matrix® compared to compression therapy alone[20]. In patients with lower limb venous and arterial defects, a complete closure of the defect was achieved in 82% of patients when using OASIS treatment, compared with 46% when using Hyaloskin® preparation treatment (Apeldoorn, The Netherlands) based purely on hyaluronic acid[21]. Treatment benefits included lower pain and better patient comfort during treatment. Good results were achieved even in diabetic patients where 49% of defects healed after 12 weeks, compared with a 29% success rate of the Regnarex® gel with platelet derivative (Johnson & Johnson Wound Management, Somerville, USA)[22].

Derivatives based on human amniotic membrane should also be mentioned here. An example of such product is Neox® (Amniox Medical, Marietta, Ga.), primarily containing collagen and fibronectin without chemically induced cross-links. Its preferred use is in the treatment of thermal injuries where it prevents bacterial contamination and wound infection, as well as desiccation of the defect. Patches containing human amniotic membrane should be changed every two days if possible[23,24].

Synthetic acellular dermal substitutes consist of natural or synthetic polymers or of their combinations. Natural polymers include e.g. collagen, elastin, glycosaminoglycans, chitosan, fibrin, or silk[25,26,27].

A major advantage of natural polymers is their low antigenic capacity and in the fact that they do not provoke major inflammatory reactions[25]. A disadvantage is, however, in their low biostability and low mechanical durability, contributing to scar contraction. To improve the mechanical stability, cross-links are chemically induced, both within the natural polymers and between natural and synthetic polymers[25]. Natural cross-linked polymers are successfully used in clinical applications where increased strength and durability are required, such as tendon substitutes, hernia reconstruction, or in fillings where material durability and biocompatibility are preferred to cellularization. They are therefore less suitable for wound and defect healing[28].

Examples of absorbable synthetic polymers include polycaprolactone, polylactic acid, polyglycolic acid, lactic/glycolic acid polymer (PLGA), poly(ethylene glycol)/poly(butylene terephthalate), and polyethylene glycol. To name but a few examples of non-absorbable synthetic polymers, we can mention polyurethanes, nylon, or polytetrafluoroethylene (PTFE)[25,26]. Synthetic polymers can be mass-produced by available technologies as well as customised and tailor suited for achieving required properties, in particular where enhanced mechanical properties are required. Their lower biocompatibility however represents a drawback. Synthetic polymers are being used in suture and mesh materials such as nylon (Ethilon®, Ethicon, Edinburgh, UK), PLGA (Vycril®, Ethicon), polyglycolic acid (Dexon®Davis & Geck), or polycaprolactone (Monocryl®, Ethicon). They are also often used as wound dressing, such as polyurethanes Tegaderm® (3M Healthcare, St Paul, Minn., USA) and Opsite® (Smith and Nephew Healthcare, London, UK)[29,30,31].

Some dermal substitutes have a detachable semipermeable upper silicone layer preventing the desiccation of the wound as well as excessive permeability of the base layer and infection of the wound. Such skin matrices are called acellular bilaminate skin substitutes. Integra® (Integra Life Science Corporation, Plainsboro, NJ, USA) is one of such substitutes[31, 32].

INTEGRA VS. MATRIDERM – SINGLE STEP OR TWO STEP STRATEGY

Integra® (Integra Life Science Corporation, Plainsboro, NJ, USA) is currently the most accessible skin replacement and is the most commonly used in reconstruction of full-thickness or partial thickness burns[33]. Integra® is also used to support healing of chronic skin defects and acute traumatic defects with exposed bone. Integra was first introduced in 1981 [32] and approved by FDA for use in burn trauma and contracting scars. Integra® contains bovine type I collagen and shark glycosaminoglycans, chemically cross-linked with glutaraldehyde[34]. The dermal matrix of Integra® is porous and the pore size ranges from 70–200 micrometres. The pore size is crucial for the migration of autologous fibroblasts and endothelial cells as well as for the neovascularisation of the dermal matrix. The collagen in the matrix is invaded by fibroblasts from the bottom of the defect and the matrix is gradually degraded. The full decomposition of the matrix lasts 30 days, vascularisation sufficient for application of a skin graft is nevertheless achieved by the 21st day after application. Integra® is produced and supplied as a bilaminate substitute, containing the above described bottom (internal) layer and an outer silicone layer. The outer layer is removed after 21 days and a thin dermo-epidermal graft is placed on the already vascularised dermal matrix[34]. The dermo-epidermal graft is then neovascularised from the dermal matrix. The thickness of the dermal matrix itself is 2 mm. The manufacturer (Integra Life Science Corporation, Plainsboro, NJ, USA) also introduced IntegraSL®, a 1.3mm thick dermal matrix, facilitating single step application on the defect together with the dermo-epidermal graft. Integra® is at present the most widely used dermal matrix. Figures 1 to 5 describe the two-step application process of Integra® after a burn trauma.

Matriderm® (Skin and Health Care AG, Billerbeck, Germany) is a porous dermal matrix consisting of bovine type I, III and V collagen with an addition of alpha-elastin hydrolysate. Matriderm® is applied as a monolaminate dermal matrix with 1 mm thickness, immediately followed by application of the skin graft (a single-step application)[10]. This dermal substitute is used in treatment of soft tissue

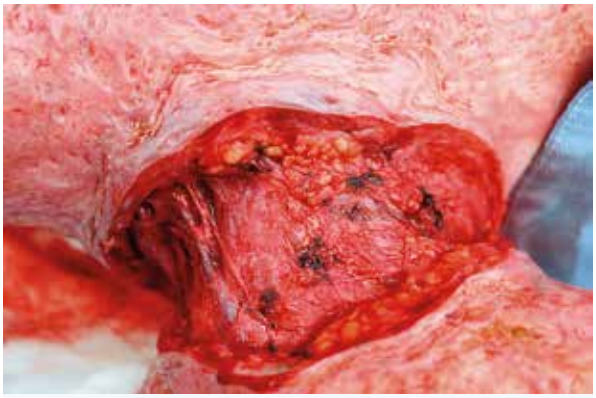

Figure 6. A hypertrophic scar incision for releasing neck adhesion (exposed outermost layer of the external jugular vein) after a burn trauma

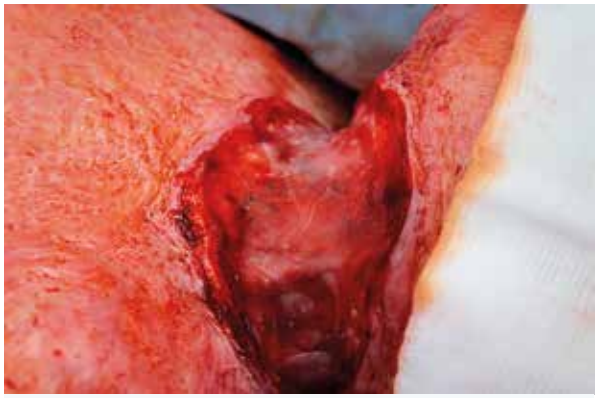

Figure 7. Matriderm® application on the site of the defect

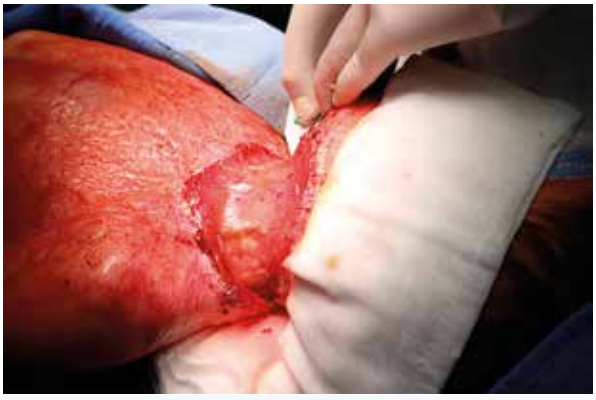

Figure 8. Transfer of the dermo-epidermal graft onto the Matriderm® matrix in a single-step procedure

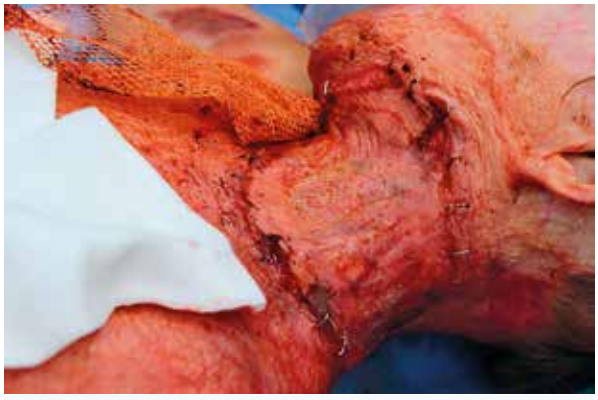

Figure 9. The defect with established dermo-epidermal graft 7 days after application

defects as well as of partial and full-thickness burns. Due to its resulting elasticity-viscosity characteristics after healing, its use is advantageous where the resulting cosmetic effect is important, in the region of joints and in children[35]. Matriderm® was in the Czech Republic first used in clinical practice at the Department of Burns and Reconstructive Surgery at the University Hospital Brno. Figures 6 to 9 show a single step application of Matriderm in a patient after a burn trauma (Figure 6, 7, 8, 9).

Schneider et al. applied both Matriderm® and Integra® in their study on a small animal model and subsequently covered them with a dermo-epidermal graft according to the manufacturer's instructions[36]. They reported that there was no difference in the neodermis thickness, in healing of the dermo-epidermal graft and in the resulting vascularisation of the dermis between the two skin substitutes. A difference in the neodermis thickness was observed between each of the substitutes and a control group where only the dermo-epidermal graft was applied. In effect, they therefore conclude that a single step procedure is more suitable as the patient is spared an additional surgical procedure and the hospitalisation can be shortened. Inhoff et al. compared the total costs of reconstruction of the complex defects of the scalp using an allogenous graft of fascia lata, dermal matrix and negative pressure wound therapy. The authors state that considering the shorter duration of the treatment, smaller number of re-dressings and improved comfort for the patients, the cost of dermal matrix treatment is bearable, despite being more economically demanding[37].

Attempts for combining dermal grafts with a scaffold cast with cells resulting in so-called living skin-equivalent grafts have been made. The pioneering work in the development of such combined skin substitutes was done by Bell et al.[38], who published the first successful result of the application of a skin substitute consisting of a superficial layer of autologous keratinocytes and from fibroblasts cast in a collagen matrix on a rat model in 1981. PermaDerm® (Regenicis, New York, USA), is a skin substitute prepared by cultivation of autologous keratinocytes and fibroblasts in a collagen matrix with a substrate. Due to the duration of cultivation of the autologous cells in the matrix, this product is not yet available for clinical application, it has however been experimentally used for burn trauma, resulting in the formation of the basal membrane as soon as 9 days after application[39]. To prevent hypopigmentation, melanocytes

were added into the keratinocyte cell culture; the resulting pigmentation was however notably variable.

"Like with like replacement", i.e., substitution of a missing tissue with a tissue of the same or similar properties (mechanical, of texture and pigmentation) is one of the basic principles of plastic surgery. Acellular dermal allografts such as Alloderm® or DermaMatrix® show very good results of resulting neodermis properties after healing. Application of acellular xenogenous substitutes is another method of choice, its results are however less satisfactory than those of allografts. Products with chemically induced polymer cross-links are less suitable for use as skin substitutes due to their cytotoxicity; they are more suitable for use as mechanical substitutes where the strength and mechanical integrity are preferred to the incorporation into the tissue. A promising way of research is development of dermal matrices with prefabricated vascular network[40]. A major drawback of the current application of skin substitutes is the absence of the subcutaneous fatty tissue layer as the current methods focus on the reconstruction of the dermis and epidermis only. This leads to reduction in mobility of the newly formed skin and the dipped contour of the healed defect is also apparent. The development of autologous cellularized dermal substitutes is significantly more expensive than that of acellular ones, which is reflected in their price. For comparison, Alloderm® or Integra® cost between 15–30 USD per square centimetre, cellularized substitutes are approximately four times more expensive[41].

CONCLUSION

Skin substitutes became an integral part of both critical and long-term care in the management of burn trauma. Although numerous case reports have been published in the literature, a uniform strategy for comparison of results of their application as well as of long-term results is missing so far. The presented paper provided an overview of the currently used skin substitutes and discussed the pros and cons of their use in clinical practice.

Role of authors: Martin Knoz: first author. Jakub Holoubek: corresponding author. Břetislav Lipový, Ivan Suchánek, Ivona Kaloudová, Tomáš Kempný, Zdeněk Dvořák: consulting authors. All authors have read and approved the final version of the manuscript. All authors declare that this paper or its part is not concurrently under review in another journal or publication.

Conflict of interest statements: All authors declare that they have no conflict of interest.

