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Microvascular reconstruction of facial defects in settings where resources are limited

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Abstract

The surgical treatment of defects caused by noma is challenging for the surgeon and the patient. Local flaps are preferred, but sometimes, because of the nature of the disease, there is not enough local tissue available. We describe our experience of free tissue transfer in Ethiopia. Between 2008 and 2014, 34 microsurgical procedures were done over 11 missions with the charity Facing Africa, predominantly for the treatment of defects caused by noma (n = 32). The mean duration of operation was 442 minutes (range 200 – 720). Six minor wound infections were treated conservatively and did not affect outcome, a return to theatre was required in 4 patients with wound infections and one with a haemorrhage; 2 flaps failed and 2 partially failed, one patient developed an oronasal fistula, and one had an infection at the donor site that required a repeat graft. In settings where resources are limited, free flaps can be used when local tissue is not available and they cause less morbidity than pedicled tissue transfer.

Keywords: Noma; Low resource; Resource poor; Free flap; Microvascular reconstruction

Introduction

Noma is a disfiguring disease of the face that has been known by many different names.[1] It has an estimated incidence of 40 000 – 140 000/year globally, and is now predominantly restricted to the "noma belt" of Mauritania, Senegal, Mali, Niger, Chad, Sudan, and Ethiopia.[2] In Europe it was last seen during the Dutch famine of 1944, although it had essentially been eradicated in the continent by the end of the 19th century and before the advent of penicillin. It is a disease of poverty and famine, and tends to affect children whose immunity is depressed after viral illness. Mortality rates are high (90%) and those who survive the acute phase are often left with complex deficiencies of bone and soft tissue.[3] In some cases local flaps cannot be used for reconstruction, which presents an additional challenge to the surgical team.

Tissue defects that are too big to be repaired with local flaps alone have previously been treated with the transfer of tubed pedicled tissue.[4] More recently, microvascular techniques have revolutionised treatment by minimising mor-

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bidity and improving results,[5,6] but they are complex and require specialist equipment, facilities, and expertise, and the potential for failure remains even when done at specialist centres. We describe our experience of free tissue transfer in Ethiopia over a 6-year period.

Patients and methods

Over 11 missions to Ethiopia between 2008 and 2014 in association with Facing Africa, a non-governmental organisation, 29 patients had 34 microsurgical procedures (Table 1). Five patients had 2 free flaps and were operated on during different missions as part of a planned, staged reconstruction. The age range was 8 - 45 years and the female:male ratio was 19:10. Defects caused by noma were scored according to the NOITULP classification (nose, outer and inner lining of the cheek, trismus, upper and lower lip, and particularities).[7] Reconstruction was with radial forearm (n = 22), anterolateral thigh (n = 5), parascapular (n = 5), abdominal (n = 1), and latissimus dorsi (n = 1) flaps. Most defects were related to noma (n = 27), but one patient had been burned and another had squamous cell carcinoma. Procedures were done at the Myung Sung Christian Medical Centre (n = 32/34), the Cure Hospital (n = 1/34), or the Yekatit 12 Hospital (n = 1/34) in Addis Ababa.

Ethiopia has a population of 94 million and 80% live in rural communities. In 2013 the country had a per capita GDP of $505 and a per capita health expenditure of $18.[8] In the absence of the visiting team the usual caseload for the plastic surgery department was burns and trauma. Local surgeons, anaesthetists, and nursing staff had some experience of tubed

Table 1
Overview of free flap reconstruction. Case numbers 6, 19, 20, 26, and 27 were treated in 2 stages.

