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The contribution of telemedicine to humanitarian surgery

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ABSTRACT

Telemedicine enables us to push back the geographical and interactive boundaries of medicine. With a role in humanitarian missions, it is particularly pertinent at two key stages: the preparation phase, and at postoperative follow-up after the mission. It is our intention to describe our experience of telemedicine within a humanitarian context.

Four teleconsultations were organized between departments of maxillofacial surgery in Caen (France) and in Bamako (Mali). 21 patients were assessed regarding their care. The preparation phase, taking place several weeks before the mission, allowed us to meet the patients preselected by Prof Traore. We were also able to review imaging, such as previous X-rays or preoperative CT scans.

After discussion between the two teams, a decision on the coordination of patient care was reached, namely surgery performed by Prof Traore and the local team in Bamako, or surgery during the next mission to Ouagadougou.

Several weeks after the mission, patients attended postoperative consultation by means of teleconsultation. This covered wound assessment, management of complications, and scheduling of follow-up surgery.

The benefits of telemedicine in humanitarian projects are manifold: real-time exchange of specialist skills with Malian colleagues, collective therapeutic decisions, academic value, and anticipation of anesthetic and surgical needs before missions.

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1. Introduction

Sub-Saharan Africa is a medical desert, with a major shortage of health professionals. According to a report on global health statistics published in 2011 by the World Health Organization, there are only 2.3 doctors per 100,000 inhabitants in Africa, compared with 33.3 in Europe. Access to health care, particularly surgical care, will be a major challenge for the African population over the coming years. The concept of telemedicine encompasses all available means for two or more physicians to exchange medical data, regardless of geographical distance. Sharing knowledge and

sharing diagnostic methods are key to improving the quality of medical care, especially in countries where access is severely limited.

Telemedicine is a form of remote medical practice using information and communication technologies. It connects one or more health professionals, either with other health professionals or with patients. It facilitates diagnosis, preventive follow-up or post-therapeutic follow-up, requests for specialist opinions, therapeutic decision making, and monitoring of patient health status. The various telemedicine services are defined in the French HPST (Hospital, Patients, Health, and Territory) Act, implemented in 2010, namely teleconsultation, tele-expertise, telemonitoring, and remote assistance with medical procedures (Decret, 2010).

Telemedicine has been officially recognized by law for 8 years, but has been in existence for over a century. The origin of telemedicine dates back to 1905, when Willem Einthoven, winner of a

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Nobel prize in medicine, transmitted the first ECG by telephone over a distance of 1.5 km (Bashshur et al., 2009).

The first use of interactive video communication in health care occurred in the late 1950s, when the Nebraska Psychiatric Institute (USA) conducted a psychiatric teleconsultation via a two-way interactive television system with the Norfolk Hospital. Subsequently, NASA's (National Aeronautics and Space Administration) research projects led to the development of these telecommunication technologies for medical support of astronauts in space (HAS, 2011).

Recent developments in information and communication technologies, and in particular the emergence of the internet, have led to a significant boom in telemedicine.

Worldwide expansion of the internet has contributed to present-day use of telemedicine in developing countries.

Telemedicine merges several components, one of which is tele-expertise. This involves sending medical data (text files, still/moving images) produced by one medical facility to another structure with a higher level of expertise via telecommunications technologies such as the internet. The purpose of such a procedure is to obtain diagnostic confirmation and helpful information regarding treatment or adjustment of patient management (Morand, 2008).

Teleconsultation is defined as a 'medical act conducted in the presence of the patient who dialogues with the requesting physician and the specialist medical consultant(s)' (Simon et al., 2008). In the context of humanitarian missions, teleconsultation comprises two key stages.

The first stage corresponds to the preparation phase of the surgical mission. This preliminary consultation takes place several weeks before the departure date.

Preliminary consultations involve the presentation of patients preselected by a local maxillofacial surgeon, visualization of any imaging (standard X-rays and CT scans), and technical discussion between the specialist team and the local team on the type of surgical intervention to be performed. During this teleconsultation, a decision is reached on therapeutic management of patients — either surgical intervention can be performed by the local team subsequent to advice provided during the teleconsultation by the specialist team or, in the most complex cases, surgery will be performed during future missions by both local and specialist teams combined. In certain, particularly serious cases physicians may decide to transfer a patient for care in France, within the department of the specialist team, usually for safety purposes in terms of anesthesia/resuscitation.

