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## A Study on Orthopedic Injuries in Survivors of 2004 Indian Ocean Tsunami.

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### ABSTRACT

Studies from centres that cared the survivors of Indian Ocean Tsunami of 2004 report very few orthopaedic cases. The first part of this retrospective study done in a tertiary care centre of South India analyses the case records of all the victims of this Tsunami received and cared with specific look out for musculo-skeletal injuries. The second part of the study analysed the pattern of 78 musculo-skeletal injuries as to their diagnoses and management. There were 57 emergency procedures on the first day and 25 elective orthopaedic surgeries over next two weeks. This study stresses difference in the occurrence of musculo-skeletal injuries between countries affected by Indian Ocean Tsunami of 2004.

**Keywords:** Tsunami-Survivors, Pattern, Musculoskeletal injuries, Tertiary care centre, Preparedness. Questionnaire

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## INTRODUCTION

Literature on survivors of the Indian Ocean Tsunami of 2004 is few. These are either from a primary health care perspective or visiting team's assessment of the existing facility. In these works only few serious musculoskeletal injuries (MSI) were reported [1, 2]. The Indian Ocean Tsunami 2004 ruined the coastal belt of South India especially the state of Tamilnadu. Our centre being the main tertiary referral centre of this area, received many cases mainly from Nagapattinam [the worst affected district of India]. In the backdrop of the available literature, we wanted (i) to find the number of tsunami victims which were received in our centre and (ii) to find if serious musculoskeletal injuries (MSI) really rare in Indian Ocean tsunami of 26th December 2004 victims. The first part of this retrospective study analyses the case records of all the victims of this Tsunami received and cared in a tertiary care centre of South India with specific look out for MSI. The second part of the study analyses the pattern within the MSI group as to their diagnoses and management.

Part 1

### AIM AND STUDY PATTERN

This is a retrospective study which aims to scrutinize the records of all the victims of this Tsunami and also assess the relative occurrence of MSI in the victims of Tsunami 2004. It also analyses the type of MSI and their treatment. The source of this study were (i) the case sheets, (ii) nominal registers of the wards (iii) operative theatre registers in the emergency and elective theatres and (iv) The mortuary book. The records of all cases received on or after 26th December 2004 were analysed. The total statistics was recorded and a clinical research questionnaire were devised and the details were entered. Of the in-patient records (case sheets) between 26<sup>th</sup> December 2004 and Seventh May 2005, 385 were due to the tsunami cases or tidal wave. The details are presented in the result section for future workers for comparison.

### RESULTS

The first case of this group was admitted on (26th December 2004) the day of Tsunami and the last case was admitted 104 days later (on 30<sup>th</sup> March 2005). Majority (95 %) of the cases were received on the first three days. The cases (5%) that reported 3 days after were those cases that were transported from other health facilities around Nagapattinam. The last case of this group was discharged on 7<sup>th</sup> May 2005. The hospital stay was a minimum of 1 day to a maximum of 126 days. Of the 385 cases received, 214 were men, 137 were women, 21 were boys and 12 were girls. The oldest patient of this group was 85 years and youngest was a 2 days old neonate. 34 patients absconded from the wards; six were discharged against medical advice; 42 were discharged at request. After the completion of definitive treatment 286 cases were discharged from our facility. 17 patients died during this treatment period and post-mortems were not done as per the policy of the government in view of the mass nature of the events. We used the services of doctors of our hospital and from the nearby government facilities. The patients were cared by three orthopaedic units and were asked to come for follow ups without any fixed day for the patients' convenience. This is because these patients did not have persons to bring them for follow ups. Of the 385 cases, there were 78 patients with MSI.

**Part 2**

**Aim:** The second part of the study aimed to analyse the musculoskeletal injuries and procedures in those 78 patients that had MSI. These are listed in the table 1. The average time lag between the arrival and procedure was 1 hours 12 hour range. This delay was due to initial resuscitation.

