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ORTHOPAEDIC MANAGEMENT OF EARTHQUAKE VICTIMS IN A TERTIARY CARE TEACHING HOSPITAL - CMH RAWALPINDI

Sohail Hafeez, Nasim Ul Majid, *Irfan Ali Sheikh, **Ahsan Hafeez

Combined Military Hospital Rawalpindi and *Muzaffarabad, **Army Medical College Rawalpindi.

ABSTRACT

Background: This study is based on the orthopaedic management of casualties coming from earthquake area after 8th October 2005.

Duration of the Study: 03 Months.

Material and Methods: All the patients requiring orthopaedic managements were subjected to major and minor operations including internal fixation, external fixation and conservative approach.

Results: A total 811 major orthopaedic operations were performed by all three orthopaedic teams at CMH Rawalpindi. 192 patients underwent soft procedures and 35 fasciotomies were carried out. 466 fixations were carried out including internal and external and rests were other procedures.

Conclusion: It is concluded that proper triage, initial management of wounds and selection of implant play a major role for better outcome in case of disaster casualties.

Keywords: Earthquake, disasters, management of mass casualties, orthopaedic.

INTRODUCTION

Human history is littered with disasters either natural or man made. Although hell seems to have fallen while we are in the midst of a disaster but the nations which learn from these calamities and improve their preparedness turn into a much stronger nation. The 7.6 Richter scale earthquakes which struck northern Pakistan on 8th October 2005, left a trail of destruction behind it, with 80,000 people dead and a large number injured. Most of the medical facilities and the infrastructure in the disaster area were destroyed so no medical infra structure existed in the earthquake zone. Within days field hospitals were established by army, civil and foreign teams in forward localities where innumerable surgeries were performed. The brunt of major casualties was, however, taken by base hospitals in Abbottabad, Murree and twin cities of Rawalpindi and Islamabad.

CMH Rawalpindi received the first casualty of the quake within 1 ½ hour of the earthquake, thanks to aviation pilots. By last light the hospital had received over 350 casualties. The hospital suspended its routine work and continued to work 24 hours a day for next one month. Now, when the dust has settled it is time to reflect upon the quality of care provided during the disaster, to underscore the strong points and to understand the weakness so that we are better prepared for handling any disaster which might occur in future.

Injuries to musculoskeletal system are common after an earthquake which has been observed in other major earthquakes of the century may it be in China [1]; Turkey [2] or Iran [3]. Orthopaedic injuries are also common in other natural disasters like tsunami [4], tornadoes [5] and hurricanes [6]. An analysis of injuries during these natural

Correspondence: Col Sohail Hafeez, Classified Orthopaedic Surgeon, CMH, Rawalpindi.

disasters and preparation can decrease morbidity and mortality in future [7].

This paper is an audit of orthopedic care provided to earthquake victims at CMH Rawalpindi which is a tertiary care teaching hospital, during a period of three months from 8th Oct 2005 to 8th January 2006. The hospital is located at about 100 km from the epicenter and the access roads pass through difficult hilly terrain.

It is a retrospective analytical study with random sampling based on the clinical record of patients.

The objective of this audit is to identify the subset of orthopaedic patients from a broader group of earth quake disaster victims reporting to a tertiary care hospital. Further categorization of orthopaedic victims into different regions and type of injuries would help us to allocate manpower instruments and implants in preparation for a future disaster. Identification of complications, errors and mistakes would help us to avoid them in similar situations and to organize ourselves better.

PATIENTS AND METHODS

Earth quake victims reached CMH Rawalpindi from the scene of disaster randomly, initially by helicopters and later by ground transport. There was no pre-transport selection at the scene nor there was any geographical or gender bias. Hence, the primary referral sample was random with no regional or injury bias. After first week we started receiving secondary referral cases from other hospitals, where initial resuscitation and management was done. These patients were sent for management of musculoskeletal injuries. Still later we started receiving tertiary referrals that had undergone skeletal stabilization in other hospitals and had some complications.

Patients reporting directly from earthquake area, were first evaluated either in the trauma center or reception hall of main OT by trained general surgeons. Triage was done and patients were shifted either to the wards or OT according to the priority of injury. The orthopedic department was divided into three teams each headed by a qualified orthopedic surgeon. On realization of large workload these teams were augmented by qualified general surgeons and trainees in surgery. Team one had five additional surgeons attached with them and team two and three had three additional surgeons. Secondary and tertiary referrals were admitted to the wards directly and shown to orthopaedic surgeons according to their duty schedule.

