



Humanitarian Mission: Surgical Treatment of Burns Sequelae in the Bush

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Abstract

Background: The burns sequelae are frequently encountered in humanitarian missions. We propose their treatment in challenging conditions.

Materials and Methods: We have done more than 30 immersion missions in the bush. We adapted our surgical treatment according to the precarious environment of the dispensary.

Results: According our experience, these burns sequelae represented on average 25% of our surgical procedures performed in the bush, i.e., 375 cases. The main etiology was domestic. We mainly took care of the sequelae of the burned hands of children. We have adapted ourselves and we have favored reliable techniques with a single operating time and which offer simple postoperative period.

Conclusion: Plastic surgery, although performed in a challenging condition, has always been beneficial for patients from a functional and aesthetic point of view.

Keywords: Humanitarian burns; Skin contracture; Surgery in the bush; Nomadic humanitarian mission

Introduction

Burns, and their after-effects, are a real tragedy for patients and, because of their numbers, represent a real public health problem in developing countries. They are frequently encountered in humanitarian missions. According to our experience, these after-effects account for 25% to 50% of our surgical operations carried out during a mission in rural areas.

This article presents the different sequelae of burns observed in current practice and in different anatomical zones. Above all, it proposes care adapted to the particular environment of the dispensary or village life.

Materials and Methods

Considering that 80% of the demand for reconstructive surgery in developing countries is in the bush, we decided to work as close as possible with the neediest patients, i.e. in the villages. The objectives of our NGO, defined in 2003, were the total immersion of the teams in the villages, the carrying out of plastic surgery missions in challenging conditions and the adaptation of the missions to the environment.

The surgical missions have been regular with, on average, three missions per year, three members per mission (plastic surgeon, anesthetist, operating theatre nurse). The mission was generally carried out in a dispensary or in a rural health centre. The teams travelled by local means with an average of 250 kg of equipment. We obeyed the principle of autonomy: We really took with us everything that was necessary to carry out the mission and to be completely autonomous. However, we have three imperatives before organizing a mission in the bush: Water (we try to be as close as possible to a well), a generator to produce electricity and a medical oxygen shell borrowed from a local hospital.

In practice and very schematically, the mission often takes place in the same way:

- Written invitation from a local health authority.
- Organization of the mission several months in advance: Collection of information on the

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location of the mission, the number of patients, age, sex, pathologies observed local conditions, etc.

- Preparing the mission: Setting up the team, plane tickets, vaccinations, administrative formalities, preparation of equipment, etc.
- Arrival in the village: Presentations and greetings to the local and health authorities, essential meeting with the village chief, meeting with explanations of the objectives of the mission, etc.
- Installation at the dispensary with the help of the local health worker: cleaning of the premises, creation of a nomadic surgical unit with unpacking of surgical and anesthesia equipment, checking of oxygen and starting of the generator, etc.
- Consultation of patients and creation of the operating program.
- Beginning of the surgical operations from the first day, starting with simple operations to test the equipment.
- Daily surgical interventions without interruption throughout the stay.
- Very frequent additional consultations between operations.
- At the end of the mission: Organization of a final consultation where all patients are seen again (and photographed); dressings are redone with a donation of material to each patient; advice for follow-up is explained to the nursing staff. The diagnosis and the operation are noted in the patient's health record or on a paper equivalent. We keep a computerized version (clinical record and photographs). Usually, a meeting is organized between the health workers of the dispensary, the organizers of the mission and the NGO team to do a summing up, comment on the progress of the mission and define the points to be improved for a future stay. A report of the mission as well as pre- and post-operative photographs of the operated patients are sent secondarily.

During our missions, we have encountered numerous after-effects of burns at different stages. The choice of surgical technique was made according to the patient, the context and the possibilities of follow-up. We used the whole classic range of reconstructive surgery techniques, i.e. skin grafts, skin plasties and flaps. We did not offer skin expansion and microsurgery in this context. Like surgery, the anesthesia was performed in an uncomfortable environment and required the presence of an experienced anesthetist [1]. Loco-regional anesthesia was preferred whenever only one limb was involved. Sedation or even general anesthesia was used when necessary. Pain management was routinely offered in the postoperative period and for dressings.