Case No.	Age (years)	Sex	Diagnosis	NOITUL	Particularities	Flap	Flap survival
1	18	M	Noma	2.3.4.2.2.1	Loss of right orbital floor	Radial forearm	Yes
2	24	F	Noma	0.2.2.2.1.1	-	Radial forearm	Yes
3	18	F	Noma	0.3.3.3.2.2	-	Radial forearm	Yes
4	11	M	Noma	0.3.3.3.2.1	Loss of left maxillary sinus	Radial forearm	Yes
5	18	F	Noma	0.3.4.0.1.2	-	Radial forearm	Yes
6	16	F	Noma	2.4.3.0.3.2	Loss of hard palate	Radial forearm	Yes
	16	F			-	Parascapular	Yes
7	45	F	SCC		-	Anterolateral thigh	Yes
8	24	F	Noma	2.3.3.3.0.0	-	Anterolateral thigh	Partial
9	17	F	Noma	1.2.2.2.2.1	-	Radial forearm	Yes
10	25	M	Noma	1.1.1.2.4.4	-	Radial forearm	Yes
11	30	M	Noma	0.3.3.4.2.1	-	Radial forearm	Yes
12	19	F	Noma	4.0.0.0.0.0	-	Radial forearm	Yes
13	18	F	Noma	4.2.2.0.0.0	Loss of premaxilla	Radial forearm	Yes
14	40	M	Noma	1.3.3.3.3.3	-	Abdominal	Yes
15	25	M	Noma	2.4.4.3.3.3	Loss of left orbital floor and left hemipalate	Latissimus dorsi	Yes
16	18	F	Noma	3.3.3.3.4.4.	Defects in both cheeks	Parascapular	Yes
17	14	F	Noma	1.0.0.0.4.0	-	Anterolateral thigh	Yes
18	8	F	Noma	1.4.4.2.3.2	Loss of premaxilla and left maxillary sinus, and partial loss of left hemipalate	Parascapular	Yes
19	11	F	Noma	3.4.4.3.4.4	Loss of right orbital floor and right maxillary sinus, and partial loss of right hemipalate	Radial forearm	Yes
	12	F			-	Radial forearm	Yes
20	19	F	Noma	4.4.4.3.4.2	Loss of premaxilla and right orbital floor	Radial forearm	Yes
	20	F		4.4.4.3.4.2	Loss of pre maxilla and right orbital floor	Radial forearm	Yes
21	25	F	Noma	1.4.4.0.3.1	Loss of left orbital floor	Radial forearm	No
22	17	F	Noma	1.3.3.3.2.2	-	Anterolateral thigh	No
23	30	M	Noma	0.2.2.3.1.2	-	Radial forearm	Yes
24	18	F	Noma	4.0.0.0.4.1	Loss of premaxilla	Radial forearm	Yes
25	20	M	Noma	0.0.0.0.0.4	-	Radial forearm	Yes
26	16	M	Noma	2.4.4.3.3.1	Loss of left orbital floor	Radial forearm	Yes
	19	M			-	Anterolateral thigh	Yes
27	32	M	Noma	4.1.1.0.4.1	Loss of premaxilla	Radial forearm	Yes
	33	M			-	Parascapular	Yes
28	30	F	Noma	0.3.4.2.4.2	-	Radial forearm	Yes
29	29	F	Burns		-	Parascapular	Partial

Table 2
Venous Anastomoses.

Facial	12 (36%)
Superior Thyroid	10 (29%)
Internal Jugular	7 (21%)
External Jugular	4 (11%)
Lingual	1 (3%)

Table 3
Arterial Anastomoses.

Superior Thyroid	22 (64%)
Facial	10 (29%)
External Carotid	1 (3%)
Lingual	1 (3%)

pedicled tissue transfer but little experience of free tissue transfer. The visiting team, which consisted of anaesthetists and support staff, theatre and ward nurses, and surgeons who specialise in craniofacial, maxillofacial, and plastic surgery, all had experience of free tissue transfer. Radial forearm flaps were preferred in case anastomoses had to be done under looped magnification because of technical or power failure. Some patients did not wish to have forearm flaps because of aesthetic concerns.

Patients were optimised for surgery by a UK medical team for a minimum of 14 days.[9] Eight had a normal body mass index (BMI) and 21 were underweight. The lowest BMI was 14. All patients were treated with anthelmintics on arrival, and had preoperative blood tests that included a full blood count, and urea and electrolytes. Those with moderate or severe anaemia as defined by the World Health Organization (WHO) were not operated on.[10] After counselling, patients were tested for hepatitis B and HIV.

The mean duration of operation was 442 minutes (range 200-720). One unit of blood was taken pre-operatively for post-operative autotransfusion and the patient was then haemodiluted. It was sometimes difficult to locate donor bags and to ensure that blood was stored correctly. Antibiotics were given at induction and for 5 days postoperatively. Arterial and venous anastomoses (Tables 2 and 3) were all done under a microscope.

We monitored flaps regularly, assessing warmth and skin turgor, and blood flow with Doppler sonography, and taught the techniques to the local recovery staff. Patients remained in hospital for a short period postoperatively (median 4 days, range 2-57) and were managed on the ward by a joint team of visiting and local nurses. They were then discharged to a local secondary care facility to ensure adequate healing and to begin oral physiotherapy when required. The median total duration of postoperative care was 36 days (range 22-71).

Case reports

Case 1 (Table 1, case number 20, Fig. 1)

A 19-year-old woman presented with central and right-sided defects and complete trismus caused by noma (classification N4 O4 I4 T3 U4 L2, loss of premaxilla and right orbital floor). In the first procedure the ankylosis was released and she had bilateral coronoidectomies and division of the fibro-osseous fusion of the zygoma and remaining maxilla to the right mandible. We reconstructed the right orbital floor and anterior maxilla with a split calvarial bone graft, and covered it with a temporoparietal fascial flap. This also acted as filler for a double-paddled radial forearm free flap anastomosed to the superior thyroid artery and vein, which was used to reconstruct the right cheek. Ten days after the operation the calvarial bone graft became exposed. It was debrided and covered with a glabellar flap.

In the second stage, one year later, we raised a second radial forearm free flap, folded it to form the upper lip, and

Fig. 1. Patient at presentation (left), after reconstruction of the right orbital floor and right face with a split calvarial bone graft and radial forearm free flap (centre), and after reconstruction of the palate and upper lip with a second radial forearm free flap (right) (published with the patient's permission).