Initial dressings, debridements and minor surgeries were done in the emergency operation theater of trauma centre. The remaining major surgeries were performed in the main OT which has eight OTs. In the first three weeks 4 OTs were allocated for orthopaedic teams which was reduced to 2-3 OTs per day after the third week. All theaters worked 24 hours a day on 12 hourly basis.

The record of all patients undergoing surgery was collected from main OT register and tallied with the record maintained in wards and central statistics department. All surgeries were categorized into different sets according to the surgeon, region and type of surgery. From this record, patients who underwent orthopaedic operations were separated and their case files studied. X-rays were collected and recorded on digital films. The patients were divided into different groups according to the region or bone injured and type of surgery performed. The type of implants used and short term results were analyzed and compared with standard teaching during peace time. The rigidity of fixation and deviation from standard practice was noted and analyzed according to the training and experience of operating surgeon.

In addition to its own 750 beds, CMH had 200 extra beds available in various hospitals and medical camps where these patients were shifted after surgery for convalescence. A surgeon was delegated to follow up these patients regularly and most of them remained under our direct care for the first one month. Hence, data of all victims is available for the first month. On final discharge, the patients were given a follow up proforma in which the injuries and operations were recorded and they were asked for a regular follow up. About 60-70% patients reported for regular follow up. Rest of the patients returned to their homes and were followed up in hospitals nearer to their homes. These patients were given specific instruction to return to CMH Rawalpindi if any complication occurred. On each follow up, the patients were examined by the team who had operated upon him and fresh X-rays were taken if required.

The data was collected by each unit and finally presented in a surgical audit on 7th Nov 2005 in the CMH. The observations of various members of the teams were collected and record of patients who had complications was traced. The data collection was continued for another two months till 8th Jan 2006. Although complicated cases still continue to report to CMH Rwp but these are sporadic and do not form part of the present study.

General observations by orthopedic surgeons and other members of the teams were recorded with special emphasis on the strong and weak points in the management of these patients.

RESULTS

In a period of three months, total of 3472 patients were admitted to CMH Rawalpindi, the maximum number being in the first three weeks. A larger number of patients reported to trauma center but due to shortage of beds some of them were sent to other hospitals after triage. A total of 6009 operations were performed in CMH, many patients undergoing more than one surgery e.g. repeated debridements or change of dressings. Out of these, 3728 (62%) minor operations were performed in the trauma centre which included dressings 3174, stitching 161, debridements 52, chest intubations 36, POP 281, skeletal traction 24. A total of 2281 (38%) surgeries were performed in the main OTs. The detail of surgery performed in main OT includes: General Surgery – (1012) which included Debridements 466, Wound excision 389, Laparotomies 59, Amputation 56, Fasciotomy 26, thoracotomies 8, I&D 5, cystostomy 3. Total 1269 surgeries were performed in sub specialties to include orthopaedics 811, spine 105, plastics 323, neuro 27, and vascular 3. The operations performed by orthopaedic surgeons also included 192 soft like debridements, refashioning of stumps, amputations and fasciotomies. Debridements, wound excisions, amputation, I&D and fasciotomies may be grouped together as wound care surgery. The total wound care surgery hence becomes 1134 which is 50% of surgeries performed in main OTs.

The present paper is the audit of 811 patients who underwent orthopaedic surgery. Results of 105 spinal surgery cases are not discussed in the present study.

There was a definite change in type of injuries reporting to the hospital during different time period from the day of earthquake. In first 1-2 days, patients had mostly open fractures which were relatively clean. From day 3-10, we received open infected fractures with some patients having frank gangrene. Surgeries performed by orthopaedic teams in the first ten days were mainly debridement & application of Ex Fix. From 10th day onward, definitive fixation of closed fractures was started. From day 20 onwards complicated and neglected cases were attended.

The unit wise orthopaedic surgeries of each team are given in (graph). Of 811 patients treated by orthopaedic surgeons, 472 (58%) underwent open reduction, 147 (18%) were treated by non operative means like closed reduction & POP etc. and 192 (24%) underwent soft tissue procedures like debridements, fasciotomies etc. A total of 35 fasciotomies were done for impending compartment syndrome.