The second stage at which teleconsultation is very useful is after return from the mission, with a session scheduled 3–8 weeks later. During this session, operated patients are reviewed and scars are assessed; any complications are resolved, and any follow-up surgery is envisaged and scheduled for future missions. Advice is also given on dressings or scar massaging.

The aim of our study, through our experience of humanitarian surgery, is to demonstrate the value of telemedicine in patient management.

2. Materials and Methods

A retrospective study was conducted between 1 January 2014 and 31 December 2015, based on teleconsultations undertaken between the maxillofacial surgery department at Caen University Hospital, led by Prof Benateau (specialist team), and that of Bamako Hospital, led by Prof Traore in Mali (local team), via the Lower Normandy telemedicine platform.

In Lower Normandy, the Health Cooperation Group Telehealth Normandy (GCS TSNB) supports the development of telehealth projects, in conjunction with national and regional institutions in charge of health, telemedicine and healthcare information systems.

In particular, this group has worked on the Telestroke project to optimize emergency stroke management, and on Domoplaies for monitoring of chronic wounds.

As a result of GCS TSNB participation, the logistics and technical resources required to set up a telemedicine network between France and Mali were implemented. The leaders of this project within the TSNB made contact with the ANTIM (National Agency for Telehealth and Medical Information Technology) in Bamako, and with the support of the University Hospital and COVALIA — a company specializing in the implementation of telemedicine projects — the project framework was finalized.

A dedicated discussion space was set up on the Lower Normandy telemedicine platform, enabling the creation of Human-e — a maxillofacial telemedicine platform (Fig. 1). The maxillofacial surgery department staff room at Caen Hospital is equipped with dual monitors, a camera, and a microphone (Fig. 2).

The ANTIM video conference room in Bamako was equipped, and its system was set up and tested. In addition, user accounts and passwords for Human-e were created for doctors in Caen and Bamako to guarantee a secure connection.

Those patients seen in teleconsultation were subjectively selected according to potential management difficulties (diagnostic appraisal, therapeutic prospects, and recommended surgical technique) by Prof Traore, maxillofacial surgeon in Bamako.

3. Results

Between 1 January 2014 and 31 December 2015, four teleconsultations were scheduled between the maxillofacial surgery departments of the University Hospital of Caen and the University Hospital of Bamako. Twenty-one patients were seen: 13 during two consultations in preparation for the surgical mission and 16 during two teleconsultations scheduled after returning to France (including eight already seen in preliminary consultation).

The twenty-one patients comprised 10 men and 11 women, aged from 3 to 52 years (mean age 19). They mainly presented sequelae of Noma and complex facial clefts of the Tessier lateral cleft variety — 28% and 24% of consultations, respectively. Other reasons for consultation are detailed in Table 1. Of the 13 patients seen in preliminary teleconsultation, 11 (85%) were selected to be operated on jointly by both teams during a future surgical mission. During the postoperative teleconsultation sessions scheduled 2 months after returning to France, eight of these patients were reviewed.

A fourth teleconsultation session was scheduled in October 2015: eight patients were seen. Three (38%) were selected for surgery on a future mission trip, and two (25%) represented patients operated on during the April 2015 surgical mission trip who were not present at the previous teleconsultation. In 25% of cases, surgical treatment was not feasible on account of tumor size and extent of vascular injury (Table 1).

4. Discussion

There are currently many types of telemedicine, particularly in the field of humanitarian action, including medical advice via satellite telephones (MSF telemedicine program) and medical forums providing specialist advice on a time-delayed basis (Walji, 2015). E-mail is the most common form of communication. The Swinfen Charitable Trust is an association that links doctors from developing countries by e-mail with specialists and surgeons from around the world who provide free advice. A secure, web-based messaging system enables transmission of photos, medical imaging, and text documents to 522 consultants from 68 different countries. They collaborate with Doctors Without Borders (MSF) to provide specialist advice.