Compliance with ethical requirements: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

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List of abbreviations:
PLGA – poly(lactic-co-glycolic) acid
PTFE – polytetrafluoroethylene
FDA – Food and Drug Administration

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CURRENT OPTIONS IN PHARMACOLOGICAL INTERVENTIONS FOR MICROVASCULARMANASTOMOSIS PATENCY: REVIEW

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ACTA CHIRURGIAE PLASTICAE, 62, 1–2, 00-00.

SUMMARY

The key point for microvascular reconstruction is to preserve patency of flap vessels. Despite great improvement in reconstruction success rates in the last 30 years, ischemic complications are still an undesirable event. The authors assessed recent as well as older literature and compared progression in perioperative pharmacology interventions in antithrombotic prevention.

KEYWORDS

Microvascular anastomosis, free flap, thrombosis, flap ischemia, antithrombotic, vasospasm

INTRODUCTION

The scope of reconstructive techniques using microsurgical anastomosis continues to expand. The surgical approach and materials were mostly standardized. Nevertheless, the patency of microvascular anastomosis and prevention of thrombosis of peripheral vessels of the flap remain the key points of a successful reconstruction. Although most specialists agree that the surgeon's experience, quality operative techniques and well-chosen and prepared patient lead to major reduction of ischemic complications in the first place, and some authors consider this to be the only relevant factor, there are still various drugs applied to prevent clot formation in the anastomose site and inside the flap.

Despite the long history of microvascular reconstructive procedures, no consensus on a single perioperative pharmacological approach exists between the authors. The literature offers mostly retrospective studies, presentation of individual experiences or laboratory experiments. Strong factors influencing potential research are interindividual differences in vessel quality and individual coagulation status among patients. Most protocols are based on the creation of iatrogenic hypocoagulation or hypoaggregation condition in perioperative care for prevention of thrombotic complications, yet the used doses of drugs differ. Minority of protocols use spasmolytics, promote faster epithelization and minimize expression of pro-inflammatory and pro-coagulative factors in the anastomose site.

PHARMACOLOGICALLY INFLUENCEABLE CAUSES OF FLAP ISCHEMIA

Beginning with general conditions, flap could be ischemic due to the alteration of blood circulation, which can be caused by low cardiac output, hypotension, hypothermia or low haematocrit, high blood viscosity or excessive blood loss. Locally may occur peripheral vasoconstriction or in 5–10% cases spasm of flap nutrition vessel[1]. Low blood flow with damaged endothelium and hypercoagulopathy lead potentially to thrombus formation[2].

Blood clot in anastomosis site is the most frequent local event resulting in flap failure[3]. That is the reason why increased effort is necessary during perioperative period to prevent this condition and also microthrombotisation of peripheral flap vessels. Venous thrombus is more frequent than arterial. 90% of arterial thrombi are formed usually within the first 24 hours. Conversely, the venous thrombus occurs mostly between the first 24–48 hours after surgery[4]. Other unfavourable local conditions as vessel kinking, strangulation or compression by haematoma should be eliminated by proper surgical technique.

PERIOPERATIVE FLUID AND PHARMACOLOGICAL MANAGEMENT

Former recommendations aimed at prevention of the flap vessels spasm by administering vasodilators and usage of peripheral vasoconstrictors for mean arterial pressure (MAP) stabilisation was considered risky[5]. MAP around 100mmHg is

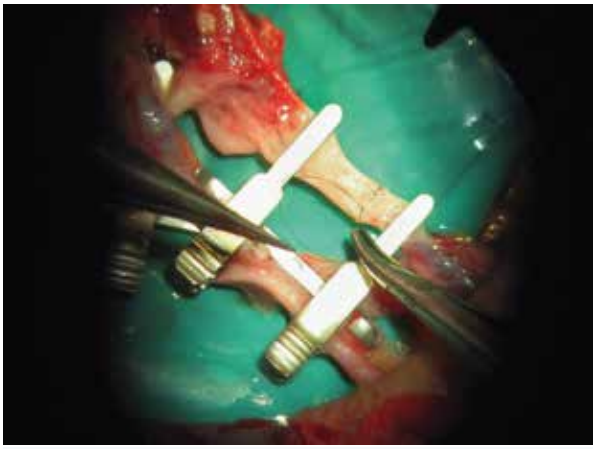

Figure 1. The surgeon´s experience and quality operative technique are major factors of success (archive of the author)

now recommended and considered appropriate for sufficient perfusion of the flap. Recent studies have not demonstrated that administration or omission of peripheral vasoconstrictors e.g. phenylephrine, ephedrine, dopamine, dobutamine, noradrenalin in perioperative period is important for flap survival[6]. Some studies differentiate between drugs influencing blood pressure and circulation; for example Suominen prefers usage of Dobutamine that increases stroke volume and decreases systemic vascular resistance more than dopamine, which only increases stroke volume[7]. German society for microsurgery of peripheral nerves and vessels recommends to use norepinephrine rather than dobutamine[8]. Mokatef reported better flap perfusion with norepinephrine or dobutamine[9]. (Figure 1.)

It is recommended to maintain normal partial pressure of O_2 a CO_2 during general anaesthesia (GA). Hyperoxemia and hypokapnia as well as hypothermia and insufficient postoperative pain control can lead to peripheral vasoconstriction[5]. Drugs used in GA often lead to systemic hypotension. Sevoflurane is the most commonly used volatile anaesthetic agent. It has documented protection for endothelium against ischemic damage, it promotes healing of vessels and in comparison with Propofol it decreases capillary filtration coeficient[9]. As prevention of hypotension during GA, it is recommended to reduce doses of anaesthetics and to increase circulating fluid volume. It is necessary to balance pros and cons. The benefit is elevation of MAP, but it may cause oedema of tissues within the flap, worsening of microcirculation, haemodilutive coagulopathy or heart failure[10].

Ševčíková found that 20–30% haemodilution by crystalloids can lead to hypercoagulative condition, caused by dilution of coagulation inhibitors and by lowering threshold for positive feedback, which is a component of coagulation cascade[11]. Administration of more that 130 ml/kg crystalloids per day or more that 7 litres during the operation correlates significantly with perioperative complications including thrombosis and flap loss. The recommended dose of crystalloids in the first perioperative 24 hours is 3.5 to 6.0 ml/kg per hour[9].

Infusion of colloids as hydroxyethyl starch or gelatine can help to maintain reasonable MAP, and also cause mild prolongation of activated partial thromboplastin time (aPTT) and prothrombin time (PT). Five percent human albumin influences coagulation less than starch solutions[9].

No data support dependency of haematocrit level on the flap loss[16]. Also, an association between blood transfusion administration and more surgical complications and flap failure is disapproved. Complications occur more often with more administered transfusions, but increased frequency of complications depends more on polymorbidity of the patient.

Although corticosteroids promote pro-coagulative state and release of platelets, their administration is supported as an anti-swelling agent and for prevention of postoperative nausea and vomiting[8]. Surgical complications were observed more frequently with longer duration of GA[12].

Pentoxifylline increases red blood cells deformability and lowers blood viscosity. Vasodilation effect was observed too[1]. Statins prevent endothelial dysfunction, release of nitrogen monoxide (NO) from endothelium, and reduce inflammatory response and by that act anti-thrombotically. Some studies on animals also support vasodilatation[1,13].

SYSTEMIC ANTICOAGULATION AND ANTIAGGREGATING

The most common way how to minimize the risk of thrombus formation is to create hypocoagulation or hypoaggregation of blood. The most commonly used drugs are heparin, low molecular weight heparins (LMWH) and acetylsalicylic acid[14].

Heparin is an anticoagulant and it prevents both arterial and venous thrombosis acting on various systems: it inactivates or reduces activation of coagulation factors[15], lowers the recruitment of platelets and fibrin deposition and in higher doses increases vasodilation probably by releasing NO from endothelium[3]. Effect of Heparin is measurable by activated Partial Thromboplastin Time (aPTT), the normal range of which is 22–35 s[2]. Measurement with thromboelastography (TEG) is more dynamic, but aPTT is considered the standard[16]. As heparin cannot dissolve an existing clot, it should be administered systemically preoperatively in a bolus, or before the division of flap vessels in the harvest site. Some protocols recommend administration before clamp release after suturing the anastomosis[17]. However, flap is not presaturated with heparin in these cases. Heparin medication is often prolonged after surgery.

Heparin can also be used locally, when anastomosing vessels are irrigated by heparin solution, or flap is totally flushed with heparin solution. Pressure of irrigation solution should not be more than 100mmHg, because of the risk of intimal damage[4].

The use of heparin can lead to complications. The most common is haematoma formation and bleeding, less commonly heparin induced thrombocytopenia may occur[18].

Low molecular weight heparin (LMWH) is a derivate of heparin, with more specific effect on factor X. Easier administration is the major benefit as well as higher biological availability and lower risk of thrombocytopenia[17]. However, monitoring of the activity of LMWH with anti-Xa is not as precise as in heparin with aPTT and the effect on arterial thrombosis prevention is doubtfull[3].

Acetylsalicylic acid (ASA) irreversibly inhibits cyclooxygenase in platelets. By this, the transformation of arachidonic acid to thromboxane and prostacyclin is blocked[13]. Thromboxane is a vasoconstrictor and platelet aggregator;

Figure 2. Blunt double side vented irrigation tip cannula for root cannal irrigation during endodontic treatment can be well used for intraluminary application of solutions **(**Endo/Tech™, Halifax, Canada**)** Double Side Vented Irrigation Tips [internet] Endo/Tech™, Halifax, Canada [cited 2020 May1] Available from: https://endo-tech-com.3dcartstores.com/Double-Side-Vented-Irrigation-Tips_p_205.html

the effect of prostacyclin is the opposite. ASA also interferes with thrombin formation[13]. ASA is commonly used in vascular surgery. Dosage and time of administration is important. The vessel patency is better if ASA is administrated 10 hours before a surgery. The dose of 5mg/kg sufficiently blocks synthesis of thromboxane and maintains synthesis of prostaglandins[4,17]. ASA is usually used in combination with heparin or LMWH. Most common complication is higher risk of perioperative bleeding and haematoma formation, renal dysfunction and bleeding from the gastrointestinal tract[19]. Because of relevant interindividual pharmacokinetic differences and inhibition of only external path of coagulation cascade, warfarin is not used in free flap surgery. Also, usage of ticlopidine and clopidogrel is only experimental in free flap surgery[20].

Figure 3. Solution for intraluminary irrigation during microvascular suture used at our department. **Solution is consisting of:** 10ml of Mesocain 1%, 10ml $MgSO_4$ 10%, 5ml of Agapurin (Pentoxifyllinum 100 mg). Then 19ml of this solution is mixed with 1ml of Heparin 5000 IU/ml (archive of the author)

Dextrans as plasmaexpanders lower blood viscosity and improve rheology of blood and act antithrombotically by increasing electronegativity of red blood cells, platelets and endothelium[13]. Anaphylactic reaction, acute respiratory distress syndrome, risk of heart failure and kidney damage can occur as a negative complication[3,4]. In prospective randomized studies dextran does not have an effect on flap survival in comparison with the group without any antithrombotic medication. Systemic complications were observed in both cases[9].

Zhou pointed out in 2018 in a prospective randomized double-blinded controlled clinical trial that the use of antithrombotic agents in head and neck microvascular surgery does not decrease the risk of thrombosis formation and may increase the risk of haematoma formation. He also summarized that postoperative antithrombotic agents should not be used routinely, but administration should be based on an individual risk assessment[21].

We follow the procedure to measure the actual aPTT, PT, red blood cells and platelets just before the flap division and administer usually 10,000 IU bolus of heparin systemically. Since the end of surgery, we administer an infusion of 1000ml of normal saline + 10ml of 1% Mesocain + 10ml of 10% $MgSO_4$ + 5ml of pentoxifylline (Agapurin) continually for 24 hours. Heparin is administered continually with an effort to maintain aPTT between 42–45s for the following week.

TOPICAL AND LOCAL DRUGS

The idea of the vasodilator administration locally onto or into the sutured vessel as a prevention of spasm and subsequent prevention of systemic effect have led to local administration of drugs. A survey of plastic surgeons in the United Kingdom revealed that although 94 percent routinely used vasodilators intraoperatively, 99 percent of surgeons used them topically, with 19 percent additionally irrigating the vessel lumen[1]. There are two major ways to smooth muscle relaxation: increase of NO synthesis and blockage of Ca^{2+} channels. Well documented effect and simple application has lidocaine as a local anaesthetic. Increased release of NO, blockage of Na^{2+} channels and sympathetic innervation of vessel produces vasodilatation[1,22]. Lidocaine is administered topically and intraluminary onto the sutured vessel in 4% concentration[4,9,23]. Vasospasm was observed in the concentration of 1% or less. Although the total dose administered this way exceeded DMS, no signs of intoxication were observed[24]. Hyža proved vasodilatation effect of 1% trimecaine and 10% $MgSO_4$[25].

