Acta Biomed 2021; Vol. 92, N. 6: e2021301 DOI: 10.23750/abm.v92i6.10089

Original article

Major scalp defect reconstruction with free flap: analysis of the results.

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Abstract. *Introduction:* The purposes of this study were to report 10-years experiences in microsurgical reconstruction of major scalp defects, comparing outcomes, evaluating complications. *Materials and methods:* From November to July 2015, 10 consecutive patients underwent microsurgical procedures for severe scalp defects. *Results:* The average age was 55,1 years ranging from 6 to 87 years. The mean follow-up was 16.7 months ranging from 12 to 24 months. The size of the lesions ranged from 9x10 to 16x20cm. The average hospital stay was 20 days ranging from 8 to 43 days. Mean operative times was 5.3 h ranging from 5 to 6.45 h. Free flaps included 8 Latissimus Dorsi flaps (LD) and 2 anterolateral thigh flaps (ALT). The superficial temporal vessels were used as recipient vessels in 9 cases while the superior Thyroid artery was used in remaining case. *Discussion:* For large or complex lesions, the use of free flaps is mandatory. Nowadays LD and ALT flaps are among the most common reconstructive choices for scalp defects reconstructions. Older age does not contraindicate the operation procedure nevertheless in younger patients the size of vessels is proportionately larger and pristine. *Conclusion:* Microvascular free tissue transfer is the mainstay of scalp defects coverage. In our series early complications are less common and concerning than late complications and in fact reoperations are mainly required to manage these latter. Advanced age should be not consider a contraindication for free flap surgery and the procedure can be considered safe and reliable in both old and young population. (www.actabiomedica.it)

Key words: Microsurgery, Scalp reconstruction, latissimus dorsi, ALT flap, free flap, microsurgical reconstruction

Introduction

Scalp defects occur frequently after cutaneous tumor resection, trauma, burns, infections or following neurosurgical procedures. Several reparative techniques have been described: secondary intention healing, skin grafts, dermal matrix, local or free flaps. Skin grafts require the presence of intact periosteum although dermal matrix can be used. Local flaps can be adopted to repair defects up to 6-8 cm^2 in size or smaller for lesions located at the hairline. Furthermore, the inelasticity of the scalp limits the mobilization of the surrounding tissues that can be partly overcome by weakening the galley (1-3). Wider defects with skull or calvaria's prosthesis or deeper tissues exposure require free flaps. Microsurgical techniques evolved over the past decades and different flaps are available for scalp reconstruction: omentum flap, rectus abdominis myocutaneous flap, scapular or parascapular flap, serratus anterior flap, deep inferior epigastric perforator flap, radial forearm flap, and thoracodorsal artery perforator flap (7,8,9,10). Some of these have only an historical value even if they could be applied in strictly selected cases. Today the most popular free flaps in scalp reconstruction are the Latissimus Dorsi (LD) and the Anterolateral Thigh Flaps (ALT) (4,5,6). The purpose of this study is to report 10-year experience (November 2006- July 2016) in microsurgical reconstruction of major scalp defects comparing outcomes and evaluating complications.

Materials and methods

From November 2009 to July 2015, 10 consecutive patients underwent microsurgical procedures for severe scalp defects. Inclusion criteria were: defects greater than 9 cm^2 with skull exposure, resulting after trauma, tumor resection and dehiscence consequent to previous surgical procedures. Pre- and postoperative photographic documentation was acquired in standard conditions and in digital format. Personal and medical data were collected and reported in Table 1. Preoperative screening included vascular doppler evaluation both of the flap and recipient vessels. No angio-MRI or angio-CT scan were performed. Patients were clinically followed-up at 1, 3, 6 and 12 months including photographic documentations. All operations were performed under general anesthesia by the same surgical team. Microsurgical anastomosis were performed under microscope. Arteriorrhaphies were performed with non-absorbable interrupted sutures (Nylon 8-9/0), while the venorrhaphies using end-to-end anastomotic devices (Coupler®). In all cases, intravenous intra-operative antibiotic prophylaxis was administered. The postoperative pain management for patients aged >18 years was through Patient Controlled Analgesia (50 mg morphine + 100 ml of physiological solution) with self-administered doses of 2 ml (1 mg of morphine) repeatable every 5 minutes.