Results

For this presentation, we have defined a window of observation over 10 years of missions (2003-2013), i.e. over 30 surgical missions. Over this period, we have carried out approximately 1,500 operations. Burn after-effects represented 25% of the indications on average, i.e. 375 cases. However, and depending on the missions, the percentage of burns after-effects varied and reached 50% of the cases presented. We did not observe any gender difference among the patients in consultation. We observed a preponderance of children and young adults in our missions in rural areas.

Domestic accidents were the main etiology of burns observed

in the village. As there was no adapted initial care in this context, there were major retractions. Patients presented in consultations with more or less old incapacitating retractions. The children who remained in the family home presented a satisfactory nutritional state. On the other hand, we observed with adults disabled by burn injuries, personal situations, and therefore health conditions, more often deteriorated.

We have only occasionally met patients with acute burns on mission. Work-related accidents were even more exceptional in this context but generally more serious.

Skin after-effects were systematically observed after a burn. All anatomical regions were affected, but the majority of the injuries were to the limbs and especially to the hand. In our casuistry, the sequelae flanges on the upper limb concerned about 70% of our indications. Scar bands with a real functional impact were observed in the cervical region, the axillary region, the elbow, the wrist, the fingers, the knee and the ankle. At the joint level, the retractile band was often associated with a surrounding scarring cupboard.

Only the axillary region, the anterior side of the elbow and the posterior side of the knee sometimes showed a retractile band with relatively respected surrounding skin. In our experience in rural missions we encountered few stiff joints. Only one old retraction required concomitant arthrolysis. Finally, and in our experience, we have encountered a great demand for aesthetically pleasing repairs on the part of patients.

We used the classic techniques of plastic surgery. The simple flanges were cut. The scarred placards were excised. Losses of substance were systematically closed. Depending on the region, we most often combined skin grafts and local skin flaps. For large areas, we performed thin skin grafts and total skin grafts. For very large areas, we have sometimes done thin skin grafts in a mesh. A flange with healthy surrounding skin responded to "Z" or "trident" plasties. When retraction was associated with a scar cupboard, we preferred an asymmetric "Z" plasty. When the demand for thin skin grafting was extensive, the site of removal was the thigh. When the need for total skin grafting was also great, we preferred harvesting in the lower abdominal fold region. Loco-regional anesthesia has always been preferred. General sedation with Ketamine or general anesthesia was proposed in children when a concomitant skin graft was required.

We have not noted any more complications, especially infectious ones, than in our French surgical activity. Physiotherapy was non-existent in postoperative care due to the lack of trained health workers. On the other hand, we have noted a very strong capacity for self-rehabilitation in adults by returning to work and, above all, in children through play.

Long-term follow-up was difficult to really assess, but the immediate post-operative improvement was most often convincing. Pre- and post-operative photographs were systematic and confirmed the feeling of immediate clinical improvement.

Discussion

In order to better meet the demand for care in rural areas, we have chosen to work in dispensaries for the past twenty years. This has enabled us to provide care to patients who, as we know, cannot afford to go to hospitals [2].

It is currently impossible to give precise numbers in these developing countries, but experience in the field has shown us that

the after-effects of burns are a real public health problem [3].

All ages have been affected by the after-effects of burns, but there have been large numbers of children and young adults in these rural areas. We explain this by the etiology of the burn, which is mainly domestic, with the traditional household inside the hut. On the other hand, the adults came less often to the consultation because they often have other priorities such as work in the fields and harvesting. The adult has generally adapted himself to an ancient retraction and cannot always afford to stop working. There was therefore a selection bias in our village consultations. Not all patients showed up.

