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Early outcome of noma surgery

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Summary *Introduction:* Reconstructive noma surgery is performed on many short-term medical missions. The treatment outcome, however, has rarely been studied.

Materials and methods: We studied complications and clinical outcome of reconstructive noma surgery performed during four short-term medical missions. Logistic regression analysis was used to determine which factors influenced treatment outcome.

Results: A total of 74 treatments were performed on 63 patients. We found a complication rate of 64% ($n = 47$) and a success percentage of 59% ($n = 44$). Complexity of treatment procedure and occurrence of complete trismus were independent significant factors negatively influencing the outcome. Only 14 of the 36 complex procedures had a good outcome.

Conclusions: Our study is one of the first to evaluate the early clinical outcome of reconstructive noma surgery in short-term medical missions. It shows that the outcome is not always favourable, particularly in complex reconstructions and in the subgroup of patients with complete trismus.

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Noma is a devastating orofacial gangrene affecting malnourished children in developing countries who are often further debilitated by diseases such as measles and malaria.^{1–3} Its global incidence has been estimated at 30 000–40 000⁴ with a mortality rate of approximately 90%.⁵ Patients who survive the acute stages of the disease often suffer facial disfigurement and functional disabilities such

as trismus, oral incontinence and difficulties with speech and feeding.^{1–3}

Nowadays, numerous short-term medical missions are undertaken to provide health care to the developing world.⁶ Noma patients, too, have become subject of humanitarian projects for plastic and reconstructive surgery.

Publications on this subject often describe the success of such missions, the numbers of patients treated and the surgical techniques used, illustrated by case reports.^{7–9} However, critical evaluations of complication rates and eventual treatment results are very rare.¹⁰ Follow-up hardly ever outlasts the short duration of the mission.

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We studied the early clinical outcome of reconstructive noma surgery in short-term medical missions.

Patients and methods

The research population is formed by the noma patients treated during four humanitarian missions for plastic and reconstructive surgery in 2007 and 2008. Two took place in Addis Ababa (Ethiopia) and two in Sokoto (Nigeria). In all four missions, the same research methods were applied, as initially developed for the first mission in Addis Ababa in 2007.¹⁰ Missions lasted 2 weeks and were undertaken by European medical teams consisting of plastic surgeons, maxillofacial surgeons, anaesthesiologists and nurses. Each team was accompanied by an independent researcher.

Team doctors assessed the patients' fitness for surgery, considering general health and co-morbidity. They estimated the extent of the noma defects using the NOITULP classification system.¹¹ The letters of the acronym NOITULP represent the anatomical units of the face of which the degree of destruction is scored (Nose, Outer lining cheek, Inner lining cheek, Upper lip, Lower lip), Trismus and Particularities. Based on this they considered the surgical options and objectives.

Researchers determined nutritional status by measuring height (cm) and weight (kg) and mid-upper arm circumference (MUAC) and comparing these to international standards.¹²

The presence of trismus was analysed through measurement of the interincisal distance (mm) using calibrated callipers. Patients were asked to successively open and close their mouth as far as possible. The difference between these two states constituted what we defined as mouth opening. Trismus was defined as a mouth opening ≤ 40 mm. In the event of a trismus release, additional measurements of the mouth opening were carried out at the end of the surgery (with the patient still under general anaesthesia) and regularly in the postoperative period.

Treatment procedures performed were classified as either 'simple' (single-stage procedures using local flaps and/or skin grafts) or 'complex' (multi-stage and/or free-flap procedures).

The preoperative state, treatment procedure and in-hospital postoperative period were observed and recorded with clinical notes and photographs by the researchers. Follow-up periods varied from a few days to 5 weeks postoperatively, ending either with the patient's discharge from hospital or with the researcher's departure, which was usually 3 weeks after the end of the mission.

Occurring complications were marked 1–3 according to their severity (1 = minor complication, not affecting the duration of hospital stay, 2 = intermediate complication, prolonging hospital stay and 3 = major complication, life threatening).

Finally, a judgement on early clinical outcome was made by each researcher together with an independent noma expert (K.M.). Five outcome categories were defined as according to Huijing et al.¹⁰: 1 = excellent result, clear functional and/or cosmetic improvement, entirely as anticipated preoperatively; 2 = satisfactory result, clear improvement, although not as good as anticipated;

3 = mediocre result, slight improvement, not as anticipated; 4 = poor result, no improvement compared to preoperative state and 5 = very poor result, patient is in a worse state than before treatment (as a result of the surgery). For further analysis, these five categories were reduced to two, 'good' results (categories 1–2) and 'bad' results (categories 3–5).