Other drugs for local administration such as pentoxifylline, calcium channel blockers, papaverine, sodium nitroprusside, amrinone, phenolamin, chlorpromazine, botulotoxin, vascular endothelial growth factor (VEGF) and prostaglandins are documented mostly in vitro and on animal models[1,15,26,27,28,29]. Use of a blunt endodontic cannula with side hole has showed in our practice as a smart solution for internal irrigation of sutured vessels. We irrigate vessels topically and intraluminary during suturing using a solution consisting of mesocain, Agapurin, $MgSO_4$ and heparin. (Figure 2, 3.)

MONITORING

The following techniques should be mentioned as standard methods of flap assessment: visual inspection of skin

Figure 4. Near infrared spectroscopy (NIRS) sensor for children is suitable for skin flap measurement because of its size (archive of the author)

Figure 5. Trend is more important than absolute value. Recommended ranges for different flaps are also investigated (archive of the author)

or mucous island colour, flap temperature, invasive blood pressure (IBP) with MAP, Doppler ultrasound for flap vessel blood flow detection, pin-prick test in soft tissue flaps with fresh bleeding up to 5 seconds. Promising seems to be near infrared spectroscopy (NIRS) for continual monitoring of flap perfusion. In case of patients with artificially altered coagulation or aggregation, it is possible to use thromboelastography/metry (TEG/ROTEM) besides the standard measurements of aPTT and antiXa. (Figure 4, 5.)

SALAVGE PROCEDURES

Beside revisional surgery, medical leeches can be applied on a venostatic flap also after successful revision of anastomosis. Venostasis can be reduced by bleeding and by hirudin released in tissues. Infection of a wound by bacteria from leeches' digestive tract can occur as a major complication[3].

Thrombolytics such as streptokinase, urokinase, t-PA are enzymes dissolving a thrombus. Their use is experimental in anastomosis revisions and in replantation surgery because of a serious risk of bleeding[4].

CONCLUSION

Despite the wide range of drugs in investigation, mainly heparin, LMWH, acetylsalicylic acid and various local agents are in fact used nowadays. Other drugs have a potential for future research rather than for an actual daily administration in free flap surgery. Moreover, recent well-documented studies do not justify routine use of antithrombotic agents in head and neck free flap surgery. Good message is the dismissed concern of blood transfusions and vasoconstrictor administration and also more options for perioperative monitoring. The perioperative pharmacological management evolves from special interventions based on theoretic pathophysiology to less complex care similar to other comparable surgical procedures as a result of research. Nevertheless, surgeon should definitely stay focused on a meticulous operative technique.

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List of abbreviations

MAP – mean arterial pressure
GA – general anaesthesia
aPTT – activated partial thromboplastin time
PT – prothrombin time
NO – nitrogen monoxide
TEG – thromboelastography
LMWH – low molecular weight heparin
ASA – acetylsalicylic acid
VEGF – vascular endothelial growth factor
$MgSO_4$ – magnesium sulphate

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INDICATION AND IMPORTANCE OF RECONSTRUCTIVE SURGERIES OF FACIAL SKELETON IN MAXILLOFACIAL SURGERY: REVIEW

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SUMMARY

Malignant head and neck tumors belong among common diseases and their incidence constantly rises. In the Czech Republic, the proportional representation of orofacial tumors ranges around 2% of the total number of malignancies. Rational treatment of these tumors is complex and long. In the course of therapeutic planning, you have to consider the age of the patient and the stage of the disease including the presence of distant metastases. Removal of the tumor with a sufficient safety margin and an eventual treatment of the relevant lymphatic system according to the type of the tumor is an important prerequisite for the success of the surgical therapy. Reconstructive procedures in maxillofacial oncosurgery presume good interdisciplinary cooperation and a high professional preparedness of the surgical and nursing team. Selection of the right patient is also very important with regard to the risks of both local and systemic postoperative complications. Use of the free flap techniques is currently the gold standard, but it is also necessary to master pedicled flap techniques, whose advantages lie in simpler technique and often better aesthetic results. At the same time, we have to realize that even traditional, classical reconstructive procedures using prosthetic replacements can still represent the ideal solution in many cases.

KEYWORDS

Flap, pedicled flap, free flap, head and neck surgery

INTRODUCTION

Carcinomas of the oral cavity and the oropharynx belong among 10 malignancies most frequently occurring in the human population. There are approximately 500,000 newly diagnosed cases worldwide every year. However, only approximately one third of the patients survives 5 years after the diagnosis. The proportional representation of these tumors in the total number of malignancies ranges around approximately 2% in the Czech Republic (3% in the USA, 35–40% in the countries of southeast Asia).[1]

Currently, the incidence of oropharyngeal malignancies in younger generation increases (frequently occurring carcinomas in the third or fourth decade of life) as well as the malignancy percentage in women and the number of distant metastases from extraoral primary tumors.[2]

In 90% of cases, these represent malignant epithelium tumors, most often spinocellular (epidermoidal) carcinomas. The remaining 10% consist of adenoid cystic carcinomas, mucoepidermoid and other salivary gland adenocarcinomas, malignant lymphomas, rarely sarcomas. On the skin of the face, we most often find basocellular and spinocellular carcinomas, melanomas, and as an exception, some other rare malignancies, such as the Merkel cell carcinoma. On the other hand, malignant mesenchymal tumors (except for haematological malignancies) are much rarer in the oropharyngeal region.[3]

The prognosis of malignant tumors of the oral cavity and oropharynx is determined primarily by the degree of invasiveness of the primary tumor and the extent of the metastatic involvement of regional and distant nodes. It is significantly affected by a timely determination of the diagnosis, which is in turn strongly affected by clinical experience and oncological awarness of both physicians and layman population.[4] In the postoperative period of time, especially in case of more voluminous tumors, the prognosis is affected by their complete removal, which is easier to achieve if the resection is not limited by the possibilities of the subsequent reconstruction.[5]

At present times, free flap techniques (radial forearm flap, latissimus dorsi flap, anterolateral thigh flap, free fibula flap, rectus abdominis muscle flap) are used primarily in reconstructive oncosurgery of the head and neck. Reconstruction of bones and large defects of the orofacial re-

gion is the main advantage of these osteomyocutaneous and myocutaneous flaps. A certain limitation of these flaps lies in the performance of vascular anastomosis, which can be difficult in these oncological patients because of frequent sclerosis of the vessels caused by smoking and poor regime. In older, polymorbid patients, we use pedicled flap techniques (pectoralis major flap, submental flap, supraclavicular flap, facial artery musculomucosal flap – FAMM), in which the procedure is shortened by omitting the microsurgical vascular anastomosis, and therefore, the total operational stress on the patient is decreased. In addition, the texture and color of the skin are similar to facial skin in case of these regional flaps located above the level of clavicula, which contributes to an aesthetically pleasing result. Osseous and voluminous cranially located defects represent the limitations of the use of pedicled flaps because of the limited rotational arc and the insufficient volume of the necessary tissue.

EVALUATION OF PROBLEMS

Principles of surgical treatment and tissue defect reconstruction

In head and neck oncology, apart from prolongation of life, more and more emphasis is being put on the quality of life of the patient while keeping in mind the preservation of functionality of the orofacial system (mastication, swallowing, breathing) and an acceptable aesthetic result without a significant negative impact upon the socioeconomic status of the patient. Interdisciplinary cooperation between a maxillofacial surgeon, otolaryngologist, reconstructive surgeon, oncologist, speech therapist and a psychologist is important to achieve the best possible result. In surgical procedures of this difficulty, the importance of paramedical personnel in presurgical and especially postsurgical care cannot be forgotten. Before the surgical procedure, several criteria have to be considered and the best possible relation and balance between them has to be found. **Complete removal of the tumor is an absolute priority and it must not be affected by the complexity of the defect reconstruction**. Therefore, two viewpoints are important in the reconstructive surgery: functionality and aesthetics. From the viewpoint of function conservation, we evaluate the ability to articulate, masticate and swallow. The best aesthetic result is achieved by a defect reconstruction using the surrounding tissues with similar color, thickness and skin texture.

The condition, volume and mobility of the surrounding soft tissues and bones represent the critical factors for the decision on the type of defect closure (direct suture vs. flap) after primary tumor removal.

The reconstruction of both maxilla and mandibula does not depend only on the volume of the resected tissue, but also on its location. Apart from localization of the defect, the mobility of the surrounding soft tissues, which differs in individual anatomic locations, is also important. Removal of important structures (nerves, blood vessels and cartilage) can also affect the functionality and quality of life of the patient.

In small, well-localized tumors, we usually perform a primary closure of the defect using a direct suture due to the great mobility of the surrounding soft tissues. In larger

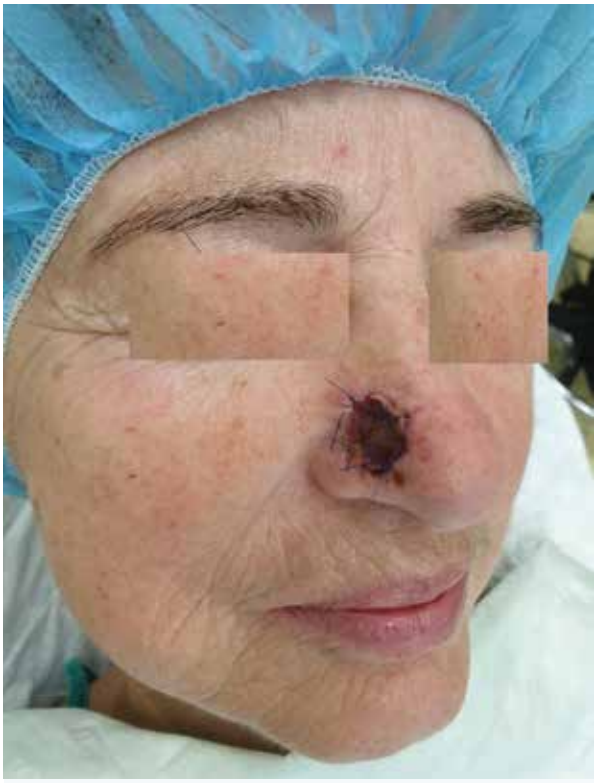

Figure 1. Condition after a radical excision of a malignant lesion on an ala nasi (author's archive)

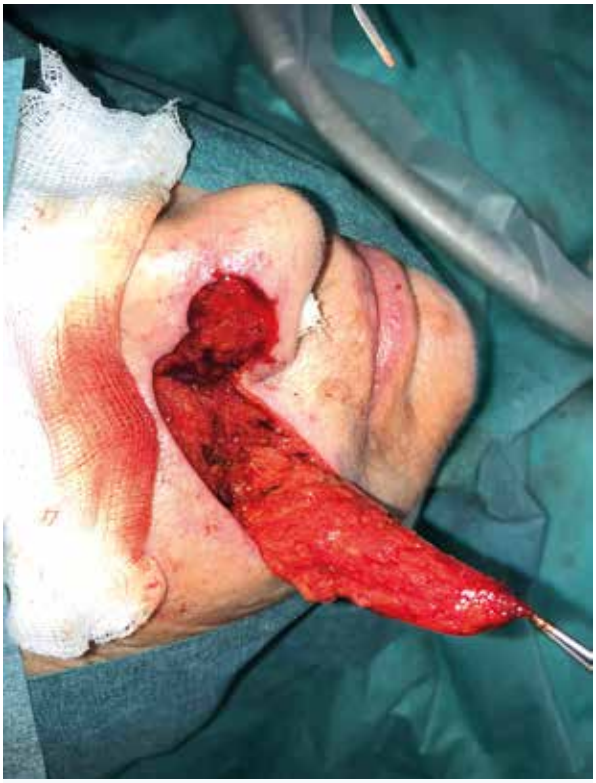

Figure 2. Elevation of the nasolabial flap (author's archive)

tumors, direct closure of the defect using a suture is not possible, and that is why we have to perform the reconstruction using local or distant or free flap techniques.