S no	Injury	No	Treatment.
1	Cervical spinal injury no neurological deficit	1	Conservative
2	Stable pelvic injury. stable type 1 Marvin Tiles	5	Conservative
3	Clavicle fractures	2	Conservative
4	Humerus fractures including 1 fracture dislocation of shoulder	6	4 were plated and 2 were treated with plaster only One old lady had associated fracture dislocation of shoulder and another patient had pnemonitis
5	Forearm fractures	4	2 had open reduction and internal fixation
6	Galleazi fractures	2	1st (open) debrided and K- wire fixation 2nd had plating of radius. 2nd case also had a rib fracture which was treated conservatively
7	Crush injuries of hand .	2	Disarticulation of wrist for both
8	Phalange fracture of hand	1	Conservative
9	Posterior and one central hip dislocations.	6	1 posterior - dislocation had posterior lip fracture of acetabulum 2 All [6] reduced under spinal anaesthesia by Bigilo's method & immobilized in traction
10	Traumatic synovitis of hip	1	Conservative
11	Un-displaced fractures of trochanter	2	Conservative
12	Sub trochanteric fractures	2	one fixed with barrel plate and screws other had deep cut wound which was debrided and kept in traction and later fixed
13	Femoral shaft fractures	6	5 intramedullary nailing/1 plating
14	Floating knee.	1	Intramedullary nailing for femur /tibia conservatively
15	Quadriceps rupture,.	1	Debrided/repared /immobilized .
16	Hemarthrosis,	1	Aspiration/ plaster .
17	Medial collateral strain	1	Conservative
18	Internal derangement of knee.	1	Conservative
19	Fractures of both bones of leg	21	6 closed fractures conservative/ 7open debrided and external fixation of these 1 patient had bone transport for bone loss(illustrated) /3 compartment syndrome had fasciotomy /external fixation 5 -inter locking- nailing after a week 1 had CoronaryArtery Disease and 1 had Diabetes Mellitus
20	Tibial plateau fracture/compartement syndrome.	1	Fasciotomy / plaster immobilization.
21	Undisplaced Tibia fracture .	1	Conservative
22	Isolated Fibula fracture	1	Conservative
23	Injuries around ankle	3	1fixation for lateral malleolus /rest treated conservatively.
24	Phalangeal fracture of foot	1	Conservatively.
25	Crush injury foot.	1	Debridement
26	Haemothorax with fracture of rib	1	Inter costal drainage.
27	Crush of leg	2	Below knee amputations for both
28	Crush injury of thigh and leg	1	Disarticulation of hip for gas gangrene

**Table 1: Musculo skeletal injuries from tsunami and treatment done**

## RESULTS

### Injuries

There were 55 lower limb (including a case of floating knee) and 17 upper-limb injuries. The single most site of bony injury was both bones of leg (21 cases). Of these, three developed compartment syndrome. One of the tibial shaft fracture patients also had coronary artery disease and while another was a known patient of Diabetes Mellitus. There were one stable spinal injury and four stable pelvic injuries. There were six hip dislocations, all describing an experience of their affected lower extremity pulled by the current of the tidal wave. The injury list did not have any dorsal or lumbar spine injuries, Monteggia fracture dislocations, metacarpal fractures, femoral neck, and femoral condyle or patella fractures. No other tarsal was involved other than calcaneum. The patient with Galeazi fracture dislocation also had a rib fracture which was treated conservatively.

### Emergency Procedures

In the first 24 hours, 57 emergency procedures were done. These are presented in table 2. These mainly included closed reductions of hip and shoulder dislocations, amputations and disarticulations for crush injuries and fasciotomies for compartment syndromes of leg and forearm. Plaster immobilizations and pin tractions were applied for the most of the long bone fractures for initial stabilization so that definitive management can be done later. **Table**

**Table 2: Emergency – Procedures**

S no	Procedure	number
1	Closed reductions of shoulder dislocation	1
2	Closed reductions of hip dislocations and Pin- tractions after reductions	6
3	Amputations and disarticulations for crush injuries of leg below knee	2
4	Hip disarticulation	1
5	Amputations and disarticulations for crush injuries of upper limb	2
6	Fasciotomies for compartment syndromes of leg and external fixation	4
7	Debridement and external fixation	7
8	Plaster of Paris immobilizations for the most of the long bone fractures	20
9	Pin- tractions were applied for femur fractures	9
10	Hemarthrosis aspirated and above knee plaster applied	1
11	Debridement of wound sub troch leg	1
12	Debridement of wound foot	1
13	Debrided/repared /immobilized. Quadriceps rupture,.	1
14	Haemothorax with fracture of rib- inter costal drainage.	1
	Total	57

### Elective and definitive procedures

From the next day (27-12-2004) onwards to up to ten days after, the definitive fractures fixations were done. 26 elective procedures were done in the regular operation theatres. Most of the long bone fractures of tibia and femur were fixed with intra-medullary nailing. One patient with femoral shaft fracture died in the post operative period due to pulmonary embolism. One gentleman [illustrated in figure 1 a to g ] with an open fracture of tibia with bone loss, who was treated with Ilizarov - fixator went on to develop serious

infection of the corticotomy site also. He needed further procedures of compressing the corticotomy site and later on an interlocking nail and repeated instillation of bone marrow aspirate at corticotomy site and fracture site for union. He was the patient with long follow up till 2009. During their course in the hospital ,wounds of certain patients developed severe ,deep infection which are resistant to antibiotics resulted in amputation and disarticulation. This may well be due to sea water contamination e.g. a patient who had crush injury and a below knee amputation on the first day, developed gas gangrene later ending in a hip disarticulation. He survived all this and was discharged after treatment. One case of fracture of humerus had pneumonitis. A young boy with crush injury leg with panic attack had a below knee amputation followed by psychiatric management with major tranquilizers.

