Original Article

Role of Plastic Reconstructive Surgery in the management of earthquake victims of Nepal in Tribhuvan University Teaching Hospital

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Abstract
An earthquake of magnitude 7.8 richter on 25 April 2015 and its major aftershock on 12 May 2015 struck Nepal resulted inmassive destruction of Kathmandu valley and rural areas causingmore than 8800 mortalities and left more than 23000 injured. The casualties who were brought to the hospital were treated by various surgical specialties including plastic surgery. This is a cross sectional study in which the authors evaluated soft tissue injuries treated by the plastic surgery team in one month period after the earthquake. Information was gathered regarding pattern of soft tissue injuries and their treatment. There were total of 486 earthquakevictims admitted in the hospital and 532 major operations were performed. Total of 77 patients were admitted under plastic surgery and 115 operative procedures were performed for the 104 soft tissue injuries in these patients. Operations for soft tissue injuries accounted for 22% of the total operations performed. The most common operation was split thickness skin grafting (34%). Local and regional flaps were performed on ten cases(9%) and free flap was done in four cases (3.4%) ofmajor soft tissue defects requiring coverage of exposed bones.Complications occurred in 23 patients (29.87%) and included infection, skin necrosis, partial skin graft loss, Acute Kidney injury and sepsis. The authors conclude that the role of plastic surgeons is vital in disasters like earthquake and it helps in the appropriate and timely wound care and debridement and alsohelp to identify patients that would potentially benefit from limb salvage.

Keywords: earthquake, crush injury, plastic surgery, skin grafting, pedicled flaps, free flaps.

Introduction

An earthquake of magnitude 7.8 richter struck Barpak in the historic district Gorkha of Nepal on Saturday, 25th April 2015 at 11:56 am NST. Its epicenter was identified at a distance of 80 Km to the Northwest of Kathmandu, the capital of Nepal. A major aftershock of the 25thApril earthquake occurred on 12th May 2015 at 12:51 pm NST with a magnitude of 7.3 richter. The epicenter was on the border of Dolkha and Sindhupalchok, two districts of Nepal.The central and western regions of the country including Kathmandu valley were severely affected resulting in extensive damage to the buildings and collapse of many historic monuments. Poorer rural areas were particularly devastated due to their inferior quality of houses and were further isolated due to road damage and obstructions.The earthquake caused death of more than 8800 people and injured more than 23000 people.The injured victims were transferred and treated in different hospitals of the country. Many patients from rural areas were airlifted to the tertiary hospitals for further treatment. Some patients were evacuated alive from the collapsed buildings even after 1 week and treated. Professional search-and- rescue teams and medical teams from countries all over the world participated and helped in rescuing the victims entrapped in ruins and inthe treatment of the wounded.

Soft tissue and musculoskeletal injuries are the major types of injuries seen in such event. Minor soft tissue injury can be managed by any surgical specialties including general surgeons, orthopedic surgeons or plastic surgeons. But the complex soft tissue injury requires help of plastic surgeons for the proper management. The purpose of this study was to define the magnitude of soft tissue injuries that was treated by plastic surgery specialty in disasters like earthquake and to observe the effectiveness in management of trauma patients if plastic surgery team is available from the very beginning.

Methods

The day of the earthquake was a major crisis period when hundreds of earthquake victims including those killed in collapsed buildings were brought to the hospital. The injuries included minor crushes and cut wounds to severely traumatized limbs and body parts. After about half an hour of the earthquake, the people started bringing the injured victims. Initially medical personnel on duty managed the cases and after sometime rapid rescuing of those injured were possible with spontaneous involvement of the in-house resident doctors and medical students. At the beginning there was a lack of control and coordination among health personnel, but after few hours, medical teams headed by Hospital preparedness for Emergencies (HOPE) and consultants of emergency and other departments coordinated the managementof the patients by implementing triage system. The patients were categorized according to severity and need for intervention and sent to various triage areas – Red, Yellow and Green areas for further treatment. Treatment of the victims with life threatening injuries wasdone immediately and necessary operation performed included neurosurgeries, laparotomies and amputations. In the initial few days three major operation theatres were run 24 hours a day and later the number of operations performed gradually reduced. Orthopedic team started fixation of fractures and soft tissue injury were managed by general, orthopedic or plastic surgeons with surgical residents available at the scene from the first day of the incident.