Local flaps

Local flaps with random vascularization

We use *local random pattern flaps* to close defects, which could not be closed using a direct suture and which are surrounded by a sufficient amount of mobile tissue. The defects are differentiated to mucosal defects and skin defects in accordance with their location. Tongue flap, pharyngeal flap and palatal flap are being used in reconstructive surgeries to cover mucosal defects. [6,7,8,9,10,11,12] The first two mentioned can be used in reconstruction of defects of the oropharynx and pharynx, but their disadvantages lie in the fixation of the tongue or narrowing of the pharynx, and that is why they are considered as flaps of second choice. On the other hand, palatal flaps, which can be used without any unacceptable impairment of the swallowing and breathing functions, are still used to close smaller defects at present. Well-perfused orofacial system offers a wide spectrum of local skin flaps, which are used primarily in smaller skin defects, often with a great visual and functional result. In principle, these are local mobile, rotational or transposition flaps. The most commonly used local flaps in the head and neck region are nasolabial flap (superficial random pattern flap), glabellar flap, rhomboid flap and bilobed flap. Nasolabial flap can also be used as an axial flap, which is nourished through the angular or lateral nasal branch of the facial artery, and as such, it can be used to cover intraoral defects (Figure 1–4). [13,14,15,16] The principle of the rhomboid flap described by Limberg [17] lies in the removal of the lesion of the aforementioned shape and in an elevation of the rhombic flap in the adjacent pliable area with its subsequent transposition. Bilobed flap (first described by Esser) can be used not only for surface defect reconstruction, but also for facial defects communicating into the oral cavity. [18]

Local flaps with defined vascularization

Regional pedicled (axial) flaps have been used since 1970s. Their principle lies in the elevation of tissue with a nutritional vascular pedicle in the extent of the dermatosome. Therefore, their vascularization is clearly defined. From regional flap techniques, the pectoralis major, submental, supraclavicular and temporal flaps are used most commonly for the reconstruction of defects in the oropharyngeal region. Forehead flap, trapezoidal flap and m. latissimus dorsi pedicled flap [19–31] are used less often. Facial artery musculomucosal flap (FAMM) has to be mentioned within this group of flaps as well. [32,33] Lower technical difficulty and the related shortening of the surgery time is one of the advantages of pedicled flaps, which do not require microsurgical anastomosis. These are mostly indicated in older and high-risk patients. Possible limitations include smaller radius and extent of flaps, possible inferior perfusion in comparison to free flaps and practical usability only in soft tissues reconstruction. Admittedly, the pedicled pectoralis flap can be elevated with a rib and the pedicled musculus latissimus dorsi flap can be elevated with the scapula, but from the implantological point of view, it represents a bone material of insufficient quality, which is acquired for the price of significant morbid-

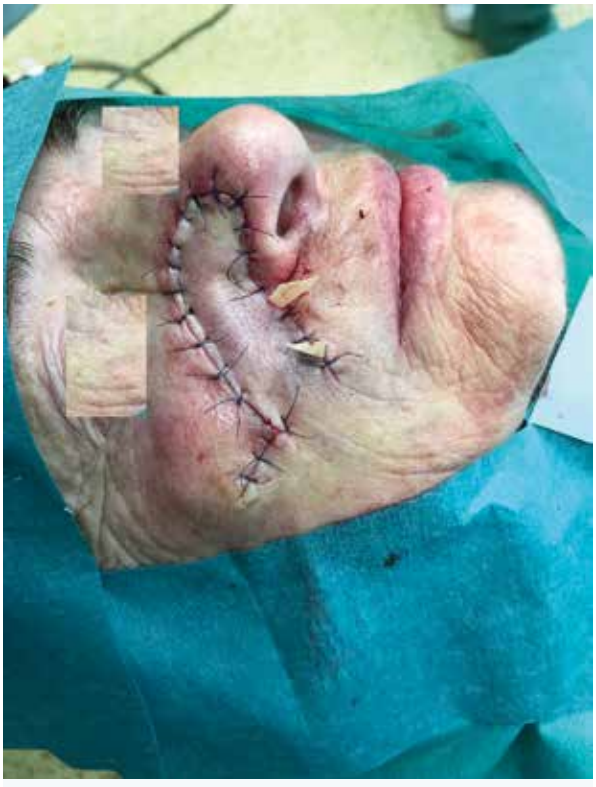

Figure 3. Condition after sewing the nasolabial flap into the defect (author's archive)

Figure 4. Condition 1 week after healing of the nasolabial flap (author's archive)

Figure 5. Elevation of the submental flap (author's archive)

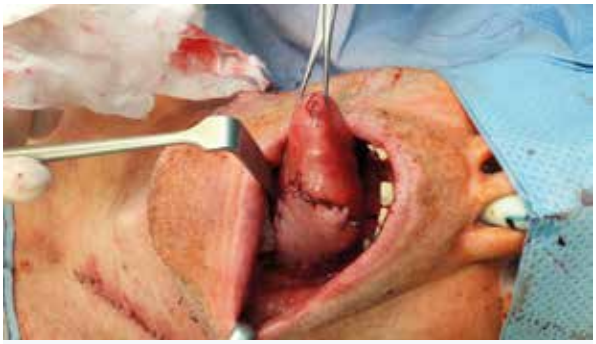

Figure 6. Condition after sewing the submental flap into the defect of the tongue (author's archive)

ity and complicated healing of the donor location. They may seem less aesthetically acceptable due to the larger number of post-surgery scars, but on the other hand, if these are flaps above the level of clavicles, then they usually retain more natural color and texture for the head and neck region and they are less conspicuous than free flaps. Especially the submental (Figure 5–7) and supraclavicular flaps are thin, pliable and easy to dissect flaps with good cosmetic and functional results. Their advantage also lies in the minimal morbidity of the donor site. Some authors already consider the supraclavicular flap to be the gold standard for reconstructions of head and neck soft tissue defects[34].

Distant flaps with defined vascularization – free flaps

In the past 50 years, free flap techniques have created a new dimension in the reconstructive surgery. The **free microvascular flap** technique was used for the first time by Seidenberg in 1959, at which time he used a vascularized jejunum flap to reconstruct a pharyngeal defect.[35] The first transfer of a vascularized fibula flap is dated into 1973, when Ueba and Fujikawa used this flap on an 11-year-old boy to reconstruct an ulnar defect after a removal of a neurofibroma.[36] Two years later, Taylor used the same flap to reconstruct a tibial defect.[37]

As regards the orofacial region, vascularized fibula flap was used for the first time by Hidago in 1989 to repair a mandibular defect[38], and five years later, Nakayama used it to reconstruct a maxilla.[39] The year 1981 was an important milestone, because Shaw reconstructed a nasal defect[40] using a forearm flap in this year. Later, in 1980s, an intense development of microvascular reconstructive surgery in the maxillofacial region has begun.

Almost any defect can be reconstructed using these techniques, but a certain professional restraint and humility should be maintained. Careful dissection of the vascular pedicle and a responsibly performed microanastomosis – a satisfactory vascularization, the failure of which represents the main complication of these flaps – is a prerequisite of a successful reattachment of these flaps. Funds to pay for the surgical microscope, instrument kit, training and leasing curve of the microsurgeon represent other difficulties. That is why these procedures should be performed by a surgeon knowledgeable in this field, who performs these procedures often, and if possible, regularly. In accordance with the tissue content, free flaps can be divided to cutaneous, myocutaneous and osteocutaneous or osteomyocutaneous.

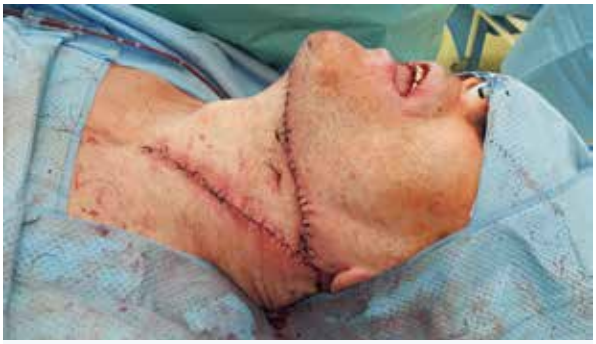

Figure 7. View of the submental flap donor location (author's archive)

In the oropharyngeal region, the most commonly used are radial forearm flap[41], anterolateral thigh flap[42], musculus latissimus dorsi flap[43], musculus rectus abdominis flap[44], vascularized fibula flap[38], vascularized hip bone[45] and scapular skin flap.[46]

In the pre-operative planning, it is important to plan the actual harvest of the free flap very well and to consider the morbidity of the donor site, because it should correspond with the tissue, which is being reconstructed as much as possible in terms of shape and aesthetics. That is why a good communication between the surgeon performing the destructive phase and the reconstructive surgeon is a must. In cases where we cannot achieve satisfactory functional and aesthetic result using local and regional flap techniques, free flaps represent the first choice in head and neck reconstruction. In maxillofacial oncosurgery, these most often concern reconstructions of jawbones, full thickness facial defects and defects in other parts of the oral cavity. The procedural benefit and health risks of the patient have to be evaluated before the procedure. We especially focus on comorbidities such as diabetes mellitus, hypertension, cardiovascular diseases and last but not least the blood vessel permeability. That is why the greatest attention is paid to senior patients suffering from atherosclerosis, in whom we consider mandibular reconstruction with a vascularized bone.

Mandibular reconstruction

In order to achieve a satisfactory mandibular reconstruction, we have to take several viewpoints into consideration – functional, anatomical and aesthetic. From the functional

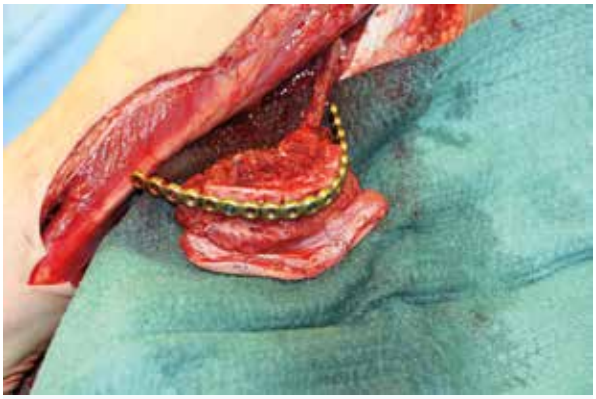

Figure 8. Elevated fibula flap after modelling along the shape of the reconstructive splint, hanging perfused on a lower limb (author's archive)

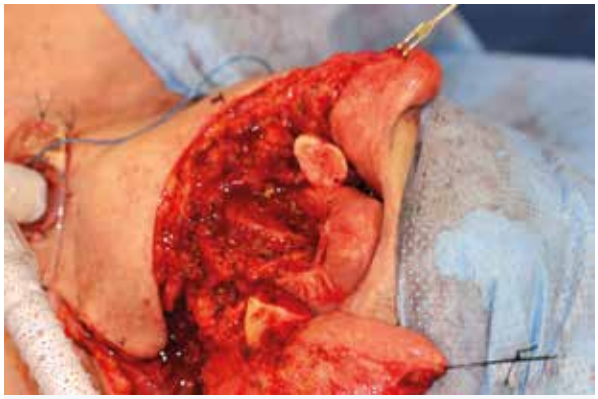

Figure 9. Defect after resection of the mandibula and the base of the oral cavity (author's archive)

viewpoint, satisfactory mastication and phonation should be guaranteed, the swallowing reflex should be preserved as well as the permeability of the upper respiratory tract. From the anatomical viewpoint, we evaluate restoration of the occlusal plane and the correct position of the TMJ (temporomandibular joint) head on an OPG (orthopantomogram) image. From the aesthetic viewpoint, the important factors include facial symmetry, chin prominence, height of the lower third of the face and frequency and visibility of the scars.[38]

The following circumstances have to be taken into consideration before the mandibular reconstruction:

- overall state of health of the patient (cardiovascular diseases, ischemic heart disease, diabetes mellitus, toxonutritive hepatopathy, vessel permeability) and their capability to undergo a long surgical procedure)
- age of the patient (the calendar age of the patient does not have to correspond to the biological age)
- whether this is a primary or a secondary surgical procedure (irradiated terrain, blood vessel wall quality and the number of blood vessels usable for microanastomosis)
- location of the defect on the mandibula (lateral vs. anterior)
- volume and biological character of the tumor
- donor site morbidity after flap harvest

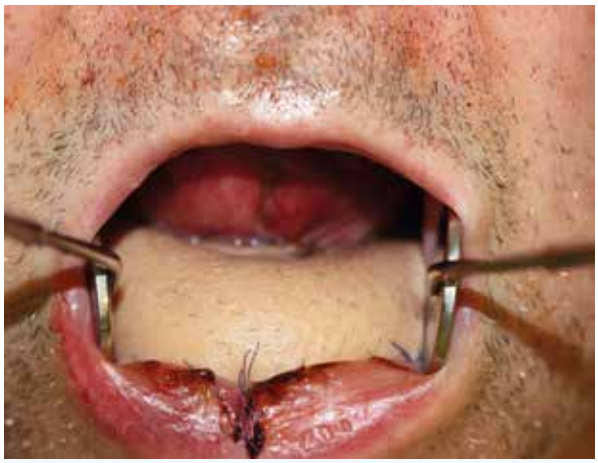

Figure 10. View of the oral cavity after healing of the fibula flap with a skin island (author's archive)

- the wishes of the patient and their standpoint and motivation, willingness to cooperate
- alcohol addiction, which represents a **strong limiting factor** in accordance with our experiences

Reconstructive surgical techniques	Indication
No reconstruction	Senior patient, defect in the lateral portion of the mandibula, high medical risk, possible primary suture of the defect.
Bone graft (hip bone)	Defect smaller than 5 cm, no neoadjuvant or adjuvant radiotherapy.
Reconstruction limited to soft tissues, no bone reconstruction (free-end)	Senior patient, lateral portion – defect of the mandibular ramus, large tumors expanding to the surrounding soft tissues.
Reconstruction splint (wrap-around)	High-risk patient, secondary surgery, lateral portion. No adjuvant radiotherapy.
Titan mesh filled with autologous bone. Distractor	Young patient, no neoadjuvant or adjuvant radiotherapy.
Free flap (fibula, hip bone, shoulder blade)	Fit individual capable of undergoing the procedure, good quality and size of vessels.

