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ORIGINAL PAPER

Amputations of limbs during the 2005 earthquake in Pakistan: a firsthand experience of the author

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Abstract
Purpose On 8 October 2005 a massive earthquake hit the northern mountainous areas of Pakistan and Kashmir causing 73,338 deaths and leaving over 125,000 severely injured. In a region which was less prepared for such an enormous disaster, mobilising rescue, relief and rehabilitation posed great challenges. The lead author (SMA) established two level 1 orthopaedic trauma and rehabilitation units in existing public hospitals through private philanthropy in the earthquake struck cities of Muzaffarabad in Kashmir and Mansehra in Khyber Pakhtun Khuwa (KPK) Province. The purpose was to combat the major catastrophe and later study the pattern of injuries especially amputations so as to improve the future strategies in similar scenarios.
Methods This is a retrospective descriptive study of patients suffering from injuries of the limbs due to the earthquake who were managed in these centres with special emphasis on the patients with amputated limbs. The patients were received, worked up, investigated and prepared for definitive surgical procedures, in this case amputations. All patients were provided assistance for the fitting of a prosthesis and rehabilitation by referring them to specialised centres.
Results Of 128,304 patients, 19,700 were managed in the centres established by the lead author over a period of seven months. Of these, 112 patients underwent amputations of upper and lower limbs.
Conclusions In a massive calamity over a wide geographic area away from big university hospitals, such as the 2005 Pakistan earthquake, the level 1 operating theatre facilities must be established within the area to meet the needs of the patients nearest to their homes and families, and run forever so that patients can have excellent follow-up and can use the same facilities regularly. For example, in this study we managed 112 amputees and placed them in a rehabilitation programme, and transferred these centres to the hospital authorities after five years.

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Introduction

Disaster comes from Latin word for "bad star", i.e. bad luck, described as "*An event causing great damage, widespread destruction, injury or loss of life*" [1]. On 8 October 2005 at 08:50:38 Pakistan Standard Time (03:50:38 UTC) a massive earthquake, 7.6 on the Richter scale, struck the northeast of Pakistan and western Kashmir [2]. The epicentre was located near Muzaffarabad, the capital of Pakistan-administered Kashmir, 100 km northeast of Islamabad (Fig. 1). It was the world's third deadliest natural disaster of the past 25 years, surpassed only by the 2004 Asian tsunami and the 1991 cyclone in Bangladesh [3, 4]. During the earthquake approximately 3.5 million people were displaced, of which 73,338 died and 128,304 were severely injured [5]. Those who were reported to have a limb loss totalled 713 accounting for 0.9 % of the major injuries (WHO Geneva Report 2006).

The evidence of amputation as a medical treatment for trauma or disease comes from ancient Egypt [6, 7]. It has been estimated that there were 664,000 persons living with major limb loss in the USA in 2005 and more than 900,000

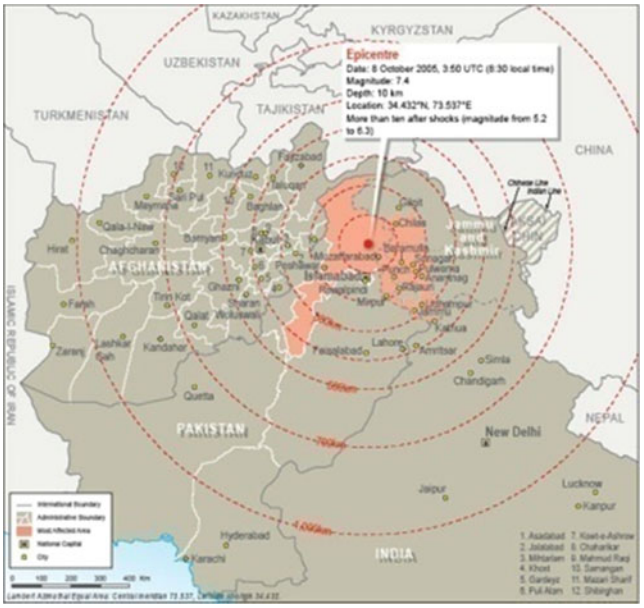

Fig. 1 Geographic location of the earthquake-affected area

with minor limb loss. "Major" limb loss is defined as amputation above the elbow, below the elbow, above the knee, below the knee or the foot. "Minor" limb loss is defined as amputation of the hand or digits (fingers or toes) [8]. Lower limb amputations are much more frequent than upper limb amputations and are most commonly the result of disease followed by trauma [9]. Limb loss is one of the most physically and psychologically devastating events that can happen to a person. Despite advances in medicine and surgery, amputation continues to be a large problem [10]. The annual cost of lower extremity amputations in the USA is reaching US$4.3 billion [11].

Worldwide prevalence estimates of amputation are difficult to obtain, mainly because amputation receives very little attention and resources in the countries where it is prevalent are low [12, 13]. The overall rates of amputation due to trauma or malignancy are decreasing, while the incidence of vascular amputations is rising. Peripheral vascular disease accounts for most leg and foot amputations, and up to 80 % of these patients have diabetes [14]. There is significant geographical variation in amputation rates, mortality rates and below knee to above knee amputation ratios [12]. In the developing countries trauma is the leading cause of amputation, whereas it is second only to peripheral arterial disease in the developed countries [9, 15].