During first week, the patients were treated both inside the hospital buildings and outside in the tents. Although the hospital building itself is considered as an earthquake resistant, majority of the patients were managed outside hospital building because of constant aftershocks and patients' fear of entering the building. Allthe patients were reassessed in the morning combined rounds which included orthopedic, general and plastic surgeons, and the further planning for operations was done according to the priority. Patients with minor injuries like lacerations and closed fractures were treated in minor surgical room setup and discharged from the green zone.

In the first week, main work load was musculoskeletal injuries which were mainly treated by orthopedic team. Plastic surgery team was mainly involved in amputations of unsalvageable mangled limbs, debridement of complex wounds and suturing of lacerations. After 1 week, there was gradual increase in referrals from orthopedic team for soft tissue defects and definitive plastic surgery reconstruction started only after 1 week.All cases of soft tissue injuries managed by plastic surgery team during 1 month after earthquake were included in this cross sectional study.

Results

There were a total of 1812 cases of disaster victims brought to the hospital during theone month period from the time of earthquake and out of these 486 patients were admitted for treatment. Total number of major operations done for the injured patients was 532, and rest of the patients had only minor lacerations, sprain, closed fractures which were treated and sent home.

Total number of admitted patients who underwent plastic surgery treatments for soft tissue injury was 77. There were 46 male and 31 female patients and age distribution of the patients are shown in Table 1. Forty two patients had sustained soft tissue injuries only whereas 35 patients had both soft tissue and bony injuries.The patients who had both soft tissue and bony injury were treated first by orthopedic team for bony injury and were later referred to plastic surgery team for soft tissue defects.Many patients had sustained injuries at multiple sites and so multiple procedures wereperformed for a single patient. Multiple debridements were needed for a single wound because of high contamination and crushing of tissues, before final closure of the injury with the skin graft or flaps. So there were 104 cases of soft tissue injuries seen in these 77 patients and total of 115 operative procedures were done by plastic surgery team over 1 month period after the earthquake.Ninety five operations were performed by Neurosurgery team for head injury, spinal injury, skull bone fractures and scalp injury over one month duration. Twenty eight patients with scalp injury were managed by Neurosurgery teams that were not included in our study. Similarly during this one month period, orthopedic team performed 238 operations for fixation of various fractures. Concomitant simple soft tissue injuries were largely managed by orthopedic team themselves and these were also not included in our study.

Table 1. Age distribution of earthquake victims treated by plastic surgery team in 1 month period

Age in years	Number of patients
0-20	31
21-40	31
41-60	9
61-80	6
Total number	**77**

Types of injuries sustained in the earthquake are listed in Table 2. Crush injury of the extremities was the most common type of injury that accounted for 70 cases out of total 104 injuries (67%). Isolated soft tissue injurieswere seen in 32 cases (lower limb - 26 and upper limb - 6) and both soft tissue and bony injuries were

seen in 38 cases (lower limb - 21 and upper limb - 17). Other common type of injury sustained was lacerations in different parts of the body caused by sharp or blunt objects while the earthquake or during an attempt to escape.

Table 2. Types of soft tissue injuries sustained in seventy seven earthquake victims treated by plastic surgery team

Soft tissue injury types	Number	%
Crush injury of Lower extremities (soft tissues injuryonly)	26	25
Crush injury of Lower extremities (both soft / bony injury)	21	20.2
Crush injury of Upper extremities(soft tissue injury only)	6	5.8
Crush injury of Upper extremities(both soft and bony injury)	17	16.4
Lacerations – face/ scalp/torso	9	8.7
Lacerations –upper extremities	8	7.7
Laceration – lower extremities	5	4.8
Degloving injury	3	2.9
Ring avulsion	1	0.9
Burn	2	1.9
Tendon injury	4	3.8
Peripheral nerve injury	2	1.9
Total	**104**	**100**

Most of the soft tissue injuries were found in the lower and upper extremities (53% and 36% respectively. (Figure 1).

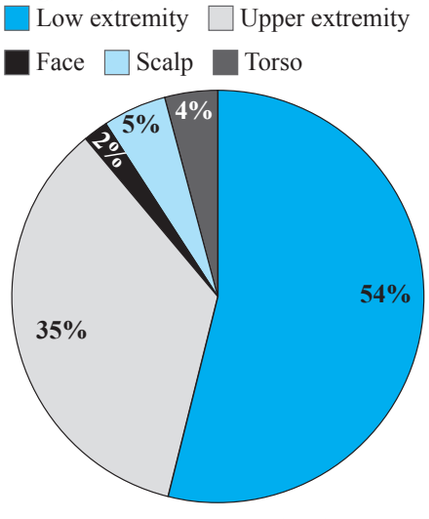

Figure 1: Distribution of soft tissue injuries in different body parts.