Table 1. Mandibular reconstruction options

In case of a positive decision, we approach the reconstruction type selection. At the moment, we have several modalities at our disposal (Table 1):

If the overall state of health of the patient allows, free flap is currently the first-choice method for reconstruction of extensive defects. Alternatively, we can reconstruct the mandibula using a splint and a muscle or a musculocutaneous flap, which covers the splint (wrap-around technique).[47] In senior patients suffering from smaller tumors located in the lateral portion of the mandibula, the defect can be closed using a primary suture and the mandibula can be kept without any reconstruction. In larger defects, without any option of primary suture, we only reconstruct soft tissues using a musculocutaneous flap (free or regional) and we keep the resected bone stubs free (free-end). On the contrary, in young patients without the security of radiotherapy, in which we resect the mandibula up to 5 cm, we can use a bone graft harvested from the hip bone for the reconstruction.[48] Other options include mandibula distraction[49] and mandibula reconstruction with a titanium mesh of size and shape corresponding to the mandibula, filled with milled autologous bone.

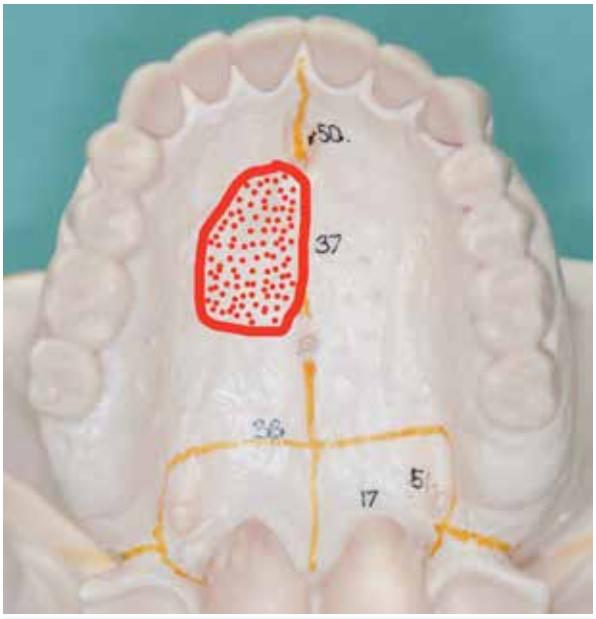

Figure 11. Ia. class defects

We have to realize that even after a free fibula flap is properly healed into the defect, it is often followed by radiotherapy, which can cause its post-radiation osteonecrosis. That is why an interval of at least 5 weeks after the surgery has to be kept and the reconstruction splint has to be shielded as much as possible during the radiotherapy.[50]

Free flaps most often used for mandibula reconstruction

Vascularized fibula flap

At present, free fibula flap is used most commonly for mandibula reconstruction, because it provides a bone of good quality and the right length (maximum harvest of 24 cm) (Figure 8, 9, 10).[51, 52] The morbidity of the donor location is acceptable after the defect is healed, the patient is able to walk fast and ride a bicycle[53]. The skin island flap is segmentally nourished by minor perforators, which lead from arteria peronaea towards the skin, which allows us

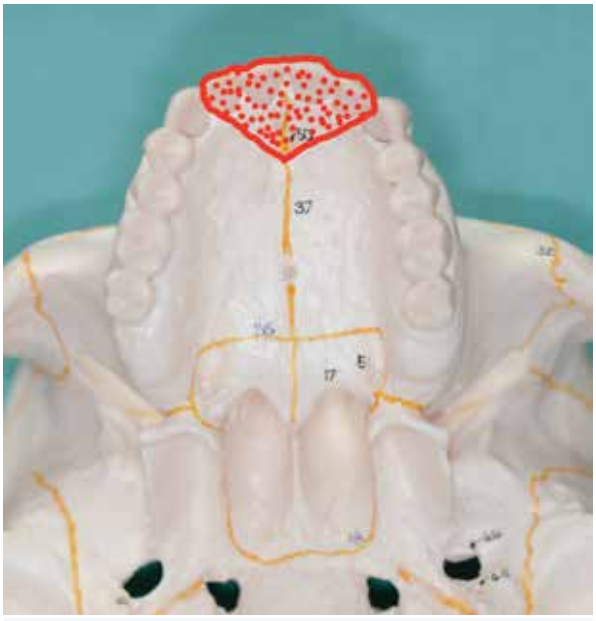

Figure 12A. Ib. class defect

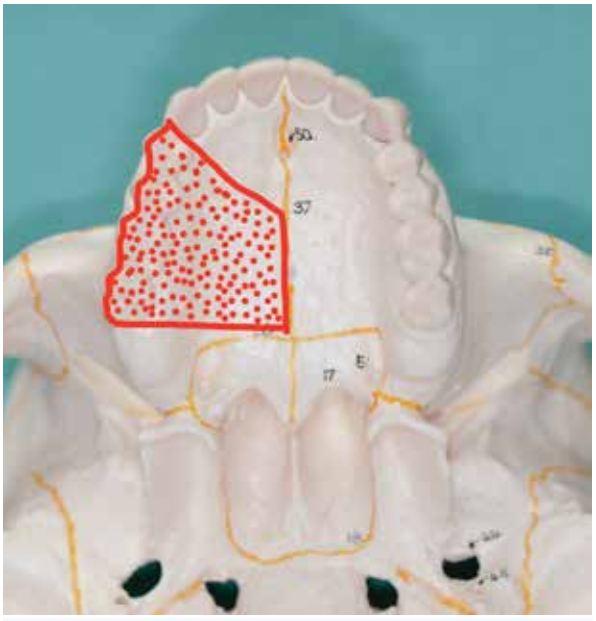

Figure 12B. Ib. class defects

(Figures 11–12 were created in accordance with Okay D., Genden E., Buchbinder D., Urken M. Prosthodontic guidelines for surgical reconstruction of the maxilla. *J Prosthet Dent.* 2001, Oct;86(4):352–63. Author's drawing on a photograph.)

Reconstructive surgical techniques	Indication
Local flap advancement, tubular tongue flap	Smaller defects not interfering with the alveolus.
Pedicled flaps (temporal flap, submental flap, FAMM, facial flap)	Large jaw defects with low retention for prosthesis.
Free flaps (rectus abdominis muscle, radial forearm flap, free fibula flap, scapular flap)	Large jaw defects with low retention for prosthesis.

Table 2. Surgical techniques used for maxillary and palatal reconstruction

to perform several osteotomies with subsequent shaping of the fibula into the desired shape and a harvest of bone with a skin island in order to cover soft tissue defects[54]. The flap harvest is a rather demanding procedure for the patient and it requires good technical hinterland and excellent knowledge and skill on the part of the surgeon. The actual shaping of the flap is performed either "free-hand" or using a previously engineered 3D model.[55] We affix this model to the fibula and we perform several osteotomies under the selected angle (ideally using a piezo-surgical device to protect the perforators) and we "fold" the individual fragments of fibula into the desired shape of the mandibula even before detaching the flap from the pedicle. It is this very technique, which decreases the period of ischaemia, blood loss and the blood vessel damage risk, which the patients face in case of shaping of the vascularized fibula by "free hand". The length and quality of the fibula allows replacement of virtually the entire mandibula, which no other free flap allows. The option to operate in two teams with a significant shortening of the surgery time is another advantage of this procedure.

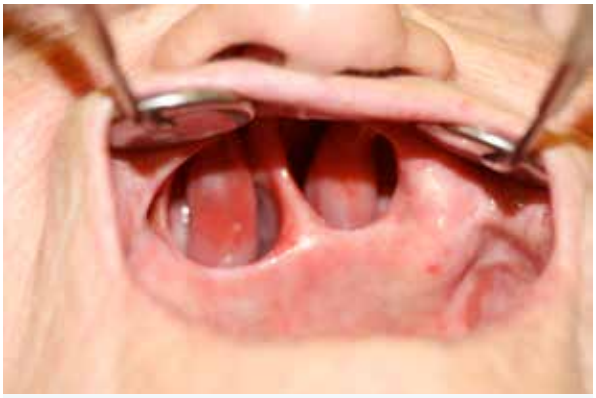

Figure 13. Example of Ib. class defect after spinocellular carcinoma extirpation – 8 years after surgery (author's archive)

Figure 14. An obturator covering Ib. class defect of the maxilla and palate (author's archive)

Vascularized hip bone

Mandibula replacement with a hip bone graft is limited by the small size of the harvested bone, relatively short vascular pedicle and the larger ratio of spongiosa over corticalis. In addition, the morbidity of the donor site is larger in comparison to the fibula and patients often suffer from post-operative hernia, severe pain and haematoma formation. Vascularization is not segmental and soft tissues are voluminous, inflexible and poorly pliable.[56] Nevertheless, despite all the aforementioned disadvantages and risks, the hip bone flap is preferred by some authors because of the volume of bone tissue usable for reconstruction, especially in the lateral sections and in the mandibular angle.[57,58]

Vascularized angle of the scapula

Mandibular replacement with a scapula is suitable for reconstruction of larger soft tissue defects and smaller bone defects[59]. The bone quality is good, but its disadvantage lies

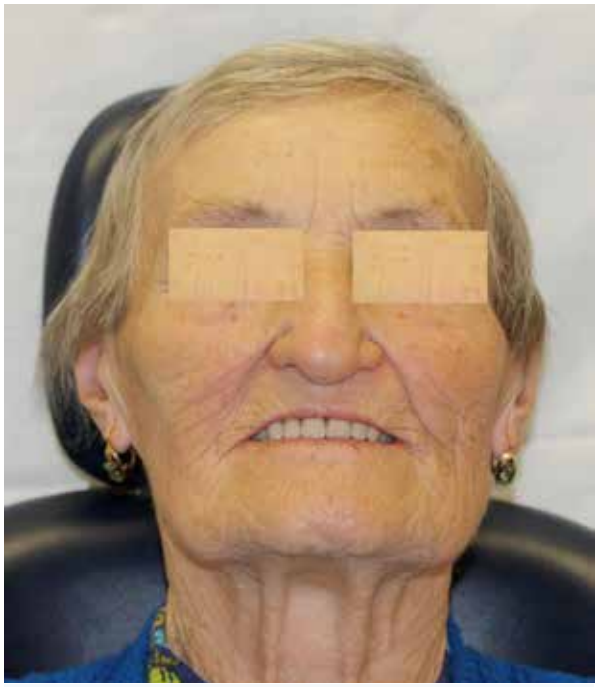

Figure 15. Prosthetic rehabilitation of a maxilla defect with an obturator in a female senior patient (author's archive)