Total of 466 different fixation devices were used which included Ex Fix 153 (33%), DCP (Dynamic Compression Plate) 121 (26%), DHS (Dynamic Hip Screw) 41(9%), DCS (Dynamic Condylar Screw) 8 (2%), Intra-medullary nails 75 (16%), Kirschner (K) wires 60 (13%) and Misc. 8 (2%).

Regional details of different musculoskeletal injuries and their management are given in the following paragraphs.

A total of 13 pelvic fractures were treated out of whom 4 were treated operatively while 9 were treated by skeletal traction alone. The operative treatment included fixation of pubic disruption and SI (Sacroiliac) joints by 3.5 mm DCP. 6 fractures of acetabulum were treated by open reduction and internal fixation by employing 3.5 mm reconstruction plates (fig. 1).

Nineteen patients with posterior dislocation of hip reported to the hospital out of which 17 were managed by closed reduction. Only two patients required open reduction because the patients reported later than 72 hours and head of femur had button holed through the external rotator muscles. After reduction all patients were treated by traction for three weeks. None of the patients had a re-dislocation in immediate post reduction period.

A total of 54 patients of all age group presented with fractures of proximal femur. 41 of these patients were treated by DHS/DCS. The different orthopedic implants used in this category are given in (table). Some unusual method of fixation included use of 3.5 mm DCP and T plate for internal fixation of fracture of proximal femur in 3 children (fig. 2).

A total of 150 patients with fracture shaft of femur were treated which formed the second largest group of patients. Most of them were closed fractures and majority, 45 were treated by closed interlocking nails. 31 fractures of femur in children were treated by DCP. 15 fracture femurs were treated by open Kuntscher nails and 21 open femoral fractures were treated by debridement and Ex Fix which were used as definitive implants in these patients. Remaining 38 paitents were managed by skeletal traction and hip spica. Some of the complications observed in this group included malposition of fracture treated by Ex Fix (fig. 3), proximal migration of Kuntscher nails (fig. 4), bending of narrow Kuntscher nail (fig. 5) and broken DCP (fig. 6) used in children. The use of Kuntscher nails in skeletally immature patients was also observed.

Four supra condylar fractures of femur were treated by DCS and 5 fracture patellae were treated by tension band wiring. One case of MCL rupture of knee was treated by primary repair and one case of neglected rupture of ligamentum patellae was treated by reconstruction employing hamstring tendons.

Tibia was the commonest bone to be fractured, total patients being 229. Most of the fractures were open out of which 103 were treated by Ex Fix. 70 patients were managed by closed reduction & POP cast. Some of these patients required revision of POP and wedging. 21 tibiae were treated by ORIF (Open Reduction and Internal Fixation) with DCP and 7 patients were treated by IL IM (Interlocking Intramedullary) Nails. In 8 children minimal osteosynthesis was done by employing K wires. 18 patients required soft tissue coverage alone and 2 patients underwent amputations due to extensive nature of injury.

A total of 35 patients with injuries around ankle were operated upon in the hospital. 8 underwent open reduction & internal fixation; 7 were treated by closed reduction & POP; 3 were treated by Ex Fix. In 16 cases minimal osteosynthesis was done with the help of K wires especially in children. One patient had a rupture of Tendo Achilles which was treated by primary repair of the tendon.

A total of 29 patients with injuries to the foot were managed. This included debridement in 15, closed reduction in 5, ORIF of talus in 4 and ORIF of metatarsal bones with K wires in 5 cases.

In the upper limb one case of dislocation of sternoclavicular joint was managed conservatively. 3 patients with fracture proximal humerus were managed by ORIF with T plate; 2 dislocations of shoulder required open reduction and one patient of fracture clavicle required open reduction because of impalement of soft tissue.

Total 42 patients of fracture humerus were treated at CMH Rawalpindi. 10 patients underwent open reduction and internal fixation with DCP, 3 with IL IM nail; 10 patients of open fractures required Ex Fix. Two patients had concomitant injuries to brachial vessels which required vascular repair with flap coverage. One of them worked well but the second patient ultimately underwent amputation due to extensive post op infection. 14 patient of fracture humerus were treated conservatively by U slab only. In five children humeral fractures were fixed by K wires only.