Types of operationperformed are listed in Table 3. The common operative procedures performed were split thickness skin grafting (34%) and re-debridement (24%). Ten cases of local and regional flaps including faciocutaneous flaps, radial artery forearm flap, sural flap, groin flaps and soleus flaps weredone for complicated soft tissue injuries (9%) (Figure 2 and 3). Four cases of free flaps were performed during the one month period but two flaps were subsequently lost. (Figure 4).

Table 3. Types of operations performed by plastic surgery team in one month duration after earthquake.

Operation	Number	Percentage
Skin grafting	39	34
Re-debridement	28	24.3
Primary/ secondary suturing	14	12.1
Flaps (Local / Regional)	10	9
Amputations (Fingers/ toes/ foot)	8	7
Free Flaps	4	3.4
Tendon repair	4	3.4
Revision amputations	2	1.7
Above knee amputations	2	1.7
Below knee amputations	2	1.7
Peripheral nerve repair	2	1.7
Total	**115**	**100**

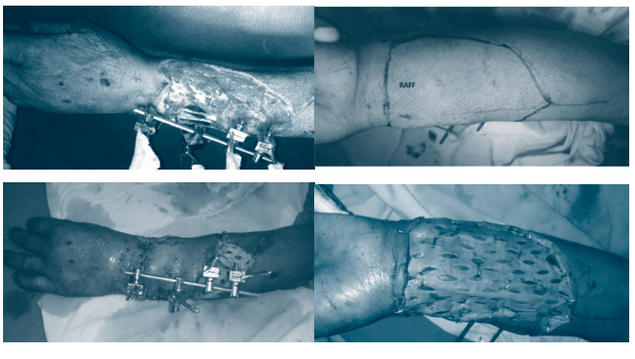

Figure 2. Crush injury to left forearm of 79 years woman with exposed ulnar bone and necrosed extensor carpi ulnaris. After debridement of wound, pedicled radial artery forearm flap was used to cover the defect.

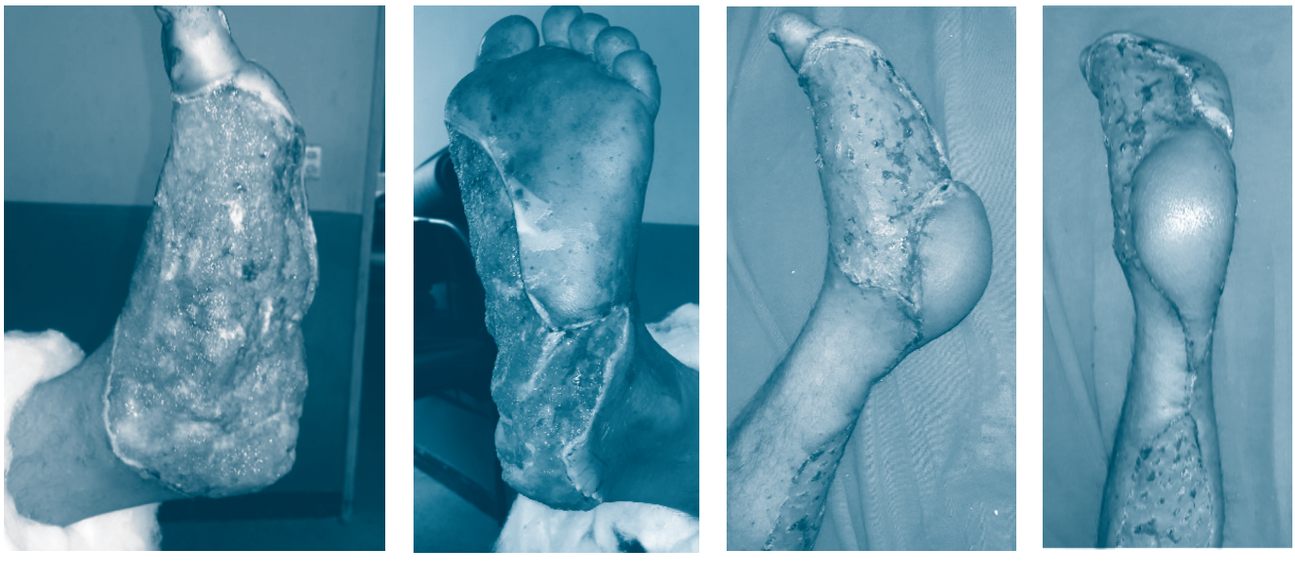

Figure 3. Crush injury to left foot involving sole and medial aspect of foot. The defect was covered with sural flap and skin grafting.