Results

Patients included in the present study were 5 males and 5 females. The average age was 55,1 years ranging from 6 years to 87 years. The mean follow-up was 16.7 months ranging from 12 to 24 months. The size of the lesions ranged from 9 x 10 to 16 x 20 cm. The average hospital stay was 20 days ranging from 8 to 43 days. Mean operative times was 5.3 h ranging from 5 to 6.45 h. Clinical and surgical data are reported in Tab 1.

Patient 2 and 5 previously underwent radiotherapy respectively 1 and 7 years before surgery. Patient 4 underwent neo-adjuvant chemotherapy. Both patients 1 and 5 underwent partial calvarias resection (respectively 18x15 cm and 13x11 cm in size) with simultaneous reconstruction using methyl-metacrylate prosthesis and titatium mesh respectively. For soft tissue reconstruction two ALT and eight LD flaps were performed; muscle flaps were successively covered with skin grafts. Superficial temporal vessels were used in 90% of cases as recipient vessels.

In case 3 thrombosis of the left temporal artery occurred 4 hours after surgery. This complication was managed with anastomosis revision and vein graft, using small saphenous vein, to ipsilateral facial artery. The flap healed uneventfully with no flap loss. Furthermore, at 1 month follow up, wound marginal dehiscence were observed in cases 1 and 2, solved with rotation of local flaps. No complications at the donor sites and no total or partial necrosis of the flaps were observed.

Discussion

Reconstruction of the scalp must restore tissue integrity, protecting the skull and its contents, ensuring satisfactory cosmetic appearance (11). Although their thickness and resistance can be fortified by fat graft, skin graft provide a thin and inelastic coverage not very resistant to traumas and wear, showing a tendency to ulceration. Local flaps can provide satisfactory and aesthetically pleasing results for scalp defects $<$ 6-8 cm^2. According to the nature of the lesions and the compliance of the patients' skin expander can be adopted (13-14). Nevertheless for large or complex lesions free flaps are the gold standard.

The radial forearm flap, firstly described for scalp repair in 1986 by Chicarilli, provided an ideal thickness and texture coverage and a long pedicle with good vessels caliber (20). Although it resulted adequate to repair small to medium size scalp defects. It has fallen out of use because it requires the sacrifice of a major artery and poor aspect of the donor site (21). Parascpular osteocutaneous flap, provided multi-tissue reconstruction of defects $>$ 25 cm^2. Even if it resulted easily conformable to parietal-temporal area reconstruction, the length of its pedicle, usually less than 8 cm, often required a vein graft for the

Table 1. patients' data. Squamous cell carcinoma (SCC); Basal cell carcinoma (BCC); LD (Latissimus dorsi flap); ALT (anterolateral thigh flap); STa (Superficial Temporal Artery)

PZ	AGE	COMORBIDITY	ETIOLOGY	FLAP	LOCATION OF DEFECT	SIZE^{CM}	RECIPIENT VESSELS	COMPLICATIONS	OPERATING TIME ^{H}	HOSPITALIZATION ^{DAYS}
M	87		SCC	LD	Parieto-occipital	21 × 17	STa	Dehiscence	6,45	25
M	78	Diabetes type II	SCC	LD	Parieto-occipital	16 × 20	STa	Dehiscence	6,4	43
F	72		Poro-carcinoma	LD	Fronto- parietal	12 × 11	STa	Thrombosis of STa	5	27
M	65	Diabetes type II Hypertension	Angiosarcoma	ALT	Parieto-temporal	22 × 14	Thyroid artery Giugular vein		6,30	10
M	58		BCC	ALT	Parietall	18 × 15	STa		6,20	12
F	38		Dehiscence	LD	Parietal	17 × 9	STa		5,30	22
F	76	Diabetes type II Hypertension Atrial Fibrillation	BCC	LD	Parieto-occipital	22 × 21	STa		5,45	19
F	6		Trauma	LD	Fronto-parietal	12 × 10	STa		5,30	15
F	9		Dehiscence	LD	Fronto-parietal	15 × 9	STa		6,35	19
M	62		BCC	LD	Parieto-occipital	13 × 11	STa		6	13