Five patients of supra-condylar fractures of humerus were treated by open reduction and internal fixation with the help of reconstruction plate or K wires. 3 patients of old dislocation of elbow required open reduction. 5 fractures of olecranon were treated by tension band wiring.

Seventy-one patients with fracture radius and ulna reported to CMH Rwp. 33 were treated by open reduction and internal fixation with DCP, 5 with the help of Rush nail, 12 with Ex Fix; 5 with closed reduction and POP whereas 16 required only soft tissue procedures. The patients treated by Rush nail required conversion to DCP at a later stage.

Nine patients with fracture of distal radius were managed 5 patients by closed reduction and K wire fixation, 2 with closed reduction and POP and 2 with closed reduction and Ex Fix.

Eleven patients with fractures of hand skeleton were managed by the orthopedic department. Most commonly used implant for fixation of hand skeleton was the K wire. Most of the hand trauma, however, was managed by the plastic surgeons.

Complications included 11 amputations – 3 due to extensive soft tissue loss, five due to gangrene and 3 due to widespread infection. Six deaths occurred in the hands of orthopaedic surgeons, 3 due to septicemia and 3 due to compartment syndrome and renal failure. 35 fasciotomies were done for impending compartment syndrome out of which five ended in amputation and 3 into crush syndrome and death.

Limitation of theater space was the major handicap. This necessitated that patients with equal priority had to wait at time for over 48 hours before surgery. The wards and theaters were run by different surgeons and there was suboptimal coordination between wards and OT. This resulted in unplanned and at times unprepared patients reaching the OT in first two weeks. Later on the coordination improved and different surgeries were planned and prepared properly. In addition sometimes infected and clean cases were mixed in OT resulting in closure of OT for disinfection. Another limiting factor in the management of orthopaedic victims was availability of only one image intensifier. This problem was resolved in the second week by donation of two additional C arms.

Another limitation factor was the lack of trained ORAs and doctors. This was corrected by attachment of doctors, surgeons and ORAs from different hospitals to CMH Rwp. The presence of volunteer surgeons from other organizations and countries required diplomatic handling. Due to better working environment most of the visitors wanted to operate in the military hospitals but due to limitation of theater space all volunteers could not be accommodated. Moreover, volunteer surgeons came from different areas with varying standards of training and experience.

DISCUSSION

Although each disaster is different from a preceding one, the lessons learnt from one disaster would help us to prepare ourselves better for the next one. In a natural disaster of large magnitude different surgeons with varying skills, training and expertise are working in difficult environments with limited resources and overstretched logistics. The primary objective of management of victims in such a situation would be to provide best possible care for maximum number of victims [7].

The study is intended to define the number of patients requiring orthopaedic care in a natural disaster. The study has an inherent difficulty that there was no exclusion or inclusion criteria and only those patients were included which managed to reach the base hospital. Since many people were managed in forward and other hospitals it is difficult to apply meaningful conclusions to the entire disaster population. However, different studies in similar situations like Chinese earthquake of Tangsham [1], Marmara earthquake of Turkey [2] and Bam earthquake of Iran [3] show that majority of patients in an earthquake disaster sustained injuries to limbs with or without fractures. Similarly other studies from Kashmir in Oct 05 earthquake [10,13] showed that over 50% patients suffered injuries to limbs mostly fractures.

Maximum number of patients reported to base hospital in first three weeks which is similar to findings in a study in Los Angeles earthquake [11]. Hence, the hospitals should be prepared to receive maximum primary casualties in first two weeks.

The present study shows us the case mix which ultimately reached the tertiary care hospital. In the present study a total of 3500 patients were admitted on whom 6009 operations were performed with 3728 (62%) minor and 2281 (38%) major surgeries. Although it is difficult to draw definitive conclusions due to sampling bias, it is reasonable to conclude from the present study that a tertiary care hospital looking after 3500 mass casualties would perform approximately 2300 (38%) major surgeries. Out of the patients requiring major surgeries about 800 (35%) would require orthopaedic operations of different types.