Earthquakes in areas with financial constraints and difficult geographical terrain can result in substantial morbidity and mortality [16]. The earthquake in Pakistan also destroyed 594 small, medium and large health facilities in the area, thus complicating the health care delivery services. [3].

The purpose of this study is to audit the incidence of amputations of limbs at the time of a natural disaster such as the 2005 earthquake of Pakistan and the need to manage these amputees through the rehabilitation phase.

The aim of this study is to propose recommendations for the improvement of strategies during any such massive natural or man-made disaster in the future.

Table 1 Frequency of different body parts injured in our data of 19,700 patients

Body part injured	Percentage
Lower limb	50
Upper limb	28
Pelvis	10
Spine	5
Head	3
Face	2
Abdomen	2
Chest	1
Eye	1
Total	100

Materials and methods

The lead author (SMA) established two new "level 1 orthopaedic surgery and rehabilitation centres" through private philanthropy in existing public hospitals [one at the Abbas Institute of Medical Science (AIMS) Muzaffarabad in Kashmir and the other in DHQ Hospital Mansehra in Khyber Pakhtun Khuwa (KPK) Province]. The aim was to create a treatment facility for injured within the earthquake-affected areas. The hospitals were taken over on 8 October 2005 and continued working under his direct supervision till the year 2010. All patients with injuries to the upper limb, lower limb and spine were accepted in these centres for management. All patients who had major and minor limb amputations belonging to all age groups are included in this study retrospectively while analysing the trends in the overall mass causalities. Those received dead and treated on an outpatient basis (i.e. received no minor or major surgical procedure) were excluded from the study. Great

Table 2 Distribution of the types of amputations (total body parts 112)

Types of amputation	No. of body parts
Above knee	24
Below knee	36
Above elbow	16
Below elbow	6
Toes	4
Fingers	8
Hand	6
Feet	12

Fig. 2 Crushed lower leg and ankle with autoamputation of foot due to collapse of building

care was taken to organise and computerise individual records of patients.

Results

In our centres a total of 19,700 patients (with earthquake injuries) were received in the first seven months (emergency transfers and referrals from small centres in far-flung mountains), of which 12,000 were treated in Mansehra and 8,700 in Muzaffarabad. Table 1 shows the distribution of injuries in these patients. Of these injuries 58 % were of the lower limb, 28 % of the upper limb and 10 % of the pelvis. Of the 19,700 injured registered in our centres in the first seven months, 4,772 underwent implant surgeries like external fixation, nailing, plating (DCP, DCS, DHS, etc.), hemiarthroplasties (AMP), prosthesis etc. Treatments such as casting, traction, debridement, amputation, skin grafting and manipulations were performed in 14,928 patients. The statistics of distribution of amputation cases is given in Table 2.

Fig. 3 A young boy being trained after fitting of an above knee prosthesis on ramp and stairs

Fig. 4 Rectification of mould for manufacturing of the socket of the prosthesis

In the first 1,700 patients that presented to DHQ Mansehra 46 patients had amputations with 23 of the upper and 23 of the lower limbs (Fig. 2). Meanwhile in Muzaffarabad camp within the first days, 20 injured were amputated, of which 11 had lower limbs and had upper limbs amputated. The total number of body parts amputated was 112, of which "below-knee" was the most frequently performed amputation.

Discussion

Earthquakes are known to cause mass deaths and injuries with devastating effects on infrastructure and civil structure [4]. The October 2005 earthquake left a colossal economic loss of over US$5 billion and a challenging task of 13,000

Fig. 5 Final shaping of the socket of an above knee prosthesis

reconstruction projects [17]. The magnitude and impact of this disaster shook the whole nation. In the earthquake, 40,000 were injured, of which 55 % had major injuries. Limb injuries accounted for 60 %, cavity injuries 20 %, spinal injuries 2 % and head injuries 1 % (WHO Geneva Report). Though amputations accounted for just 0.9 % of the total injuries, they needed to be managed in the immediate and urgent phases of the triage [4]. Further, these patients needed extensive rehabilitation dealing with their physical, psychological and occupational liabilities.

The WHO statistics on total amputees admitted in Islamabad, Rawalpindi, Lahore, NWFP and AJK during 2005 was 713. The data show that most of the amputees were adult women (>18 years) reflecting the nature of the disaster. The number received in our camps was 112, and in a British report 150 were received in Pakistan Institute of Medical Sciences Hospital, Islamabad.

In our centre, the number of body parts being amputated from upper and lower limbs was equal. This is contrary to international trends where lower limbs are affected more frequently by trauma.

A "Limb Fitting and Physiotherapy Centre" was established by the lead author (SMA) in AIMS Muzaffarabad, with the financial support of private philanthropists and technical assistance by the "Society for the Welfare of Orthopaedically Disabled Pakistan (SWOD)". The goal was to rehabilitate the great numbers that were disabled (Fig. 3). The centre provided over 150 modern upper and lower limb prostheses (to amputees from other centres as well) and serviced many for physiotherapy (Figs. 4 and 5).

The firsthand experience reported here is in line with the recommendations of the "Earthquake Rehabilitation and Reconstruction Authority (ERRA)" of Pakistan, which are:

- Restoration of health care infrastructure through a seismically safe and rationalised health care system
- Providing an integrated health care delivery system covering preventive, curative and rehabilitation services
- Strengthening the health services through revival of the management and organisational system

Conflict of interest The authors declare that they have no conflict of interest.

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