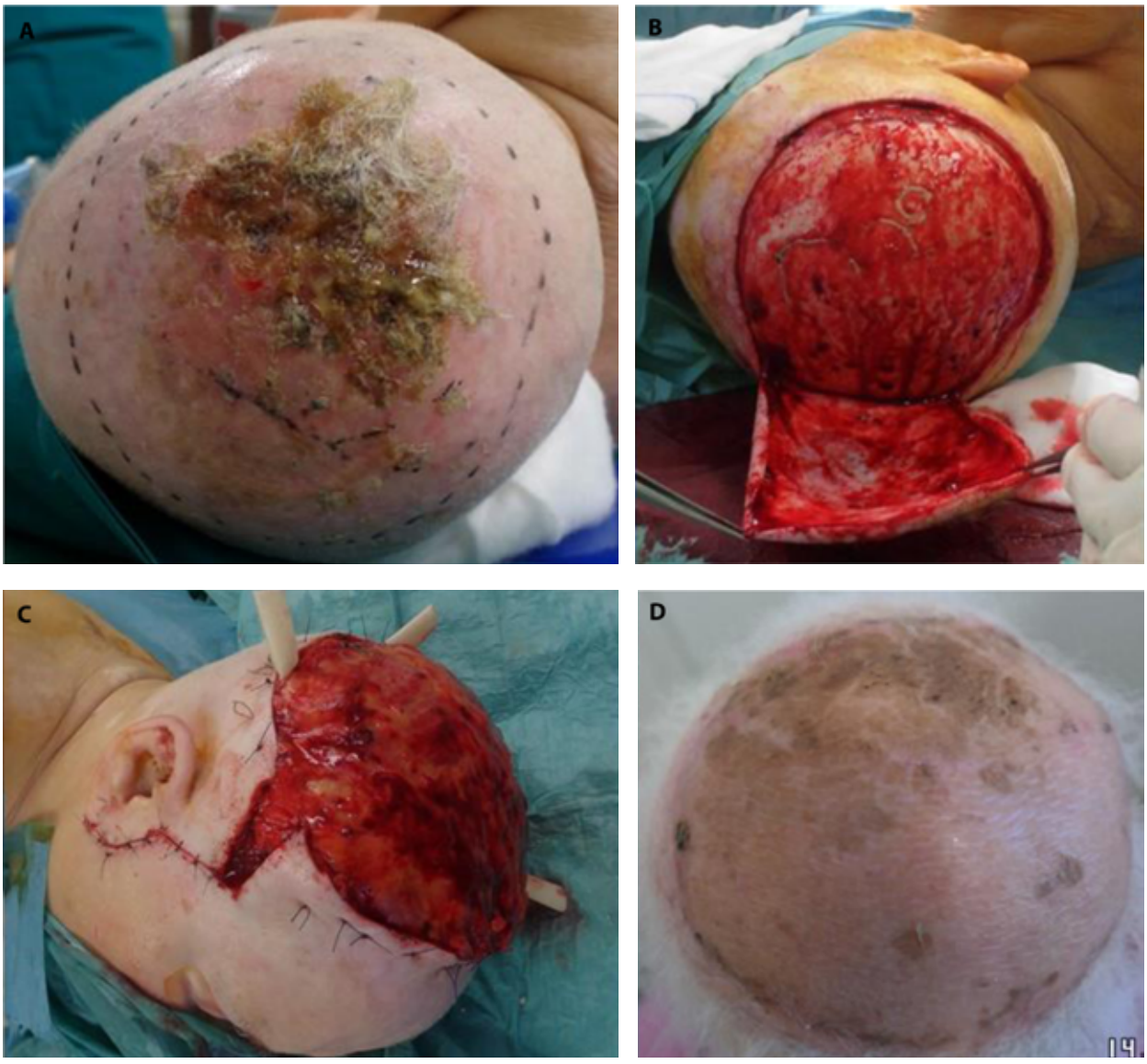

Figure 1. A) Pre-operative view of a 76 years old patient affected by basal cells carcinoma involving the major part of the scalp; B) Intra-operative view of the defect; C) Latissimus dorsi flap tailoring; D) 12-months follow up.

anastomosis (11). Nowadays, LD and ALT are the most common reconstructive choice for scalp defects. The former can be easily tailored to the cranial profile achieving satisfactory aesthetic results. LD flap provides a large muscle, a long pedicle, vessels of good calibre and when necessary, it can be harvested with a rib portion to repair small skull defects (6,11,24). Nevertheless the contraction resulting from the muscle atrophy following its denervation, can cause marginal dehiscence exposing the underlying bone or calvarias prosthesis. This complication can be avoided harvesting larger flaps. LD flap requires skin grafts which offers poor resistance to repetitive wear and tear traumas and often times are inadequate to bear adjuvant radiotherapy when necessary. The perforating adipo-cutaneous thoracodorsal artery flap (TDAP) does not require any muscle sacrifice, but its thickness may result excessive (15).

Figure 2. A) Intra-operative view of a 65 years old man affected by an angiosarcoma of the right Temporo-parietal area; B) Antero lateral tight flap harvesting; C) Antero lateral tight flap insetting; D) 15 months follow up

ALT flap was firstly described in scalp reconstruction by Koshima in 1993. Since then it has become one of the most popular choice for repairing defects of the scalp (16). With patient in supine position it allows a double surgical team approach. Certainly ALT provides smaller amount of tissue compared to LD but it does not require any muscle sacrifice. The length of its pedicle is variable; usually an intramuscular location of the pedicle is associated with a greater length of the perforator but a more tedious dissection. ALT flap can be also harvested with a part of the vastus lateralis muscle or in association with vascularized fascia lata to reconstruct the dura madre (17,19). ALT flap can allow direct closure of the donor site with poor donor site morbidity, provides an adequate skin coverage but its thickness may require a debulking to optimize its contouring to the cranial profile (1).