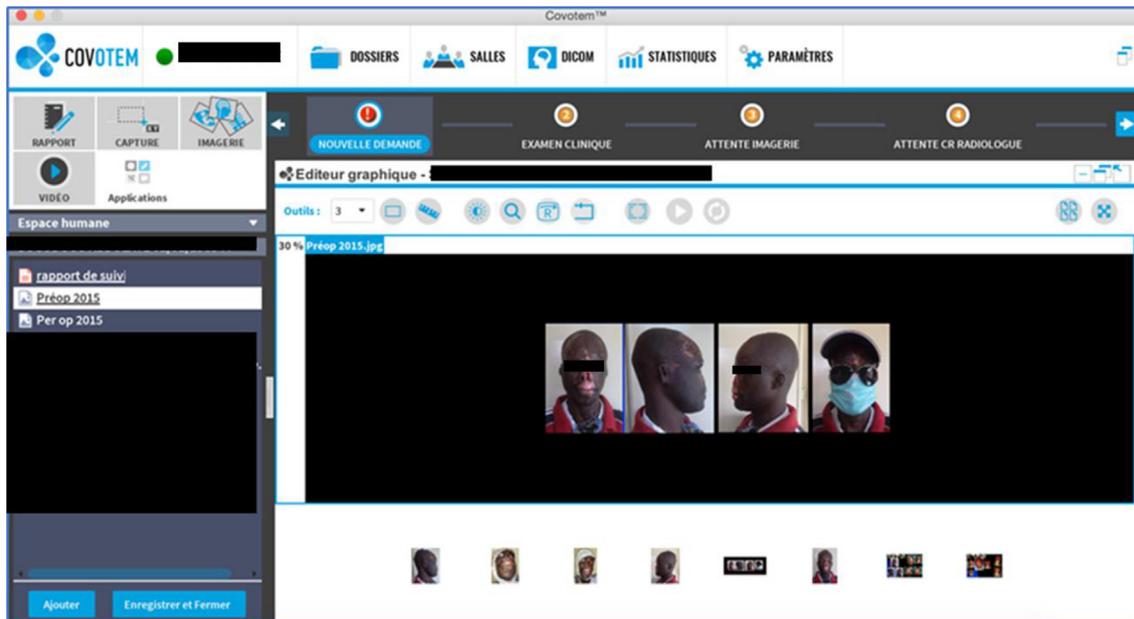


Fig. 1. Dedicated discussion space on the Lower Normandy (France) telemedicine platform: Human-e.

In Mali there has been an international network of telemedicine since 2003, which was initiated by Malian doctors. It is known as the RAFT network (French-speaking Africa Telemedicine Network) and numbers over 200 health professionals from 18 countries in Africa, South America, and Asia (Bediang et al., 2014). The aim of this project is to develop communication, collaboration, and distance learning in order to improve the working conditions and efficiency of isolated professionals located far from African capitals.

Telemedicine is well-adapted to developing countries. It improves access to care and reduces inequality between developing and Western countries (Wootton, 2008). Its benefits in a humanitarian project are multiple, and are based on demand, context, and medical specialty. In the field of maxillofacial surgery alone, numerous requests arise on a regular basis: advice on maxillofacial trauma in an emergency context (after a terror attack, for example); recommendations regarding rare malformations wherein determination of type of incision is agreed jointly; how to approach

tumors (preliminary biopsy, further medical tests); or preparation for a humanitarian mission.

Wootton (Wootton, 2008; Wootton et al., 2009) consider that in developing countries a second opinion is likely to be required in about 100 consultations, representing approximately 5 million requests for advice per year. But at present only five thousand applications are made each year via telemedicine networks. According to their analysis, only 0.1% of requests for second opinions are successful. This is based on an estimation rather than on precise data. Nevertheless, these estimates highlight the need for physician-to-physician communication (Wootton et al., 2009).

A study conducted by Bertani in 2012 (Bertani et al., 2012) found that the specialists' responses result in revision of management in 69% of cases, regarding either indication or potential surgical techniques. Establishing a relationship of trust is essential to ensuring effective physician–patient communication. In the case of telemedicine, distance, problems affecting equipment or logistics, and also socio-cultural differences, can be sources of breakdown in communication or misunderstanding. In our view, it is essential to foster these exchanges through long-term human partnerships involving professionals who meet each other, get to know each other, and share their skills.