The analysis of general and orthopaedic surgeries in such a scenario would help us to distribute the scarce manpower properly. In the present study it was noticed that some of the skeletal stabilization was done by general surgeons, whereas, some of the soft tissue procedures and wound care was done by the orthopaedic surgeons. This resulted in suboptimal skeletal stabilization in some patients and increased workload for the orthopedic surgeons in others. By looking carefully at the total surgeries performed by all surgeons in main OT it becomes clear that 1134 of 2281 i.e. 50% required wound care surgery. Hence, it may be concluded that in a scenario of a natural disaster about 50% patients would require surgery for wound care and this can be done by trained general surgeons assisted by a plastic surgeon. This is comparable to the study in Bam earthquake where 75% surgery was of wound care [3] and also in a field hospital in Kashmir where wound care surgery was 37% [10]. The general surgeon would also be able to handle injuries to abdomen, 59 or 2% according to present series, and chest 0.28% in present series. It is therefore, recommended that a trauma team should have at least 3-4 well trained general surgeons and all wound care should be done by them. The orthopaedic surgeons should be used exclusively to handle only skeletal injuries.

In view of our experience, it is recommended that the hospital theater should have two tier arrangements preferably in separate but close locations. All victims should first undergo a first look surgery in primary theaters by general surgeons where the nature of wound should be ascertained and wounds debrided at the outset. The same theaters should be used for wound care surgery e.g. change of dressings, repeat debridement etc. Infected cases should not be allowed to go to the secondary theaters. After primary debridement the patients requiring urgent surgery like Ex Fix or definitive internal fixation should be operated upon in the second set of operation theaters. These secondary theaters can also be used for major surgeries in other specialties like general, plastic or thoracic surgery.

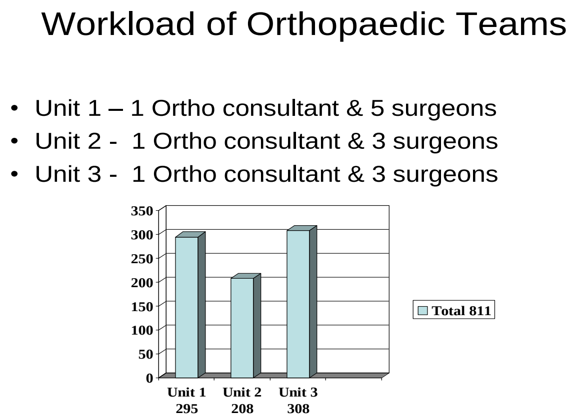
If we exclude all wound care surgeries we would leave with an 1147 patients out of whom 619 (54%) would require management by orthopaedic surgeons. The orthopaedic workload in different series is different e.g. in Maramara earthquake in a university hospital 16.8% had extremity fractures [12] whereas, in Los Angeles earthquake of 1994 this figure was 50% [11]. Of the orthopaedic surgery performed, 58% required open reduction and use of different implants. This might be different from series of other hospitals in forward areas [13,14] as we were working in a base hospital where relatively clean OT environment was available. In the present series 18% orthopaedic patients were treated by conservative methods which are a reasonably good method in such a situation.

Study of different devices showed that Ex Fix was the commonest device used (33%) as most of the fractures were open. Hence, in such a situation an ample supply of different Ex Fix is mandatory. For a hospital catering for about 850 orthopaedic patients a minimum of 200 Ex Fix should be available. The principles of reduction, safe corridors, mechanical rigidity etc. should be strictly followed during the application of external fixators. All Ex Fix should be applied under direct supervision of orthopaedic surgeons. When the situation is optimum other orthopaedic devices like DCP, DHS, DCS, reconstruction plates, interlocking nails & Kirschner wires would be required. In addition to the orthopaedic implants, clean OTs, pneumatic drill systems, image intensifier, fracture table and autoclaves are essential for handling orthopaedic patients.

What type of injuries should an orthopaedic surgeon expect in such a situation? A detailed study of regional injury pattern would help us to answer this

Table-1: Implants used for fracture of proximal femur.

Implant used	Number
Cancellous Screws	4
Dynamic Compression Plate	2
Austin Moore Prosthesis	3
Dynamic Hip Screw	37
Dynamic Condylar Screw	4
External Fixator	1
Skeletal traction	3
Total	54



Graph: Workload of different orthopaedic teams.

Fig. 1: Complex acetabular fracture treated by ORIF with reconstruction plate.

question. Although the trauma surgeon should be well versed in application of Ex Fix, he should be well trained to handle all kind of trauma like difficult pelvic fractures, complicated proximal femoral and humeral fractures and insertion of interlocking nails.