The superficial temporal vessels are equidistant from any part of the scalp, are easy to access and are rarely involved by degenerative processes. Furthermore, they offer a certain working comfort for operators.

In patient aged < 6-7 years, the relationship between cranial surface and the lower limbs is generally unfavorable; coverage of extensive area requires, in virtue of its greater amplitude, to inevitably use LD flap. In pediatric population the size of the vessels is proportionately larger than in adults and the quality is pristine but they have a major tendency to peri-operatory vasospasm. [26] By contrast older age does not contraindicate this procedure. In our opinion, in older patients and/or with associate co-morbidity, LD is preferable because of the consistency of the anatomy, the size of the vessels allows a quicker operative time which results safer for patients.

Conclusion

Microvascular free tissue transfer is the mainstay of scalp defects coverage. In our series early complications are less common and concerning than late complications and in fact reoperations are mainly required to managed these latter. To date there is no ideal flap to repair all the types of scalp defects, but it is necessary to choose the most suitable flap for each individual case. The key feature for a good surgical choice reside in a careful evaluation of the size and thickness of the defects and patients' needs in order to guarantee a proper protective coverage that contemporaneously restores normal profile of the skull. Advanced age should not be considered a contraindication for free flap surgery and the procedure can be considered safe and reliable in both old and young population.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

Ethical approval: All the procedure performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Received: 1 June 2020
Accepted: 29 June 2020
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