Fig. 2. Patient at presentation (left) note the "anarchie dentaire", and after reconstruction of the left face with a radial forearm free flap (right) (published with the patient's permission).

sutured the palatal extension to the remnant of the hard palate with anastomoses to the superior thyroid artery and vein. After one year we corrected a right ectropion with a Fricke flap and did a right commissuroplasty. At this stage the calvarial bone graft had resorbed so we repaired the orbital floor with a conchal cartilage graft and Champy plate. Reconstruction of the nose is planned.

Case 2 (Table 1, case number 3, Fig. 2)

An 18-year-old girl presented with a left-sided defect caused by noma, and complete trismus (classification N0 O3 I3 T3 U2 L2). After bilateral coronoidectomies and excision of bony ankylosis of the right ramus, she could fully open her mouth. We reconstructed the left side of her face with a radial forearm free flap anastomosed to the superior thyroid artery and internal jugular vein. There were no complications and the flap survived well.

Case 3 (Table 1, case number 18, Fig. 3)

An 8-year-old girl presented with a left-sided defect caused by noma (classification N1 O4 I4 T2 U3 L2, loss of the left maxillary antrum). After a period of nutritional rehabilitation we reconstructed the defect with a parascapular flap anastomosed to the external carotid artery and superior thyroid vein. Formation of a haematoma 2 days after operation had caused the flap to be poorly perfused but after it was evacuated there were no further complications and the flap survived well.

Results

Of the 34 microsurgical procedures, 17 healed without problem. Six minor wound infections treated conservatively did not affect outcome, but 4 wound infections required a return to theatre. One patient had a postoperative haemorrhage that required a return to theatre, 2 flaps partially failed and 2 failed completely, one patient had an oronasal fistula and one an infection of the donor site that required a repeat graft. There were no anaesthesia-related complications.

Discussion

Noma is a devastating disease that affects the most vulnerable people in developing countries. Patients who survive are left with complex bony and soft tissue defects and associated functional, sociological, and psychological problems. It seems that the "noma paradox" holds true in that by the time a country has developed the resources to manage the disease effectively, the associated economic developments have caused it to disappear.[11] Appropriate craniomaxillofacial reconstruction requires specialist input from surgical, anaesthetic, and nursing staff, often with support from charities, and these charities must ensure the provision of adequate long-term follow up. It is of great importance for the visiting team to involve and train local surgeons, anaesthetists and nursing staff who in turn provide valuable education and training to the visiting team.

As most of our patients were underweight on admission, it was crucial to optimise their general health before operation to reduce the risk of complications. All the flaps that partially or completely failed were in patients who were underweight according to their BMI. Patients were admitted 2 weeks before the arrival of the surgical team and all were treated with anthelmintics, reviewed by a physician, and treated for any concurrent illness. They were immediately started on a nutritional regimen that included fortified, high-calorie drinks, protein-rich foods such as peanut butter, and regular meals of local foods rich in carbohydrates.

Fig. 3. Front and lateral views of patient at presentation (above), and after reconstruction with a parascapular free flap (below) (published with the patient's permission).

They were then reviewed when the visiting surgical team arrived and only those who were physically robust and who had an acceptable BMI and haemoglobin were considered for reconstruction.

Management of the airway is challenging in this group,[12] and strategies followed guidelines by the Difficult Airway Society (DAS). A glidescope was used in those with good mouth-opening, and in those with complete trismus, awake fibreoptic intubation was preferred, with intubation in the front of the neck as the alternative.

As described by Tempest, the repair of noma defects must be simple to reduce the number of operations, and safe to reduce the number of complications. It must also be sound - missing tissues should be replaced by similar kinds of tissues (lining by lining, cover by cover), and satisfactory - functionally and cosmetically acceptable.[4] Trismus is released first so that the full defect can be visualised and appropriately reconstructed. Local flaps have less associated morbidity, are a better tissue match, and should be used preferentially, but when they cannot, alternative options are needed.[6]

Free tissue transfers have been used since the 1970s and reliability has increased considerably with improvements in the techniques and the equipment used. In our series there was a 6% failure rate. Although it does not compare favourably with that of specialist centres in developed countries, we think that the functional and aesthetic benefit of free tissue transfer in the small number of patients for whom local flaps were not possible outweighed the risk of complication. However, the infrastructure for the management of late complications is paramount. Flaps that failed were investigated rapidly, and when salvage was not possible, were removed and the defect managed conservatively. One patient had a second free flap on a subsequent mission, and in the second case, definitive treatment awaits the return of the surgical team. There was a high rate of wound infections, both minor (6/34, 18%) and requiring a return to theatre (4/34, 12%) despite

treatment with antibiotics. This may be because the population is physiologically at greater risk of infection and because of the environment in which postoperative rehabilitation takes place, including early mobilisation, interaction with other patients, and communal activities, which are designed to encourage holistic recuperation. It is possible that the education of patients and improvements in hygiene may improve these results.

Although objective assessment of postoperative functional and aesthetic improvements was considered desirable, logistical and practical limitations made it difficult to review patients who had returned to remote communities.

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patient permission

The patients have given permission for their images to be published.

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