In this rural environment, only traditional practitioners can intervene at the beginning. Most of them apply various substances (ointments, poultices) or various structures (compresses, tissues) that are completely ineffective or even dangerous. I do not mention toothpaste as it is commonly applied by patients in Africa or banana leaves in Madagascar which could have healing properties. We understand the role of traditional therapists who, in the end, are the only ones to bring some comfort to these completely destitute and isolated patients. We would simply like them to avoid aggravating the healing process through inappropriate applications and to simply wash the wound with soap and water. We also suggest that they immobilize the limb in the functional position whenever possible.

Self-medication with painkillers or even antibiotics is a real problem today in developing countries. In addition, fake medicines are a real scourge in the village markets of sub-Saharan Africa [4].

The absence of burn management has favored maximum shrinkage. The pain isolates the patient who remains prostrate and in the position of maximum retraction. The patient eventually heals but inevitably has disabling retractions. It is often at this stage that he was presented to us. Paradoxically, young age has remained a positive point in some cases. As the child played a lot, the mobilization of the joints may have led to secondary skin expansion. It was not uncommon to see flanges at the axillary hollow and the elbow in the child associated with an expansion of surrounding healthy skin. This facilitated the secondary correction of the retractile band by local flaps. In adults, we observed less secondary skin expansion. The adult rather adapted his handicap to the gestures of everyday life and we observed more often very fibrous areas on the support points. This complicated the local plasties.

In the presence of a retractable skin flange, surgery seemed to us to be the most effective solution, even in rural areas. Although the environment was not ideal for surgery, we have always observed a real benefit for the patients. We have favored reliable techniques with a single operating time and which offer simple suites [5]. The loss of substances observed after the release of the clamps was often greater than expected in the consultation. We therefore advise anticipating and removing a lot of skin for skin grafts in this context. This is why we have favored the lower abdominal skin removal which allowed us to bring a lot of skin with simple follow-up. It also has the advantage of leaving an almost invisible scar. According to our experience, we have not noted any more complications, especially infectious ones, in this environment. We were able to compare with humanitarian missions carried out in hospitals in the same countries. We believe that there are more risks of infection in hospitals than in health centers. Moreover, the germs encountered in rural areas were very sensitive to basic antibiotics.

We have always directed our techniques towards the patient and

the environment. In practice, we now offer to discuss our indications according to the different anatomical regions. Above all, we propose to focus our discussion on the particularities of our indications in this particular context.

Burns sequelae on the scalp

At the scalp level, we mainly observed old and neglected spontaneous healing losses. After effective local care, a thin skin graft often resulted in faster healing and good skin coverage.

Burns sequelae on the neck

In this location, and especially in this environment, we proposed either local skin plasties for localized straps or a large excision of the anterior cervical fibrous placard followed by a total skin graft. However, and with hindsight, we have often been disappointed with the long term result (secondary retraction). Today, we recommend that a cervical compression or neck brace be combined with a total skin graft for the medium or long term. It is always possible to find locally a suitable suit and fabric to make a compression garment such as a "press lift". We do not recommend the musculocutaneous flap of large backbone in dispensaries.

Burns sequelae on the face

The after-effects at this level did not present any particularity and we recommended the association of total skin grafts respecting the aesthetic units and local flaps. Patients with skin grafts were programmed at the beginning of the mission to be able to make the first dressing in good conditions. In our dispensary missions, we preferred techniques with a single operation time. However, and if a second mission could be seriously planned, we were able to envisage a flap with a second weaning time like the frontal flap. We remind you that this solution, in rural areas, must remain exceptional as there is a high risk of not seeing a patient again.

Sequelae of chest burns

In our experience, we have mainly encountered fibrous cupboards without any real shrinkage. In this context, we proposed the expectation. However, the slightest flange will be able to respond to a local skin plasty. The amount of healthy surrounding skin is generally sufficient.

Burns sequelae of the axillary hollow

This is a great classic of the so-called humanitarian after-effects of burns. Generally, the flange has responded very well to a trident plasty or even the combination of several Z-plasties. We have observed specificity with the burned child which often presents an axillary flange associated with surrounding skin expansion (Figure 1). In this case, the excess skin produced facilitated the practice of a large Z-plasty.