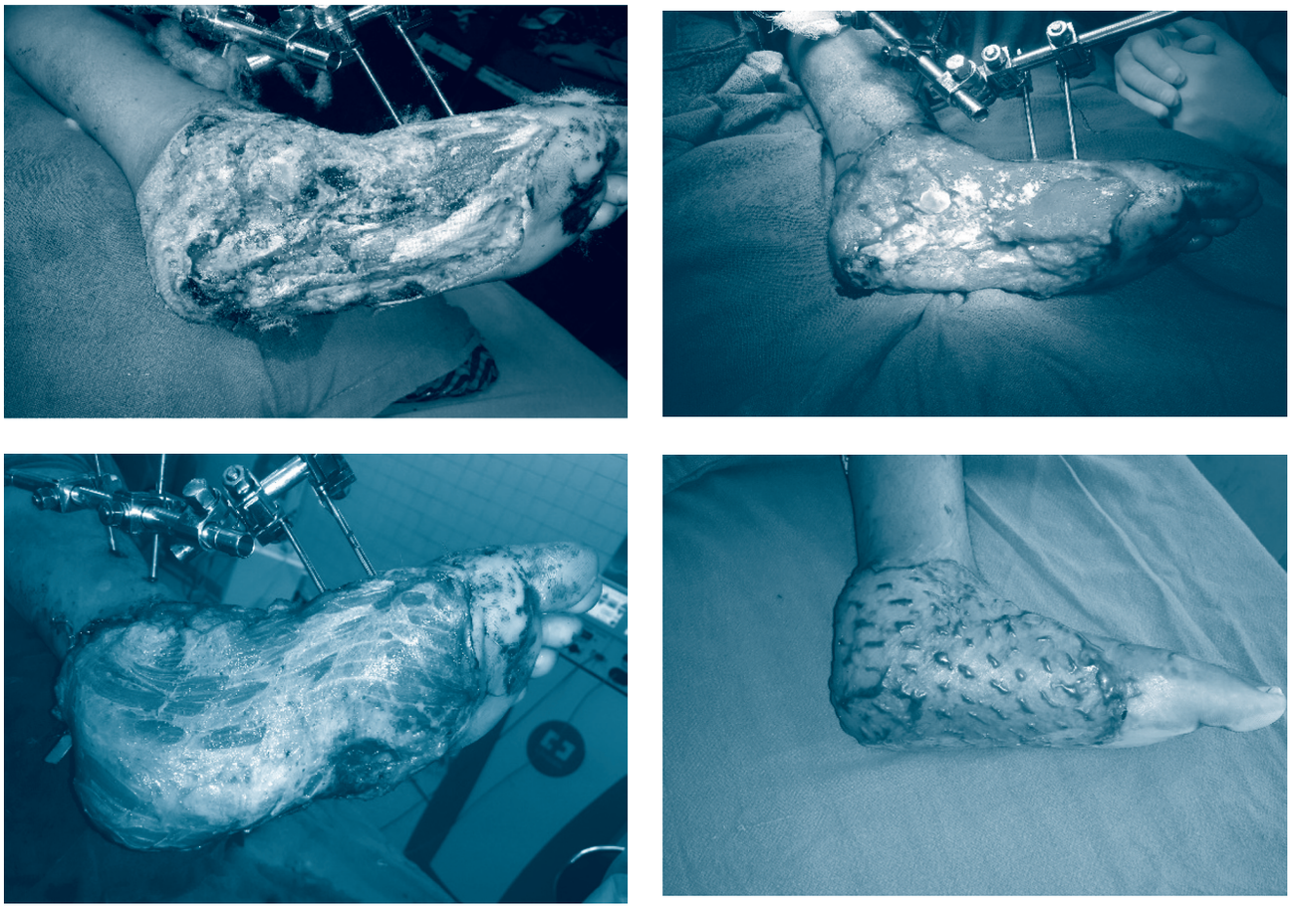

Figure 4. Crush injury to left foot. Wound was debrided and covered with Latissimus dorsi flap and skin grafting.

Complications occurred in 23 patients (29.87%) and these included infection (12), skin necrosis (2), partial skin graft loss (4), Acute Kidney injury (4) and sepsis (1).

Concomitant fasciotomy was performed to decompress increased compartemental pressure in 10 cases (lower limb -7, upper limb -3). Out of these 10 cases, 4 patients had AKI, 5 patients developed infection and one patient ended with amputation.