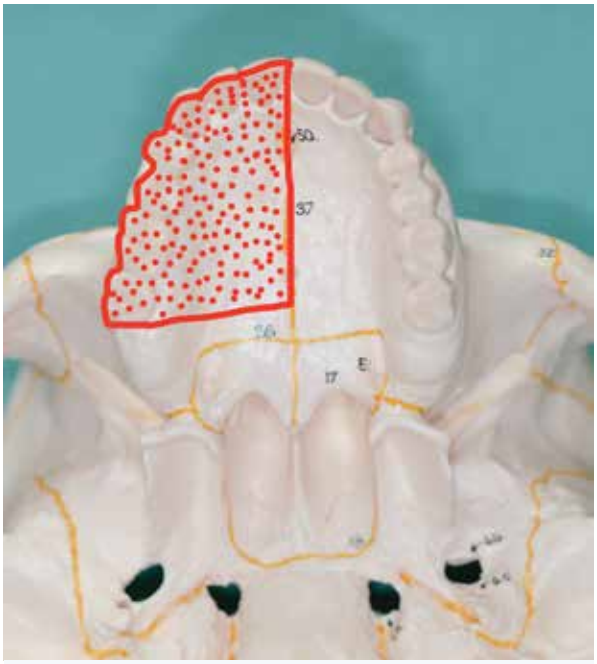

Figure 16A. II. class defect

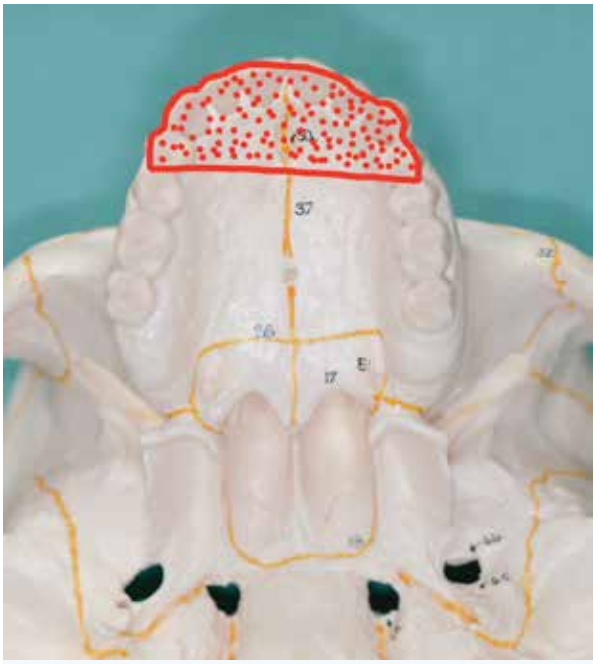

Figure 16B. II. class defect

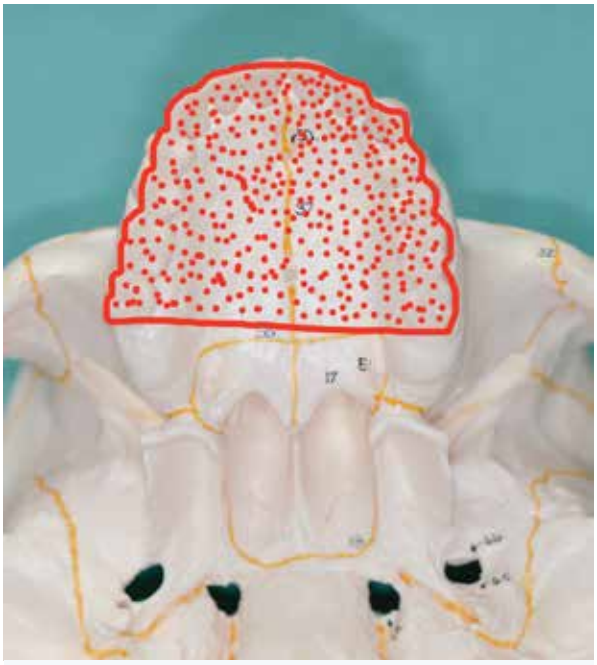

Figure17A. III. class defect

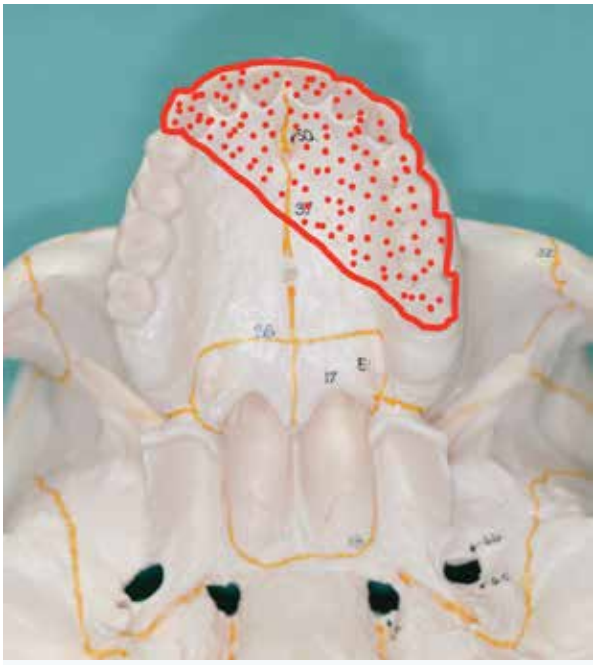

Figure 17B. III. class defect

(Figures 16–17 were created in accordance with Okay D., Genden E., Buchbinder D., Urken M. Prosthodontic guidelines for surgical reconstruction of the maxilla. *J Prosthet Dent.* 2001, Oct;86(4):352–63. Author's drawing on a photograph.)

in the insufficient thickness and the length limited to 14 cm (60). Vascularization is not segmental and therefore the bone shaping with osteotomies is considered to be risky. The necessity of positioning the patient on the side during the harvest and therefore the inability to operate in two teams and the related significant extension of the surgery length is another disadvantage of this approach. The morbidity of the donor site is not very significant, but in some patients

the limitation of the movements in the shoulder joint can occur[61]. Replacement of the lateral portion of the mandibula and the surrounding soft tissues in the submandibular and facial region is the ideal example of utilization of this flap.

Forearm flap with a part of the radius

The forearm flap is a flap with excellent vascularization of soft tissues, flexibility and elasticity.[62] Nevertheless, the vascularization of the harvested bone is not very rich and the morbidity of the donor site is significant.[63,64] The patients are facing the risk of a possible fracture of the thinned radius, the long-term healing of soft tissues with a risk of a rigid scar and a limited range of movements of the wrist. In addition, the bone volume and length are limited, and that is why the use of this flap is very limited (almost exclusively to the replacement of corticalis after an alveolotomy).

Maxillary and palatal reconstruction

The goal of the maxillary and palatal reconstruction is not only the separation of the jaw cavity and nose from the oral cavity, but also the rehabilitation of mastication, pronunciation, swallowing and appearance of the patient. The question of maxillary and palatal reconstruction is not as unambiguous as it is in the case of the mandibula, and apart from surgical techniques, we also use prostheses. Similarly to the mandibular reconstruction, we should consider several circumstances before the procedure:

a) Overall state of health of the patient
b) Defect size and location
c) Whether this is a primary or a secondary reconstruction
d) The wishes of the patient.

The size and location of the defect are important criteria when deciding between reconstruction with a surgical technique and a prosthetic rehabilitation. From the aforementioned surgical techniques (Table 2), we use local flap transposition in smaller defects not involving the alveolus and dentition. In large defects with smaller demands upon dental prosthesis retention, we use myocutaneous or osteomyocutaneous flaps, whose advantage lies not only in reconstruction of soft tissues, but also bone, which is important for the eventual introduction of dental implants in fixed or hybrid replacements.[65,66] On the other hand, large defect reconstruction using a myocutaneous flap with an expected replacement of the missing teeth with a removable prosthesis does not have to be the best solution. Admittedly, we will seal the defect hermetically using the myocutaneous flap, but we will rarely achieve the original gothic relief of the palate, which is important for the replacement retention[67]. The maxillary defect classification in accordance with Okey, who divides the defects into three groups according to their size, seems clear and well usable in practice to us[68].

Ia. class defects

Ia. class defects are located on the hard palate (Figure 11). Because they do not interfere with the alveolus and the dentition, we mostly manage them with a prosthesis (with a palatal plate or an obturator). According to the wishes of the patient or in case of prosthesis intolerance, we use local flap transposition from the available surgical techniques.

Ib. class defects

Ib. class defects interfere with the alveolar process and the dentition in the mesial direction from the canine (premaxilla) (Figure 12A), or in the distal direction from the canine (Figure 12 B). We mostly manage these defects using prosthetic replacements (an obturator with an anchoring element – continuous cast clip) and we use myocutaneous or osteomyocutaneous flaps from the available surgical techniques (Figure 13, 14, 15).

II. class defects

II. class defects involve less than a half of the hard palate in the sagittal (Figure 16 A) or transversal direction (Figure 16 B). In case of preservation of teeth with good biological factor in the surroundings of the defect, we can use a prosthesis (an obturator with anchoring elements).

In toothless jaws with a low alveolar process, we reconstruct defects using free or regional flaps.

III. class defects

III. class defects involve more than half of the palate, leave small number of the remaining teeth and minimum palatine bone (Figure 17 A, 17 B). The retention rate of removable obturator prostheses is low in these defects, and that is why we reconstruct them using free or regional flaps, if the overall state of health allows.

CONCLUSION

According to our experiences, pedicled flaps are mainly represented in intraoral defects of soft tissues of older, polymorbid patients. Supraclavicular flap, which is excellently malleable, is suitable for reconstruction of smaller defects of the tongue and the caudal portions of the face. In case of the palatal and oropharyngeal defects, we prefer submental flaps on upper pedicles over the supraclavicular flap because of its limited radius. Extensive intraoral defects are reconstructed using pectoralis major flaps for their large radius and volume of tissue.

Free flap techniques are indicated in mandibular defects, especially in its anterior portion. They are also suitable in cranial facial defects located out of the radius of pedicled flaps. We prefer these flaps especially in younger patients without serious internal comorbidities.

Flap plastic surgeries are a step forward, they allow larger surgical radicality and if correctly indicated, they provide better quality of life and longer survival.

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GUNSHOT INJURIES OF THE OROFACIAL REGION

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SUMMARY

Between 2000 and 2010, approximately 10,000 gun attacks resulting in death were registered in the EU countries. In the same period and region, approximately 40,000 suicides took place, 1,500 of which were in the Czech Republic. 82% of suicides or suicide attempts using a firearm (or another projectile weapon) led to a head injury. Typically, the shots target the temporal or submental region. The severity of the suffered injuries depends besides the wound site, projectile calibre and energy also on other factors such as the projectile trajectory, formation of secondary projectiles, shot reflection from the skeletal structures, etc. Gunshot wounds aimed at the splanchnocranium usually lead to injuries of the mandible(s), maxilla(e), orbit(s) and nose, i.e. of regions associated with multiple fields of medicine requiring multidisciplinary cooperation. The presented paper aims to explain in detail the destructive effects of gunshot injuries in the orofacial regions and to describe the recommended procedure during primary medical treatment. The team of authors aimed to clearly present important information originating both from literature and practical experience with this type of injury.
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KEYWORDS

Gunshot wounds, orofacial region, treatment protocol

INTRODUCTION

Gunshot wounds of the orofacial region are not very common in peacetime, they, however, represent a type of injury requiring a complex coordinated interdisciplinary care. Life-threatening comminuted fractures of the splanchnocranium and injuries leading to a loss of the soft tissues occur to a varying degree depending on the structure of the affected tissues as well as on the type, shape and energy of the projectile. Regardless of whether the injury is due to a suicide attempt (which is the most common), accident or an attack by another person, stabilisation of the principal vital function of the injured person according to the Advanced Trauma Life Support protocol plays a crucial role in the first stage. Only after this stabilisation and a detailed examination of the extent and character of the injuries, surgical reconstruction (in a single or multiple surgeries) can take place.

82% of suicides or suicide attempts by firearms (or, more generally, projectile weapons) lead to injuries to the head[1]. The projectile entry wound was usually in the temporal or submental region of the head. The aim of this paper is to describe the destructive effects of a projectile in the orofacial region and the recommended procedure in the primary treatment. The team of authors aimed to clearly present important information originating both from literature and practical experience with this type of injury.

EVALUATION OF THE TOPIC

Weapon and projectile types

Projectile weapons can be divided into mechanical (bow, crossbow, catapults, etc.), gas guns (propelled by compressed gas and its subsequent expansion – air gun, paintball gun, airsoft gun) and firearms defined as *"projectile weapons in which the energy necessary for expelling the projectile is supplied by rapid combustion (explosion) of an explosive substance (gunpowder)"*[2].

This paper will discuss the injuries caused by firearms. Those can be further classified according to the used *ammunition* into single bullet (single- or multiple-barrelled firearms with one or multiple barrels serving for shooting single bullets, projectiles or other shots intended for such use) and shotguns (single- or multiple-barrelled firearms ejecting multiple pellets instead of a single bullet)[2].

Bullets used in guns can be jacketed (with a greater penetration effect), semi-jacketed (deforming or fragmenting after impact to achieve an increased wounding capacity – forbidden for civilian use). Cluster shots (shotgun shells) consist of multiple pellets of identical size[2].

Mechanism of shot damage to the tissue

The wounding effect is directly proportional to its energy ($mV^2/2$) but depends also on many other parameters including jacketing or shape of the bullet[3]. Upon impact and entry of the projectile into the body, crushing, cavitation and stress wave occur to various degrees[3]. Crushing is a dominant

mechanism in low-velocity projectiles transferring the major part of their kinetic energy to the surrounding tissues[3,4]. The term "cavitation" describes the repeated process of cavity formation and collapse in soft tissues. The cavitation mechanism of injury is predominant in high-velocity projectiles. The terms "stress wave" means the transfer of kinetic energy into tissues surrounding the wound channel. Per the Huygens principle, refraction causes multiplication of the damage in the regions of tissue borders – typically, muscle disinsertion or damage to the vascular endothelia[3,5,6].

Types of gunshot injuries

The extent of the injury depends to a great degree on the energy load of the projectile. If the projectile energy is low, non-penetration injuries are common; if the bullets hit the body tangentially, we speak of grazing (or glazing) injuries. Shots with higher kinetic energy may either penetrate or perforate the body. The shape, extent and character of the gunshot wound depend besides the bullet energy, shape and properties also on the shooting range and the part of the body that was hit. If shot from the point-blank or close range, the shape of the entry wound depends on the shooting angle and shot calibre. The entry wound is characterised by an actual loss of tissue with an abrasion collar caused by the abrasion of the superficial parts of the skin during penetration. It can be surrounded by complementary gunshot factors (searing, soot, gunpowder tattoo). The exit wound, on the other hand, is usually rather of a lacerated character with a stellate, crescent or irregular rim, the individual parts of which fit together. The complementary factors of the entry wound are also missing. The wound channel also depends on many factors including the speed, calibre, mass, shape, construction and stability of the projectile as well as on the elasticity, viscosity, density and anatomical structure of the tissue. If the projectile breaks into secondary fragments, extremely complicated injuries can be expected[4,5,6].