Sequelae of elbow burns

In our missions, we mainly observed after-effects on the anterior surface of the elbow in the form of either a large scar patch or a large retractable flange.

+ Retractable band: Here, too, we were often pleasantly surprised by the presence of healthy, expanded skin around the band, especially in children.

We have explained the small extent of the burn by the natural protective reflex that is triggered by a burning spatter. The bottom of the joint fold is then spared.



Figure 1: Malagasy child with a sequelae of a burn in the right axillary hollow with secondary expansion of the surrounding skin. Views before and after a Z-plasty.



Figure 2: Preoperative view of a Chadian teenage girl presenting a sequelae of a burn on the dorsal surface of the left wrist.

+ **Scar cupboard:** In adults, and in front of a scar cupboard, we advised to avoid small local skin plasties and we preferred the complete excision of the sequelire zone associated with skin grafts. These can be total in the fold and thin in the periphery. In front of a significant exposure of the vasculonervous elements, we preferred the flap of large dorsal in an islet and in a single operation. In children, we reasoned in the same way by proposing the complete excision of the placenta associated with skin grafts. When the management conditions were less favorable, we preferred to simply section the flange and interpose healthy skin with a local skin plasty (asymmetric Z- plasty). The spontaneous mobility in the child allowed a secondary expansion of this healthy skin. The result is often surprising.

Burns sequelae on the wrist

In this location, we have proposed two criteria for our indication: the age of the retraction and the environment.

+ **Indication according to the age of the retraction:** In the face of old after-effects, with capsulo-ligamentary retractions and associated bone deformations, we preferred to wait in a dispensary. It has always been risky to expose a joint in this environment or even to perform osteotomies.

On the other hand, we have always freed a supple wrist whose amplitudes have been limited by a relatively recent skin band. However, we have drawn attention to the importance of the loss of substance produced by the surgical release of a wrist and by the frequent exposure of the underlying noble structures. In this case, a flap was often required. We have always been satisfied with the inguinal flap which has the advantage of being very reliable in this context and easy to do. However, it had the disadvantage of requiring



Figure 3: Intraoperative view of a Chadian teenager after the sectioning of the bridle and the straightening of the wrist by progressive traction.



Figure 4: Intraoperative view of a Chadian teenager after total skin grafting on the loss of substance on the dorsal side of the wrist.

a second operation after three weeks. In our experience, we always found a health worker or a local colleague for this weaning time which remained fairly simple. This may have seemed surprising, but the experience in the field proved it.

+ **Indication according to the environment:** The environment was essential in determining the indication. If a reliable flap was not possible to cover an exposed joint, we always advised not to intervene. However, in the face of some major retractions with "shoulder-to-shoulder" of the dorsal side of the hand on the forearm, we have found an alternative (Figure 2). In this context we knew that a complex reconstruction was not feasible but we learned that straightening the wrist was always beneficial for the patient. We therefore "pushed" our indications, knowing that the functional result would not be perfect. Under anesthesia, we sectioned the dorsal strap with a cold scalpel and straightened the wrist with progressive manual traction (Figure 3). We were able to achieve full extension of the wrist without exposing the joint. We were able to do a total skin graft to cover the loss of substance (Figure 4). An anterior splint was sometimes used to keep the wrist in the good position. The result was not functionally perfect (stiffness of the wrist) but the hand in better position made the patient's life easier and improved the aesthetics of the limb. This is typically an operation that was adapted to the challenging conditions



Figure 5A: Sequela flectum of the posterior aspect of the left knee.



Figure 5B: Release of the posterior surface of the left popliteal fossa.



Figure 5C: Coverage with a medial fasciocutaneous flap and coverage of the donor area with a thin skin graft.

and met the demands of the patient who lives in the bush. We would have reasoned differently if we were in a safe hospital centre.