Chi-square analysis with Yates' correction was used for nominal and Student's *t*-test for continuous variables to test statistical significance. *P*-values ≤ 0.05 were considered significant. Logistic regression was used to analyse which factors independently influenced the clinical outcome. Statistical analyses were done using the Statistical Package for Social Sciences version 16 (SPSS 16.0) for Windows.

Results

A total of 63 patients were treated (Table 1). The age range of the subjects was 7–54 yr, with a median of 17 yr. There was a significant predominance of female patients ($P = 0.017$). Twenty-five patients (40%) had some degree of trismus; 12 of those had complete trismus. Data on nutritional status were available for 40 patients. Of these, 10 patients were underweight and five severely underweight.

The four teams performed a total of 74 treatments, as 11 patients were treated by two consecutive teams.

Of the 25 patients with trismus, nine were treated by two teams, six of those nine being patients with complete trismus. As a consequence, 34 of the treatments involved patients with trismus, 18 of those concerned patients with complete trismus. Not all of those treatments comprised an actual trismus release, for in some cases the trismus itself was left untreated.

Complications were seen in 64% of all treatments ($n = 47$), 24% ($n = 18$) were minor complications, 36% ($n = 27$) intermediate and 3% ($n = 2$) major.

Table 1 Patient characteristics

Variable	<i>n</i> (%)
Gender	
Female	41 (65)
Male	22 (35)
Age group	
≤ 5 yr	0 (0)
6–10 yr	7 (11)
11–15 yr	12 (19)
16–20 yr	24 (38)
> 20 yr	20 (32)
Nutritional state (BMI)	
Normal*	25 (40)
Underweight**	10 (16)
Severely underweight***	5 (8)
Data missing	23 (36)
Mouth opening	
Normal (> 40 mm)	38 (60)
> 20 – ≤ 40 mm	6 (10)
> 0 – ≤ 20 mm	7 (11)
Complete trismus (0 mm)	12 (19)

*z-score > -2 SD; **z-score ≤ -2 SD ***z-score ≤ -3 SD.¹²

Minor complications included superficial wound infections and small dehiscences. Most intermediate complications were deep wound infections, often leading to partial or total flap loss. The two major, life-threatening complications that occurred included a case of pneumonia and a case of severe hypoglycaemia.

The early clinical outcome was good in 59% ($n = 44$) of all treatments, consisting of 'excellent' ($n = 27$; 36%) (Figure 1) and 'satisfactory' ($n = 17$; 23%) results. Thirty treatments (41%) had a 'bad' outcome; 'mediocre' in 12 (16%) (Figure 2), 'poor' in eight (11%) and 'very poor' in 10 (14%; Figure 3).

Logistic regression analysis revealed that two independent factors had a significant negative influence on clinical outcome (Table 2). Treatment complexity was the most important factor ($P = 0.004$). Of the 36 complex procedures performed, only 14 had a good outcome (Figure 4). The second significant factor was the occurrence of complete trismus ($P = 0.019$). Eighteen procedures involved patients with complete trismus, five of these had a good result.

We found no influence of the patients' gender, age or nutritional state on treatment outcome. Likewise, no difference in outcome was found between the teams.

Figure 1 Example of an excellent early outcome (scored as 1). A: Preoperative; 22-year-old man with a large noma defect of the midface including nose, right cheek, upper lip palate and maxilla (N-2 O-3 I-2 T-0 U-3 L-1 P:palate and maxilla defect) B: Result on the seventeenth day after surgery which consisted of a free radial forearm flap with an iliac crest bone graft for reconstruction of the palate and maxilla defect.

Figure 2 Example of a patient with a mediocre early outcome (scored as 3). A: Preoperative; 20-year-old man with a noma defect of the right cheek and corner of the mouth (N-0 O-2 I-1 T-0 U-2 L-1 P-0). B: Result 20 days after surgical reconstruction with an Estlander flap. Postoperative course was complicated by partial necrosis and dehiscence of the flap.

Discussion

This study aimed to evaluate the early clinical outcome of reconstructive noma surgery during short-term humanitarian medical missions. We did this by evaluating the early clinical outcome of four missions as observed by independent researchers accompanying the medical teams.

This accumulated in a substantial research population of 63 noma patients. They were relatively young, although there were no children under the age of 5. We do not have an explanation for the predominance of female patients, an observation also made by Tempest.¹ The 40% occurrence rate of trismus is in concordance with the figures in the literature, where percentages of 37–48% are reported.^{1,13}

Even though preoperative patient screening included a general evaluation of health and nutritional state, in hindsight we found 10 of the 40 patients evaluated to be underweight. Unfortunately, we were unable to assess nutritional state in all patients and – possibly as a consequence of the small numbers – found no influence of nutritional state on treatment outcome.