Discussion

Earthquakes are the leading cause of natural disaster related mortality and morbidity. Death occurs most commonly by burying in collapsed structures. Musculoskeletal and soft tissue injury of the limbs occurs mainly due to entrapment or crushing and also due to fall while trying to escape. Once the immediate life-saving phase is over, the management of these injuriesaccount for the major burden of the hospital.

Injury to limbs accounted for 56% of patients requiring hospital admission. Different studies showed between 40% and 67% of patients had limb injuries that needed admission.[1-5]

Major operations for limb injuries accounted for 63% of total operations performed in TU Teaching Hospital. It included 238 operations performed by orthopedic team for various fractures in limbs and 100 major surgeries performed by plastic surgery team for various soft tissue injuries in limbs.

Isolated soft tissue injuries admitted under Plastic Surgery in TUTH, after Nepal earthquake comprise of 9% of total admissions (42 out of 486). Soft tissue injury operations comprised of 22% of the total operations (115 out of 532). This includes all the operations done by plastic surgery team for isolated soft tissue injury of limbs and other body parts and combined soft tissue and bony injuries. Similar findings were observed in other studies. In Wenchuan earthquake, China, a total of 10.07% of the patients present in the field hospital did so for soft tissue injuries, and 21% of the operations were concerned with the treatment of soft tissue injuries.[6] After the 1999 earthquake in Turkey, the Israeli Defence Forces hospital treated 1,205 patients and 11% had isolated soft tissue injuries and more than 50 % of the operations performed were to treat soft tissues.[7] In patients admitted in Pakistan, 41 % had bony injuries and 36 % had soft-tissue injuries.[8] In one series from Haiti, cases performed by plastic surgeons accounted for 38 % of total operative volume, orthopaedic cases for 26 %, and gastrointestinal cases for 2 %.[9]

Limb injury operations comprise of 63.5% of total operations done (332 out of 532). Thirty eight operations were performed by both orthopedic and plastic surgery teams and this comprised of 11% of the total limb operations (38 out of 338). Not all of these patients were possible to be assessed by plastic surgery team for soft tissue management in initial operations, though plastic surgery team was available from the beginning. This resulted into higher incidence of inadequate debridement and inadequate fasciotomy which subsequently needed redebridement and refaciotomy.So plastic surgery team should supervise in as many as cases from the beginning to avoid incomplete treatments and complications.

Wounds after earthquake are generally heavily contaminated and soft tissue are severely crushed which require multiple debridement. All patients underwent debridement of wound at first operations and re-debridement was performed for 28 cases (24%) for initial incomplete debridement.

The most common operation performed was split skin grafting (34%). Most of skin grafts were taken well, but few cases had partial loss of graft due to infection which needed re-grafting. Skin grafting was common procedure performed in studies by different authors that ranges from 22% to 43%.[10,11,12]Ten cases of local and regional flaps (9%) were performed for major soft tissue defects and to cover exposed bone. After the earthquake in Pakistan, 14 % (127/862) of patientsunderwent flap-based reconstructions for complex soft-tissue defects.[10]Other authors noted 10% to 27 % of the patients underwent flap surgery.[11,12] Four cases of free flaps were performed by plastic team for complex defects. Two flaps out of these were lost due to infection for which one underwent amputation and another was salvaged by local flap. Twelve percent of total operations performed was for amputations for severely crushed injuries which were beyond salvage. Different studies showed amputation rates of 0.4 to 11%.[3,4]

Defining the number of limbs salvaged by the orthoplastic team is difficult to gauge, although limbs are certainly saved. Eight limbs with complex soft tissue defects out of 35 patientstreated by combined orthopedic and plastic surgery teamswere salvaged (22%).An estimated 20 limbs in 66 patients (30%)were salvaged by orthoplastic team in Pakistan earthquake.[11]In Haiti, 11 % (18/158) of patients treated by an orthoplastic team had complex defects or exposed bone that might have otherwise led to amputation.[12] After the earthquake in Pakistan,Yasin MA reported 14 % (127/862) of patients underwent flap-based reconstructions, presumably for complex soft-tissue defects that might have imperiled limbs.[10]

Conclusion

The magnitude of soft tissue injuriestreated by plastic surgery team suggests the beneficial role of plastic surgeons in disasters like earthquake. The specialist involvement from the outset will help to ensure appropriate and timely wound care and debridement and, also to identify patients that would potentially benefit from limb salvage.

Conflict of interest: None declared

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