Burns sequelae on hands and fingers

On the hand, we immediately consider the age of the retractions and the possibility, or not, of post-operative physiotherapy.

We systematically release the straps in children to anticipate deformations during growth. Total skin grafts have been widely applied to the fingers. We have preferred intermediate skin grafts for the dorsal side of the hand. The commissures responded well to local plasties [6]. The children's ability to self-rehabilitate was a contributing factor and the results in the children were often surprising.

For the older retractions observed in adolescents and adults, the lack of effective post-operative physiotherapy contraindicated many interventions. This is a particular option but we take responsibility

for it. For years we have corrected finger retractions by combining a correction of the clamps, arthrolysis and even the insertion of temporary joint pins. The lack of rigorous active and passive mobilization in the aftermath did not allow us to maintain the good result obtained immediately. In practice, and to avoid unnecessary interventions, we no longer operate on old retractions in flexion at the level of the fingers if the patient cannot have a serious follow-up. We also contraindicate all secondary tendon repairs under these conditions. This needs to be explained but acceptance by the patient or local health workers seemed difficult in practice. They did not always understand the importance of this postoperative care for the sustainability of a good result. On the other hand, and whenever possible, we freed the commissures with skin plasties and treated the digital clamps when it was positive for the patient. We used the classic arsenal of skin plasties, total skin grafts and skin flaps.

Knee burn sequelae

In this location, we also place great importance on the age of the injuries.

We have always been pleasantly surprised by the correction of a flectum in children. Regardless of the technique used, the spontaneous self-rehabilitation of the children favored the secondary extension of the limb. We recommended a local flap or a total skin graft on the popliteal fossa and thin skin grafts on the rest of the loss of substance. A postoperative splint was often favorable for the postoperative period. We did not try to achieve full extension in the first operation (risk of vascular damage on old retractions) [7].

In adults we were often disappointed by the local flaps. The section of the bridle often resulted in a great loss of substance. Local skin plasties are not always sufficient to cover the entire loss of substance. We have sometimes proposed a flap of local rotation type large IC plasty combined with complementary skin grafts. To cover the entire posterior face of the popliteal fossa, we can also propose a large fasciocutaneous medial saphenous flap with a proximal pedicle (Figures 5A-5C).

Burns sequelae on the ankle and foot

On mission, we mainly observed skin sequelae on the anterior face of the ankle and foot.

At ankle level, and in the clinic, it was difficult, even dangerous, to try to obtain satisfactory joint mobility by arthrolysis on an old blockage. We therefore limited ourselves to sectioning the skin band by one or more local plasties.

On the dorsal side of the foot, the after-effects were often accompanied by retraction of the toes. Faced with a recent retraction with mobile toes, we proposed the correction of a strap by a skin plasty and the correction of a fibrous cupboard by its removal followed by an intermediate skin graft. We no longer repair old retractions of the toes. This is still a special option but we assume it. Indeed, the correction of such a deformity requires a large skin and capsulo-ligament release followed by a sophisticated secondary reconstruction. Fixation of straightened toes requires the placement of pins. The consequences will therefore be delicate and the risks of infection not negligible. We have therefore preferred to postpone such corrections, especially since the use of open shoes in these hot countries has always made it easier to put on shoes with these deformed toes. In some cases, we have proposed the amputation of the toes to facilitate the eventual fitting and the aesthetics of the foot. This solution has been systematically refused locally and for cultural

reasons. We have respected it.

Conclusion

The demand for reconstructive surgery is very high in rural areas in developing countries. The after-effects of burns represent, on average, 25% of our cases encountered in missions. They mainly concern the upper limbs of children and adolescents.

Our surgical techniques and indications have adapted to the challenging conditions and we have been able to obtain good results both functionally and aesthetically.

The management of the after-effects of burns in the bush is, according to our experience, a real health issue for these countries. It is still possible in dispensaries using traditional reconstructive surgery techniques. It often improves an impaired function at low cost. Above all, it can transform the lives of these destitute and isolated patients.

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