In the orofacial region, projectile trapping can occur most commonly in the immediate vicinity of bones, in particular in low-energy projectiles or where multiple bones (or hard tissues in general) can be found in the projectile trajectory. The shooting channel is usually not completely straight – the changes in the density of the surrounding tissues lead to changes in turning the projectile in the long axis. In general, it can be said that the more the long axis deviates from the straight path, the more devastating are the effects on the surrounding tissues (in other words, the bigger is the cross-section of the projectile in the shot direction, the bigger is the drag of the projectile on the surrounding tissues and the greater is the damage)[5,6,7].

The pre-surgical stage from the surgeon's point of view

Shot wounds of the face can threaten vital structures and therefore, they must be attended to with maximum care. The basic life-saving tasks should follow the Advanced Trauma Life Support (ATLS) protocol. The mnemonic ABCDE sets the basic priorities of the primary evaluation and defines the specific order of the individual examinations and interventions necessary in all trauma cases[8,9,10].

Airway (airway check + immobilisation of the cervical spine)

Breathing (evaluation of ventilation)

Circulation (examination of circulation and bleeding)

Disability (examination of the neurological condition)

Exposure (undressing the patient and examination of body temperature)

Airway – it is necessary to evaluate if the airway is free and, if not so, securing it. It is necessary to consider a possible aspiration of fragments of teeth, bones, dentures or blood, as well as the potential instability of the tongue that can lead to obstruction of the airway. Endotracheal intubation can be used to secure the airway; if the injury is of greater extent and/or the lower jaw is destroyed, it is preferable to perform a tracheostomy. At the same level, we must take care of stabilising the cervical spine.

Breathing – free airway on itself does not necessarily mean sufficient gas exchange. This depends also on sufficient function of the lungs, thoracic wall, and the diaphragm, hence an examination of the chest is necessary.

Circulation – the most common cause for shock in trauma patients is blood loss with subsequent hypovolemia. Bleeding wounds must be located and resolved. The densely vascularised tissues of the head and neck can cause massive bleeding from soft tissues, in particular from the nose and mouth (tongue)[8,9]. Ligation of individual arteries may not be effective enough; in some cases, ligation of a whole artery branch can be necessary (e.g. *a. facialis* below the lower jaw, *a. lingualis* in the *trigonum Pirogovi* or *angulus Beclardi*, or ligation of *a. carotis externa* in the *trigonum caroticum*. When bleeding from the nasal cavity, anterior or anterior-posterior nasal packing (usually using a double-balloon catheter) is most commonly performed. If the nasal bleeding continues, coagulation or ligation of *a. sphenopalatina* or, if need be, *a. ethmoidalis anterior* and *posterior* can be done by endoscopic endonasal surgery. Another possibility is a selective embolisation of a branch (or branches) of *a. carotis externa* (most commonly *a. maxilaris* and *a. sphenopalatina*). It is often necessary to use blood transfusion to replace the blood loss[8,9,10].

Disability – a brief examination of the neurological findings. Awareness is evaluated using the Glasgow Coma Scale, pupil response and potential spine injury must be considered. Approximately 17 % of patients with facial gunshot wounds show signs of direct brain damage[9]. In gunshot wounds against the submental region, the injuries to the mandible and maxilla are frequently accompanied by injuries to the orbit and it is, therefore, necessary to consider the damage to the eye globe motility, or the eye globe and optical nerve themselves[10,11]. Among other things, it is necessary to look for signs of retrobulbar haematoma (obvious exophthalmos) that can, even after a very short time, lead to irreversible pressure damage to the optical nerve. In injuries by shots against the temporal region, the direction of the shot has a major influence on the resulting damage to the eye globe and adjacent tissues[10,11].

Exposure – this term means a full undressing of the patient and a detailed examination of all parts of the body to exclude additional injuries (such as ricocheted bullets)[12]. It is of course necessary to cover the patient after examination to maintain the body temperature.

If possible, it is also beneficial to look for the reasons of the suicidal attempt. In our practice, in one patient we have found a terminal stage of cancer to be a reason for such an attempt.

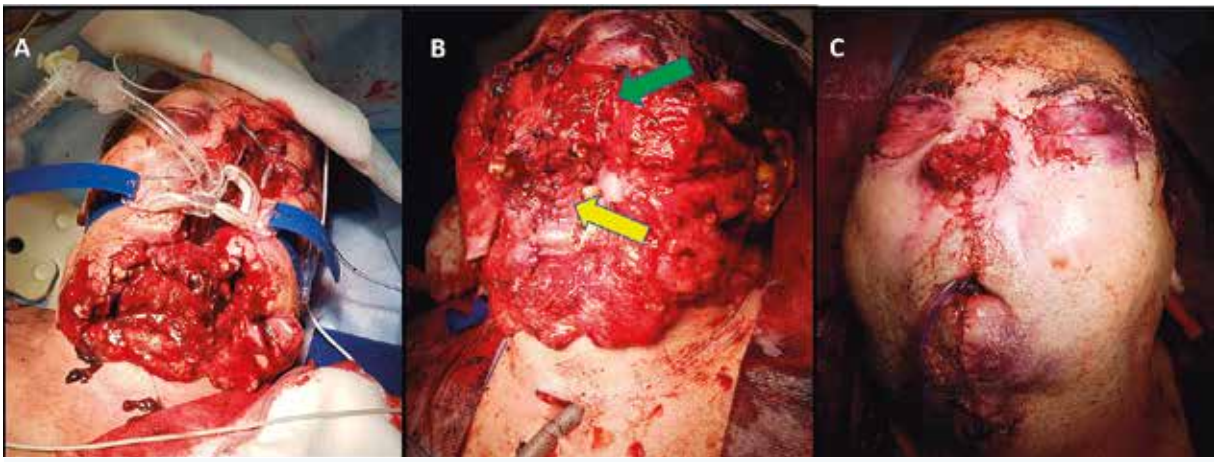

Figure 1. A) A patient intubated through his mouth following a gunshot injury to the face who was brought to the Accident & Emergency Unit, University Hospital Ostrava. The rigid cervical collar was already removed following a CT examination. B) The patient in the surgical theatre with tracheostomy and nasal packing due to bleeding; the green arrow indicates a primarily reconstructed maxilla and palate, the yellow arrow a reconstructed tongue. A loss injury to the mandible is obvious. C) Primary reconstruction of the face, nose and mouth; the lack of soft tissues is apparent (microstoma, notable lack of the nasal tissues)

Clinical examination

From the surgical perspective, it is necessary to first exclude the direct impact on central nervous system necessitating an urgent neurosurgery consultation or intervention. After that, an examination of the splanchnocranium is performed, which can be difficult due to diffuse bleeding from soft tissues; where loss injuries occur, the wound is also usually very disorganised (Figure 1). It is, therefore, necessary to first identify the source of bleeding[12]. In the extraoral region, it is important to focus in particular on the examination of visual acuity of each eye separately (if the patient condition allows it), ocular motor control, eye globes, optical nerves and adjacent orbital structures. This should be followed by evaluation of the sensory innervation of all three branches of the *n. trigeminus* as well as of potential damage to the *n. facialis*[13]. Examination of the nasal cavity, evaluating the seriousness of bleeding and assessment of the signs of rhinoliquorrhea should follow. Subsequently, the presence of bleeding from the outer ear canal or oroliquorrhea is evaluated. If any of those are present, a sterile strip is inserted into the outer ear canal and then sent for examination for beta-trace protein. If the patient is conscious, a preliminary check of hearing should be performed using a tuning fork. Once the patient condition is stabilised, an audiometric

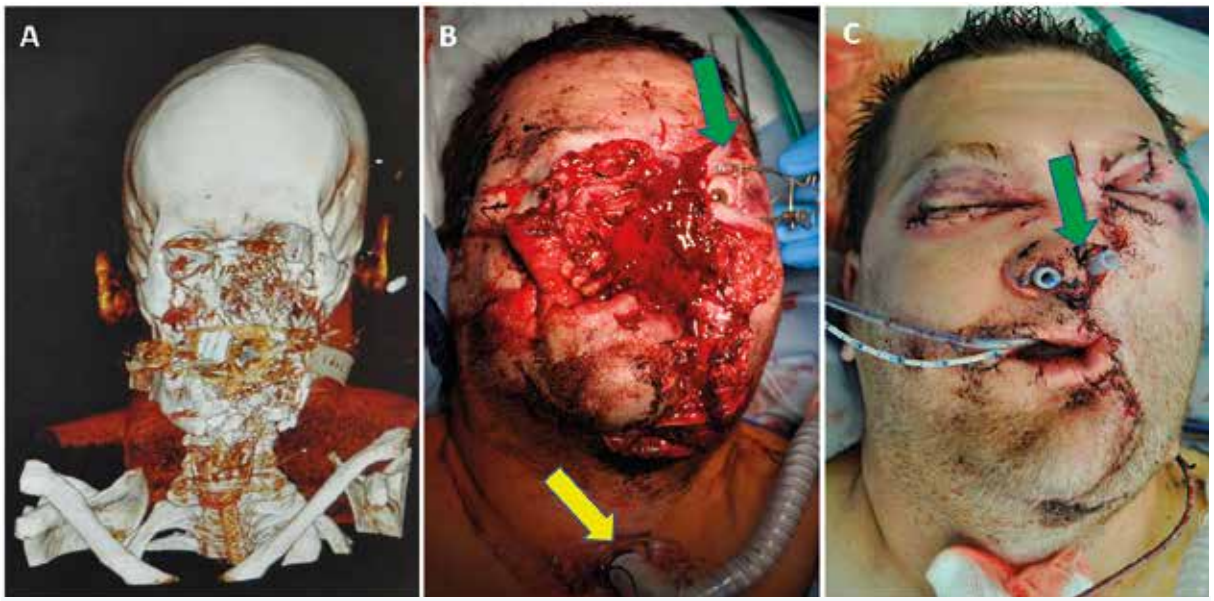

Figure 2. A) CT examination of the same patient with a gunshot injury to the face (intubated through the mouth); the scan shows a comminuted fracture of the lower jaw and a loss injury to the maxilla. B) Eye globe examination using an eyelid opener (green arrow) and tracheostomy (yellow arrow) C) Reconstructed face, the green arrow indicates tubes used for nose reconstruction

examination can be performed if the hearing is affected. If possible, we evaluate the presence and character of nystagmus, which can be a sign of either peripheral vestibular lesion or damage to the central nervous system.

Eventually, the extent of soft and hard tissue loss must be evaluated. Assessment of the course of the facial nerve is important. If the wound is in the region of the branches of the facial nerve and those are visible, the primary surgery must always include the finding of the facial nerve branches and if their continuity is damaged, a microscopic suture must be performed. The potential delayed suture of the facial nerve (several weeks later) is much more difficult and the results are significantly worse[12,13].

The intraoral examination should follow. Fragments of teeth, bones, prosthetic devices or foreign bodies can be present in the oral cavity[12]. Occlusion and intercuspidation should be assessed, it is, however (due to the patient condition), not always possible. If this is the case, incisional edges of the frontal teeth or worn out surfaces of the teeth can be helpful[12].

The use of imaging methods is a necessary part of the diagnosis. Computed tomography (CT) of head and neck is a principal imaging method in such cases[14]. For proper evaluation, at least two mutually perpendicular projections must be taken; if a 3D reconstruction is available, it provides a better general idea of the full extent of the injury (Figure 2).

Treatment protocol[8,9,10]

1. Primary life-saving procedures including haemodynamic stabilisation and haemostasis following ATLS guidelines.
2. Imaging methods: Computed tomography (CT) in all gunshot injuries to the splanchnocranium (a 3D reconstruction is desirable).
3. Interdisciplinary patient evaluation (traumatologist, anaesthetist, radiologist, neurosurgeon, neurologist, ENT specialist, maxillofacial surgeon, ophthalmologist, plastic surgeon), diagnosis and classification of the injuries, preparation of a list of diagnoses and establishing priorities of the multidisciplinary treatment protocol.
4. Tracheostomy where extensive loss injuries are concerned (if not performed during the primary life-saving procedures).
5. Treatment of periocular tissues, eye globe(s) and the orbit(s).
6. Stabilisation of the facial skeleton and osteosynthesis of the fragments.
7. If possible, nose reconstruction preserving maximum of soft tissues is desirable.
8. Closure of soft tissue defects (risk of microstoma, lagophthalmos, oronasal and oroantral communication, nose blockage) fully covering the bone fragments.
9. Patient nutrition (nasogastric tube insertion).

CONCLUSION

The extent and severity of the injuries depend, besides the site of the injury, bullet calibre and energy, also on other factors such as the bullet trajectory, formation of secondary projectiles, ricochets/deflections of the projectile from the skeletal structures, etc. In practice, gunshot wounds often cause injuries to the mandible, maxilla, orbit and nose, i.e., to organs requiring broad interdisciplinary cooperation.

Figure 3. A patient 6 months after the primary reconstruction. Scarring and deformation of the entire face are obvious

For clinical practice, the knowledge of the type of the used gun and bullet can be beneficial as it facilitates the possible estimation of the degree of tissue trauma.