Complications were quite common; only a minority (41%) of patients had a completely uncomplicated postoperative

Figure 3 Example of a patient with a very poor early outcome (scored as 5). A: Preoperative; 12-year-old girl with a large noma defect of the left cheek, upper lip and nose with absence of the left zygoma and orbital floor and a complete trismus (N-2, O-3, I-4, T-3, U-3, L-1, P: absent zygoma and orbital floor). B: Result 21 days after surgery, which included trismus release, cheek reconstruction using a temporoparietal fascia flap (TPF) and a submental flap (SF) and lip advancement. Postoperatively, complete necrosis of the TPF and partial necrosis of the SF occurred, leaving the patient with a large midface defect and a left cheek without inner lining, which would inevitably lead to complete recurrence of the trismus.

course. One other study reported complication rates of short-term missions for cleft lip and palate repair, which were much lower at 4%.⁶ Other articles do not report concrete figures on complications.

It is difficult to discuss the 59% good outcome measure that we found, as it stands on its own. We could not find any studies comparable to ours, reporting outcome of short-term missions for reconstructive surgery.

Complex treatments gave more bad results than simple ones. Straightforward as this relation may seem, it is still noteworthy. As noma defects often demand complex reconstructive surgery (49% in this study), surgeons and

Table 2 Treatment outcome

	Outcome			Odds ratio (95% CI)
	Good (n = 44)	Bad (n = 30)	Total (n = 74)	
Age group				n.s.
Minor (<18 yr)	20	18	38	
Adult (≥18 yr)	24	12	36	
Complete trismus				4,5 (1,3–15,8)*
Yes	5	13	18	
No	39	17	56	
Trismus release				n.s.
Yes	7	12	19	
No	37	18	55	
Team				n.s.
Addis Ababa I	7	10	17	
Addis Ababa II	11	9	20	
Sokoto I	10	4	14	
Sokoto II	16	7	23	
Complexity procedure				4,8 (1,6–14,1)**
Simple	30	8	38	
Complex	14	22	36	

*Significant ($0,05 > P \geq 0,005$); ** Significant ($P < 0,005$).

patients should be aware that this decreases the chance of a successful outcome considerably. One should bear in mind that noma surgery should not aim for perfection, but rather be safe, simple and sound.¹

An especially challenging subgroup of noma patients is the one with complete trismus. This statement is reaffirmed by our finding that the presence of complete trismus had a significant negative influence on early outcome. Two reasons can be given for this. First, the presence of this severe degree of trismus is an indication of the extent of the noma defect as a whole. Second, the results of trismus releases were disappointing, especially in this subgroup of patients. Twelve of the 19 trismus releases performed had a bad outcome, failing to attain a good mouth opening. Of the 13 trismus releases that involved patients with complete trismus, only three had a good short-term result.

It is clear that the treatment of trismus is still one of the most challenging aspects of reconstructive surgery in noma patients. Other studies give varying results with success percentages ranging from 37% to 100%.^{13,14} It has been

Figure 4 Early outcome of simple versus complex treatments.

shown that, even in patients with successful trismus release and extensive postoperative physiotherapy, the trismus tends to recur during the following years.¹⁵

An unexpected finding was that the four teams, although they differed considerably in terms of experience in noma surgery, did not have significantly different results. This might be due to the small number of noma patients operated by some of the teams. In addition, the team experience might influence the patient selection, with more experienced teams being presented with or themselves selecting to treat patients of a higher complexity level. For example, the most experienced team was the only one to perform several free-flap procedures.

Furthermore, even though differences in experience were present among the teams, none of them had an experimental attitude. The collaborating noma foundations in organising these missions carefully select, prepare and evaluate all teams.

A limitation of this study is that we explicitly studied early outcome as opposed to long-term outcome. It is uncertain how the results we found relate to the final outcome. Further research into late outcome would be interesting, but difficult to obtain.

Besides, this type of early outcome study also has its advantages. First, there is no selection bias. All patients can be included, whereas for a late outcome study patients have to be tracked down which is often impossible in countries such as Nigeria and Ethiopia. Second, an early-outcome study is a good means of giving feedback to the medical teams, who may be able to use the analysis of the results to make improvements.

In conclusion, this study shows the high incidence of unfavourable early postoperative results of noma surgery on short-term medical missions in developing countries, particularly in complex treatments and in patients with a complete trismus. We believe that an early outcome study can be a valuable tool for assessing quality of care and giving feedback to teams in order to improve future care.¹⁰ This improvement is key, because – to answer the question ‘Noma, should we care?’ in a previous editorial in this journal¹⁶ – we answer yes, we should care.

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Conflicts of interest

None.

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