In this series lower limb injuries were seen more than upper limb (596 or 73%). This could probably be due to entrapment of lower limbs of victims under the fallen masonry. Tibia was the commonest bone to be injured (229 or 28.2%) and majorities (103 or 45%) of these fractures were treated by Ex Fix. Many complications were observed in the application of Ex Fix. The commonest mistake was inability to reduce the fracture accurately before application of external fixator (fig. 7). Mal-positioned Schanz screws and pin tract infection was the next common complication. Some of these Ex Fix were applied by junior residents without adequate supervision and required revision at an early stage. Hence, it is imperative that all Ex Fix should be applied under direct supervision of a trained orthopaedic surgeon and should not be left to the untrained surgeons. Another important aspect in the management of these open tibial fractures was the coverage of bone (fig. 8). During first 2-3 days it was considered appropriate to have the bone covered by local or distant flap as the wounds were relatively clean. As the time passed the patients were presenting with infected wounds which were not considered appropriate for skin cover. However, the bones could not be left exposed. An innovation by the plastic surgeon for these patients was repeated debridement followed by early cover by muscle flaps. The muscle flaps were covered secondarily with split thickness skin grafts if there was no wound infection. Once the OT environments improved some of the closed tibial fractures were managed as in normal peace time situation i.e. with IL IM Nails (3%) and DCP (9%). Use of Ex Fix and internal fixation device should not draw our attention away from the conservative management of tibial fractures by closed method as done in this series (66 or 29%) with acceptable results. In fact in a situation, faced with a large number of open tibial fractures with doubtful theater sterilization it would be appropriate to treat

Fig. 2: Use of DCP for treatment of proximal femoral fracture in a child.

Fig. 3: Errors in application of Ex Fix – Inability to reduce the fracture before application of Ex Fix.

Fig. 4: Errors in application of Kuntscher nail – Migration of Kuntscher nail in an unstable femoral fracture.

these fractures in a POP cast. This might result in higher percentage of mal-unions which can be managed better than having infected non-unions with gap by overzealous use of internal fixation devices.

Femoral shaft fractures were the next common injury (150 or 18.4%) observed in the present study. Compared to tibia most of the femoral fractures were closed, only 14% were open which were managed by debridement & Ex Fix. The difference of open fractures between tibia and femur could probably be explained by the bulk of muscles surrounding the femur. 30% of femoral fractures were managed by closed interlocking nailing. However, in 15 patients (10%) open Kuntscher nailing was done. Kuntscher nail is a good device provided the fracture is inherently stable. Disregard to this principle resulted in loss of reduction or migration of nails. Use of narrow diameter nails resulted in bending of nail. Most of the Kuntscher nails were done by open method due to non – availability of image intensifier. The indiscriminate use of Kuntscher nail with violation of epiphysis in children was also observed. It may be concluded that femoral fractures are common in mass casualties. While managing these fractures it is imperative that the stability of the fractures should be observed. Closed nailing should be done whenever possible and should be locked according to the stability of the fracture. In children nails should not be used and femoral shaft fractures in children should preferably be treated by DCP.

Proximal femoral fractures were observed in 54 (6.6%) patients and most of them (76%) were managed by DHS or DCS (7.4%) giving universally good results. It is suggested that the orthopaedic surgeons should be ready to use DHS/DCS and should have the necessary equipment e.g. Image intensifier and fracture table to handle proximal femoral fractures. Similarly, hip dislocation was seen quiet frequently (19 patients). Most of them could be reduced by closed method but 2 required closed reduction due to button holing of the head through the short external rotators. A surgeon handling dislocation of hip should be ready to undertake open reduction if the closed

Fig. 5: Errors in application of Kuntscher nail – Bent nail due to use of narrow nail in an unstable femoral fracture.

Fig. 6: Broken DCP in femoral fracture.

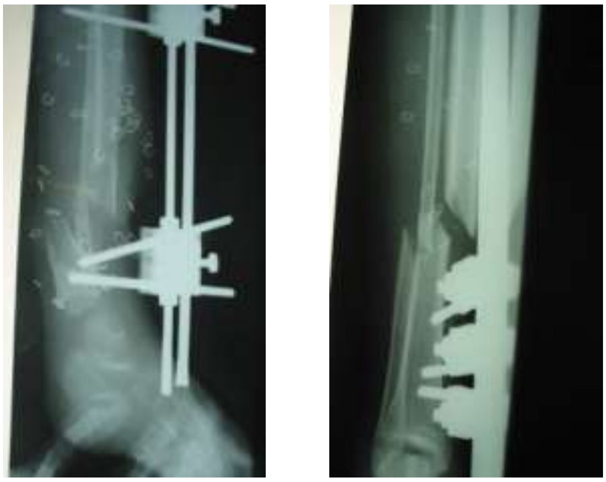


Fig. 7: Errors in application of Ex Fix for tibial fractures – Inability to reduce the fracture before applying the Ex Fix.

method fails.