The maxillofacial surgery team of the University Hospital of Bamako, led by Prof Traore, is self-sufficient and proficient in dealing with the vast majority of disorders and cases encountered. However, in particularly serious and/or complex cases, there is a high demand for specialist advice from the team. On account of their longstanding partnership with Prof Benateau, dating back to 2001, they requested the team from Caen as their specialist team. After a period of several years during which exchanges took place between the two physicians alone by e-mail or phone (using unsecured transmission of photographs and other documents), teleconsultation was eventually implemented, thereby delivering actual remote consultations, using patients preselected by the Malian team. Despite the distance, there is, nevertheless, direct contact with each patient, thus providing the possibility of interaction, of asking the patient to move and speak, and of acquiring a global view of the malformation or the wound. At the end of the teleconsultation, a collegial decision is reached: either care is



Fig. 2. The specialist team staffroom in Caen (France) during teleconsultation.

Table 1

Summary of the 21 patients seen during the four teleconsultations, including reason for consultation and proposal on the part of the specialist team. CLP — cleft lip and palate; CLVP — cleft lip, velum, and palate; NR — unspecified.

Patient	Age	Sex	Date of consultation	Reason for consultation	Proposal/opinion	Surgical treatment
1	3	M	Oct 2014	Sequelae of CLP	NR	0
2	19	M	Oct 2014	Sequelae of Noma	Mission	Nasal reconstruction
3	10	F	Oct 2014	Vascular tumor	Mission	Resection
4	15	F	Oct 2014 and Jun 2015	Sequelae of Noma	Mission	Webster flap
5	33	F	Oct 2014 and Jun 2015	Sequelae of Noma	Mission	Correction of ankyloses
6	31	M	Feb 2015	Sequelae of Noma	NR	0
7	27	M	Feb 2015	Ballistic trauma sequelae	Mission	Glossoplasty + commissuroplasty
8	30	M	Feb and Nov 2015	Burn injuries	Mission	Nasal reconstruction
9	3	F	Feb and Nov 2015	Tessier n°4 cleft	Mission	Lateral cleft repair + cheiloplasty
10	5	F	Feb and Nov 2015	Tessier n°3 cleft	Mission	CLVP repair + rhinoplasty
11	20	F	Feb and Nov 2015	Sequelae of CLP	Mission	CL repair + Camille Bernard flap
12	20	F	Feb and Jun 2015	Cheek atrophy	Mission	Lipostructure
13	18	M	Feb and Jun 2015	Nasopharyngeal fibroma	Mission	Resection
14	20	M	Oct 2015	Sequelae of CLP	Intervention next mission	0
15	4	M	Oct 2015	Facial malformations	Intervention next mission	0
16	6	F	Oct 2015	Mandibular dysmorphism	Remote reassessment	0
17	35	M	Oct 2015	TMJ ankylosis	Intervention next mission	0
18	52	F	Oct 2015	Malignant parotid tumor	Surgery unfeasible	0
19	27	M	Oct 2015	Vascular tumor	Surgery unfeasible	0
20	9	F	Oct 2015	Sequelae of Noma	Mission	Lip reconstruction
21	25	F	Oct 2015	Sequelae of Noma	Mission	Lip reconstruction

arranged in Bamako by the local team as a consequence of interaction and advice provided during the consultation; or the case is considered to be too complex, and the decision is made to operate jointly on a future mission trip. Teams from Caen and Bamako have been meeting once a year for joint missions — in Bamako from 2001 to 2009 (Association for 'Health and Development'), and in Ouagadougou since 2010 ('Enfants du Noma' — Children of Noma).

Telemedicine also provides the opportunity for postoperative assessment of patients once the team of specialists has left the country, to monitor the wound healing process, manage possible complications, and schedule follow-up surgery if necessary. Any professionals who have already participated in missions know how difficult it is to obtain updates and deliver follow-up for patients in their care on a short- and medium-term basis. Such follow-up is nevertheless vital in the context of our surgical missions. This is precisely why telemedicine is such a key factor in successful remote monitoring. The efficiency of the technical and material resources at our disposal has always ensured the smooth functioning of teleconsultation sessions. The quality of HD images contributes to accurate patient assessment. Moreover, the availability of a zoom function for the specialist center enables precise examination of the patient, including intraoral examination. By means of shared mouse pointers, the remote team is able to indicate the exact lesion on which they are requesting an opinion, and the specialist team is able to indicate the outline of potential flap reconstruction, for example. Furthermore, the teleconsultation application Human-e keeps a record of consultations. Consultation reports are filed in the patient's medical records along with pre- and postoperative imaging. By setting up dual monitors, interaction with the patient takes place as if physician and patient were in the same room on one monitor, while the physician is able to consult the patient's electronic medical records (photography, imaging) on the other monitor via the telemedicine platform. It is a simple, fast, and inexpensive method of communication.