The subsequent reconstruction of the orofacial region can represent a major challenge for the entire reconstruction team (Figure 3).

Author roles: Adam Oskera: review of literature, manuscript writing. Oldrich Res: final manuscript approval, patient treatment Juraj Timkovic: final manuscript approval, patient treatment. Adam Kopecky: final manuscript approval, patient treatment. Martin Paciorek: final manuscript approval, patient treatment. Karol Zelenik: final manuscript approval, patient treatment. Petr Handlos: manuscript writing, final manuscript approval. Jiri Stransky: final manuscript approval, patient treatment. Jan Stembirek manuscript writing, final manuscript approval, patient treatment.

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ČESKÉ SOUHRNY

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PŘEHLED A NÁŠ PŘÍSTUP K LÉČBĚ MALIGNÍCH KOŽNÍCH NÁDORŮ RUKY

Tripoli, M., Franza, M., Cordova, A.

Úvod. Diagnóza zhoubných kožních nádorů ruky je často obtížná díky přítomnosti různých anatomických struktur v této oblasti. Přesto lékaři musí být schopni odlišit typické benigní afekce od život ohrožujících nebo končetinu ohrožujících maligních onemocnění. Vzhledem ke komplexním strukturám ruky umístěným v malém prostoru musí chirurg neustále hledat rovnováhu mezi adekvátním výkonem a funkčními a kosmetickými následky. Proto se k určení správné diagnózy a způsobu léčby doporučuje multidisciplinární přístup.

Materiály a metody. V letech 2006 až 2017 bylo retrospektivně analyzováno 354 pacientů s bazocelulárními a skvamocelulárními karcinomy a melanomy ruky na oddělení plastické a rekonstrukční chirurgie Univerzity v Palermu. Chirurgická léčba byla provedena u všech pacientů a na základě histologické diagnózy byla u některých z nich nutná také radioterapie a chemoterapie.

Výsledky. Nejběžnějším nádorem byl karcinom bazálních buněk (BCC), po kterém následoval spinocelulární karcinom (SCC). Melanom byl nejčastější lézí diagnostikovanou na prstech. Hlavní metodou volby byla radikální excize. Ve 29 případech (11x SCC, 18x melanom) byla provedena axilární lymfadenektomie z důvodu metastáz do lymfatických uzlin. Během sledování pokračování onemocnění ve vzdálených orgánech došlo k úmrtí tří pacientů. Míra recidivy byla vyšší v případě infiltračních SCC a BCC.

Závěry. Odborná literatura poskytuje pouze omezené informace o maligních nádorech měkkých tkání ruky. Cílem naší retrospektivní studie je představit nejčastější maligní nádory měkkých tkání ruky, analyzovat jejich příčiny, možnosti jejich objektivního a instrumentálního vyšetření a jejich léčbu.

VYLEPŠENÝ PROTOKOL ZOTAVOVÁNÍ PO AUTOLOGNÍ REKONSTRUKCI PRSU VOLNÝM LALOKEM

Yim, GH., Lewis, C., Oates, C., Holmes, W., Proussakaia, E., Wilson, S.

Úvod. Cílem vylepšeného protokolu zotavení po operaci (ERAS) je dosáhnout dřívějšího zotavení, zkrácení délky pobytu v nemocnici (LOS) a zlepšení výsledků rehabilitace pacientek. Po zavedení našeho protokolu ERAS jsme se snažili přezkoumat získané zkušenosti. Naším cílem bylo vyhodnotit LOS, pooperační komplikace, analgezii při propuštění, spokojenost pacientky a náš protokol ERAS ve srovnání s literaturou.

Metody. Jednalo se o retrospektivní studii celé naší prospektivně utvářené databáze v období od ledna 2016 do prosince 2016. Byly shromážděny demografické údaje o pacientkách, LOS, analgezie při propuštění a komplikace. Spokojenost pacientek byla stanovena pomocí 10bodového Likertova dotazníku.

Výsledky. Celkem 70 pacientek podstoupilo rekonstrukci prsu pomocí volného laloku na dolní epigastrické stopce (DIEP). Průměrný věk při chirurgickém výkonu byl 51 let (rozmezí 23–71). Průměrný LOS byl 4,89 dní (rozmezí 4–0). Celkem 61 pacientek (87 %) bylo propuštěno do 5 dnů. Celkem 65 pacientek (93 %) bylo propuštěno domů bez nutnosti podání opioidů. Velké a malé komplikace se vyskytly u 3 pacientek (4 %), resp. u 5 (7 %) pacientek. Nebyl zjištěn žádný případ úplného nebo částečného selhání laloku. Třicetidenní spokojenost pacientek byla vysoká (> 9/10) ve všech oblastech, ale pacientky si stěžovaly na nevolnost a zvracení.

Závěr. Přijetí našeho zlepšeného protokolu zotavování po autologní rekonstrukci prsu vedlo ke snížení průměrného LOS a potřeby opioidů, podobně jako v současné literatuře. Zjistili jsme však, že existují další vylepšení, která lze v našem protokolu ERAS provést, a že stále je třeba evidence-based kontroly k ověření naší praxe. Tato musí probíhat paralelně s edukačními a kontrolními cykly, aby bylo podpořeno užívání ERAS, které může bezpečně optimalizovat výsledky u pacientek.

SYNDROM ČERVENÉHO PRSU (RBS) SPOJENÝ S POUŽITÍM SYNTETICKÉ SÍŤKY PŘI REKONSTRUKCI PRSU

Mayer, HF., Perez Colman, M., Stoppani, I.

U některých pacientek, které podstoupily rekonstrukci prsu pomocí acelulární dermální matrix (ADM), se vyvine pooperační erytém kůže nad ADM štěpy označovaný jako syndrom červeného prsu (Red breast syndrome – RBS). Podle našich nejlepších vědomostí tato entita nebyla spojována s použitím syntetické síťky.

Představujeme případ 61leté pacientky, která podstoupila bilaterální profylaktickou mastektomii s ušetřením bradavky pro mutaci genu BRCA-1. Pacientka byla ihned rekonstruována vložením implantátů přímo a implantáty byly pokryty síťkou z polyglykolové kyseliny. Dvacet dní po rekonstrukci se na kůži prsou nad síťkou objevil bledý erytém obou rekonstruovaných prsou bez známek infekce. Pacientka neudávala příznaky, jako jsou horečka nebo bolestivost na dotek a nevykazovala žádné klinické známky infekce. Její laboratorní testy byly v mezích normy. Rozhodli jsme se sledovat a čekat. Pacientka byla pečlivě ambulantně sledována. Postupně erytém začal mizet, až spontánně vymizel.

RBS byl popsán pouze s použitím ADM, ale protože v tomto případě byla síťka vyrobena z kyseliny polyglykolové, navrhujeme, aby RBS byl popisován při použití biologických, ale i syntetických sítěk. Důležitost jeho diferenciální diagnostiky spočívá v odlišení od infekce.

NÁHODNÝ NÁLEZ SYNCHRONNÍHO BILATERÁLNÍHO DUKTÁLNÍHO KARCINOMU IN SITU U MLADÉHO MUŽE PŘI MASTEKTOMII PRO GYNEKOMASTII – A CO BY PŘINESLA LIPOSUKCE? KAZUISTIKA

Horta R., Schmitt F., Pereira N., Gervásio H.

Karcinom prsu u muže je vzácným nálezem. Uvádíme případ synchronního bilaterálního duktálního karcinomu in situ (DCIS), který se vyvinul u 26letého muže s dlouhodobou přítomností gynekomastie. Pacient podstoupil bilaterální subkutánní mastektomii. Histologie odhalila bilaterálně jasný DCIS. Nebyl nalezen žádný identifikovatelný příčinný faktor pro vývoj bilaterálního DCIS a nebyla přítomna rodinná anamnéza nemoci. Žádná další léčba nebyla nutná a po 18 měsících nebyly zaznamenány žádné známky lokální recidivy. Tento případ poukazuje na skutečnost, jak je třeba být ostražitý, i pokud se jedná o přítomnost malignity v normálně benigních podmínkách. Liposukce se sice stala velmi užitečnou technikou pro korekci gynekomastie, ale existuje zde riziko diseminace neznámého maligního nádoru. V atypických případech by měla být provedena vždy chirurgická excize en bloc.

DERMÁLNÍ NÁHRADY V REKONSTRUKČNÍ CHIRURGII: SOUČASNÝ STAV A PERSPEKTIVY

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Pokrok v akutní a intenzivní péči v oboru popáleninové medicíny ve 21. století výrazně snížil mortalitu u kriticky popálených pacientů. Centrem zájmu léčby u popálených pacientů se nestává pouhé přežití, ale i kvalita života po popáleninovém traumatu, zvláště pak kvalita hojení defektů při ztrátě plné tloušťky kůže, následné vyzrávání, vlastnosti a vzhled jizev. Aplikace kožních náhrad je výhodná svými vlastnostmi eliminujícími excesivní jizvení, vznik hypertrofických a keloidních jizev a následný vznik kontraktur. Autoři ve své práci uvádějí strategii užívání, aplikace a vývoje dermálních náhrad, jakožto i současné trendy užití dermálních náhrad v léčbě defektů plné tloušťky kůže.

AKTUÁLNÍ FARMAKOLOGICKÉ MOŽNOSTI UDRŽENÍ PRŮCHODNOSTI MIKROVASKULÁRNÍ CÉVNÍ ANASTOMÓZY: PŘEHLEDOVÝ ČLÁNEK

Pohanka, Š., Šimek, J.

Klíčovým prvkem mikrovaskulární rekonstrukce je zachování průchodnosti cév laloku. I přes velké zvýšení úspěšnosti tkáňové rekonstrukce za posledních 30 let jsou ischemické komplikace stále nežádoucí událostí. Autoři hodnotili současnou i starší literaturu a porovnávali vývoj perioperačních farmakologických intervencí v antitrombotické prevenci.

INDIKACE A VÝZNAM REKONSTRUKČNÍ CHIRURGIE OBLIČEJOVÉHO SKELETU V MAXILOFACIÁLNÍ CHIRURGII: PŘEHLED

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Maligní nádory hlavy a krku patří mezi častá onemocnění, jejichž frekvence se neustále zvyšuje. V České republice se procentuální zastoupení orofaciálních nádorů pohybuje okolo 2% z celkového počtu malignit. Racionální léčba těchto tumorů je komplexní a dlouhodobá. V terapeutické rozvaze je nutno brát v úvahu věk nemocného a stadium onemocnění včetně přítomnosti vzdálených metastáz. Důležitým předpokladem úspěšnosti chirurgické terapie je odstranění nádoru s dostatečným bezpečnostním lemem a eventuálně ošetření spádového lymfatického systému dle typu tumoru. Rekonstrukční výkony v maxilofaciální onkochirurgii předpokládají dobrou mezioborovou spolupráci a vysokou odbornou připravenost chirurgického a ošetřovatelského týmu. S ohledem na rizika místních i systémových pooperačních komplikací má velký význam také správný výběr pacienta. Zlatým standardem v rekonstrukci hlavy a krku je dnes využívání volných lalokových technik, je třeba však ovládat i techniky stopkovaných laloků, jejichž přednost spočívá v jednodušší technice a často i v lepším estetickém výsledku. Současně je třeba si uvědomit, že i tradiční, klasické rekonstrukční postupy s využitím protetických náhrad mohou být v řadě případů ideálním řešením.

STŘELNÉ PORANĚNÍ OROFACIÁLNÍ

Oskera A., Res O., Timkovic J., Kopecky A., Paciorek M., Zelenik K., Handlos P., Stransky J., Stembirek J.

V průběhu let 2000 až 2010 došlo ve státech Evropské unie přibližně k 10 000 útokům střelnou zbraní se smrtelnými následky. Ve stejném období pak bylo evidováno přibližně 40 000 sebevražd střelnou zbraní, z toho přibližně 1500 případů v České republice. V případě sebevražd či pokusů o sebevraždu střelnou, popřípadě palnou zbraní došlo v 82 % případů k poranění hlavy. Výstřely byly vedeny zpravidla proti temporální krajině hlavy, potažmo proti submentální krajině obličeje. Závažnost utrpěných poranění pak závisí nejen na lokalitě poranění, kalibru střely a její energii, ale i na dalších faktorech, jako jsou dráha střely, vznik sekundárních projektilů, odraz střely od skeletárních struktur apod. V případě střelných poranění vedených proti splanchnokraniu se v praxi obvykle setkáváme s poraněním mandibuly, maxily, očnice a nosu, tedy lokalit dotýkajících se řady různých oborů s nutností široké multidisciplinární spolupráce. Cílem našeho článku je vysvětlení destruktivního účinku střelných zbraní v orofaciální oblasti a doporučený postup při primárním ošetření. Snahou autorského kolektivu bylo čtenáři předložit ve zkratce důležité informace, které byly čerpány jak z literatury, tak i z vlastních zkušeností.