Nineteen patients (2.3%) had complex pelvic and acetabular fractures. 9 (47%) underwent open reduction and internal fixation. The reason for non operative method was mainly lack of clean environment and non-availability of theater space. In mass casualties the orthopaedic surgeon must expect and should have necessary implants and instruments to handle these complex pelvic injuries.

In the upper limb the commonest bones fractured were radius and ulna (71 patients or 8.7% of total) majority of which (46.4%) were managed by open reduction and internal fixation with DCP. Rush nails used for temporary stabilization had to be revised early. Management of open fractures of forearm bones by Ex Fix did not give us satisfactory results probably because of extensive soft tissue defect or bone loss.

Humeral fractures were the next common in the upper limb (42 or 5.1%) most of which were managed by DCP or IL IM nail with satisfactory results. 10 patients with open fractures (23%) required Ex Fix Two patients had concomitant injuries to brachial vessels which required vascular repair with lattisimus dorsi flap coverage. One of them worked well but the second patient ultimately underwent amputation due to extensive post op infection. Conservative management of fracture humerus with U slab is a well established method and was done in 9 patient (21.4%) giving satisfactory results.

In addition to fractures of long bones and pelvis the orthopaedic surgeon should be ready to handle complex ligament and joint injuries like neglected rupture of ligamentum patellae, collateral or cruciate ligament and Tendo Achilles injuries. Neglected dislocations of shoulder, elbow, hip and ankle would also present occasionally and require open reduction. Fractures of small bones of foot and hand also present with varying frequency and expertise of a hand surgeon would be helpful. For management of these small bone Kirschner wire and mini-fragment set is essential as is the necessity of early wound coverage and rehabilitation.

In the present series the commonest complication was impending compartment syndrome most which required early fasciotomies. Some of these patients had crush syndrome leading onto renal failure or amputation. This is similar to observation in other earthquakes as in China [1] and Turkey [2]. Early fasciotomies, repeated wound debridements and haemodialysis can prevent the fatal complications in these patients [8,11].

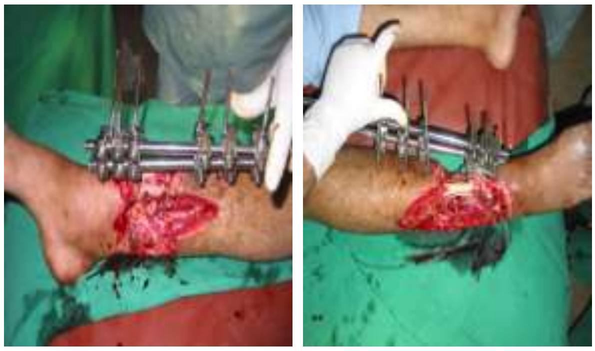


Fig. 8: The question of wound coverage.

CONCLUSION

The management of orthopaedic victims of earthquake in a tertiary care hospital has taught us many lessons. A good triage done by an experienced surgeon is the fore bearer of good management of mass casualties. The three team approach would be helpful to manage the orthopaedic patients effectively. Two tier OT arrangement is suggested where wound care surgery is done in primary OTs and definitive procedures are done in the second set of OTs. In an earthquake commonest surgery is that of wound care which requires expertise of a good general and plastic surgeon. For optimum results orthopaedic surgeons should be used exclusively for stabilization of skeletal injuries. Lower limb injuries are the commonest with open fractures of tibia as the majority. Open fractures should be treated by Ex Fix under direct supervision of an orthopaedic surgeon. The orthopaedic surgeon should be ready to handle complex limb and pelvic fractures and should have the necessary equipment, implant and clean OT environment for the task. In addition to technical errors, wound coverage, infections, Compartment syndrome, Crush syndrome and amputations are some of the complications observed in such a scenario.

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