A further advantage of teleconsultation in the context of humanitarian missions lies in the anticipation of required equipment and supplies before the mission. It is necessary to foresee all potential requirements in terms of surgical supplies, consumables, and dressings in order to be self-reliant throughout the mission. Teleconsultation also helps to anticipate technical requirements. Hence, in the event of consultation for temporomandibular joint ankylosis,

we can anticipate the risks associated with anesthesia by planning in advance for fiberoptic intubation to negotiate a difficult airway.

From a surgical point of view, the maxillofacial pathologies encountered in developing countries are sometimes unknown, such as sequelae of Noma (accounting for 28% of teleconsultations between Caen and Bamako), or else pathologies are known but are atypical due to delayed presentation (Benateau et al., 2015). Because of the opportunity to see patients before the mission, it is possible to reflect on therapeutic strategy, and to discuss the various surgical options available, while taking into account local conditions.

Local patients suffer from malnutrition, notably because of their facial pathology (restricted opening of the mouth in sequelae of Noma or in post-traumatic ankylosis of the temporomandibular joint), causing impaired food intake, exacerbated by food shortages due to the level of poverty in certain countries. Pre-mission consultations are instrumental in identifying these patients and directing them to the appropriate facilities to ensure that they are fed before the mission and the surgical procedure.

Yet another undeniable advantage of these teleconsultations is their academic aspect, since the teams of both teaching hospitals attend these teleconsultations and share their skills and knowledge. In addition to providing advice to our colleagues on site, teleconsultation also facilitates distance learning, with academic benefits for interns. Students and practitioners from Bamako receive hands-on training (observation of the consultation process; teaching of local flap markings). French medical students benefit from the opportunity to study pathologies rarely encountered in their daily practice (such as lateral Tessier clefts and sequelae of Noma) and observe discussions on the various possibilities for reconstructive surgery.

Planning teleconsultations, however, entails some limitations in relation to e-mail exchanges. Participants must be available at the same time, which can be problematic when significant time-zone differences are involved. There are a large number of pilot projects experimenting with telemedicine initiatives in the humanitarian field. It is difficult to summarize experiences of long-running telemedicine networks delivering humanitarian services because of poor scientific output on this topic. The strength of the evidence from published studies is generally scored as average (WHO — Wooton et al., 2012).

Systematic reviews of the literature on telemedicine have shown that any notion of judgment criteria for telemedicine activity

remains vague (Deshpande et al., 2008; Demiris et al., 2005; Hersh et al., 2006). In November 2011, Ekeland published a review of the literature on methodology to evaluate telemedicine activity. This article encompasses every systematic review of the literature on methodology to evaluate telemedicine projects since 2005. Of the 1593 articles selected, only 50 reviews of the literature were retained as dealing explicitly with this subject. This study highlights both the lack of controlled, randomized trials, and the fact that the study populations were too heterogeneous to conduct meta-analyses. It also underlines methodological proposals (combining qualitative and quantitative approaches) aiming to conceptualize innovative telemedicine services. Nevertheless, lack of scientific consensus persists regarding judgment criteria for the efficacy of telemedicine pilot projects (Ekeland et al., 2012).

5. Conclusion

Better access to health information has allowed developing countries to open up healthcare access in communities that are at times very isolated, and has also much improved academic teaching.

Telemedicine is instrumental in: facilitating real-time exchange of specialist skills with local colleagues; enabling collegial decisions on the therapeutic management of patients; fostering distance learning with academic benefit for interns from both teams; reducing e-mail exchange outside teleconsultation sessions; and anticipating material and technical needs from a surgical and anesthetic point of view before missions.

Telemedicine does not replace the training of local surgeons, but does play a complementary role in surgical training.

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Conflicts of interest

All authors declare that they have no conflict of interest.

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