**Table 3: Elective and definitive procedures**

Sno	Injury	Nos
1	Plating for Humerus fractures	4
2	Plating for Both bones Forearm fractures open reduction and internal fixation	2
3	K- wire fixation -ORIF - after initial debride ment for Galleazi fractures	1
	Plating for radius. ORIF - for Galleazi fracture dislocation	1
4	Barrel plating ORIF -Sub trochanteric fractures	2
5	Intra-medullary nailing/ for femoral shaft fractures	5
	Plating for Femoral shaft fractures	1
6	Intra-medullary nailing for femur / Floating knee # tibia conservatively.	1
7	Ilizarov -Bone transport for bone loss(illustrated) Fractures of both bones of leg	1
8	Inter- locking- nailing after a week , for fractures of both bones of leg	5
9	Tension band wiring for lateral malleolus	1
10	Disarticulation of hip for gas gangrene	1
	Total	25



Figure 1a



Figure 1b

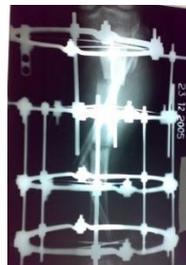


Figure 1c



Figure1d



Figure 1 e



Figure1 f



Figure 1 g

Figure 1 a to 1c shows the radiographs of internal bone transport procedure done for a segmental bone loss for a victim from Nagapattinam. This was the patient who climbed a tree after the fracture. The corticotomy got infected hence it was compressed accepting the shortening. 6 months later X-ray in figure 1d shows the infected corticotomy [the upper defect] and healed fracture [the lower lesion]. still as corticotomy union could not be achieved hence the tibia was fixed with an interlocking nail and marrow was injected for the corticotomy site. 1.e. shows the condition of the skin during the nail removal. 1.f shows the interlocking nail before removal 1.g. The nail removed on 9th October 2009. This patient is now walking without any support.

### DISCUSSION

To oversimplify the results of this study is difficult as it was from a tertiary care centre. There could be some more cases from Nagapattinam who could have been treated elsewhere. However in the year 2004 our facility is the largest referral centre for the worst affected district of Nagapattinam. The number of patients treated in our single centre [385] is comparable to the number of cases [523] treated in two centres put together in Indonesia [2] The bed centre of our centre is 678 with average bed occupancy of 90 -95 percent (610-644 patients for 678 beds) percent at any time. This leaves only 34 to 68 beds free that too in different wards. Hence the sudden influx of 385 patients within a period of 24 hours is a *mass casualty incident* as it had generated a number of patients that exceeds the capacity of the available health resource to manage using normal procedures [3] This rare intrusion by a mammoth disaster into the routine work of a health care facility is a real challenge and puts the hospital machinery into stress. The maximum number of procedures were done within 24 hours were 57. Triage in tackling the initial mass surge of patients and pooling of resources were helpful. The arrival of the next such tsunami is unpredictable [4]. We were not sure if the present set of health care personnel will be alive during the next tsunami. In the words of F.W. Swann ‘It is vital that a few such extraordinary experiences are shared so that there shall be better readiness with prospective persons who will be planning and implementing these future assignments.’ [2]

**Table 4. Statistics of Banda Aceh and Nagapattinam**

Place	Nagapattinam	Banda Aceh
Population	92,525 <sup>7</sup>	219,070 <sup>8</sup>
Dead	6065 <sup>9</sup>	167,000 <sup>10</sup>
Percentage of Dead %	6.5%	75.8%
Injured	385(this paper )	2183 <sup>2</sup>
Percentage of population	0.4%(this paper )	0.99
Musculoskeletal injuries	78(this paper )	247 All were not fractures / only 5 needed major procedures <sup>2</sup>
Musculoskeletal injuries out of the injured %	20%(this paper )	11% <sup>2</sup>
Epicentre	2000km <sup>5</sup>	300 km <sup>6</sup>

Table 4 compares the statistics of Banda Aceh and Nagapattinam with regard to the population, number of the dead, percentage of the dead, injured percentage of population,

musculoskeletal injuries and musculoskeletal injuries out of the total treated cases and the distance from the epicentre of tsunami. This work reports the pattern of injuries in the tsunami victims treated in our centre with most patients coming from Nagapattinam. Our experience was different from that of those workers in other centres like Banda Aceh in that a significant number of our patients had musculoskeletal injuries. For example one work report that 'It can be postulated that the majority of those who may have suffered incapacitating injuries during the initial tremors (such as major limb fractures) would have succumbed to the subsequent Tsunami attacks as they were unable to free themselves or find refuge on time. The common Tsunami injuries consisted of contaminated cutaneous wounds, underwater compression barotraumas and near-drowning injuries.'<sup>2</sup> In Banda Aceh they did not treat any serious musculoskeletal injury at all as such victims 'probably being washed away by tidal waves'. We did have 78 patients with musculoskeletal injuries with one long bone with one patient [patient in serial number 19 of the list in table 1 and is illustrated with an Ilizarov ring in figure 1] managed to survive by climbing a tree even after the fracture. The proximity of Banda Aceh than Nagapattinam to the epicentre of tsunami 2004, can be the reason for less fracture cases and more deaths at Banda Aceh and vice versa<sup>5, 6</sup>. Thus the reports of the previous works that all the fractured patients would have been were washed away and got drowned cannot be generalised.

As everyone will agree that,preparedness is vital in such massive disasters. .If preparation is done only from available data of studies with less MSI [1,2], one will end up with lack of proper orthopaedic equipment to cater to the need of the victims. In our set up there were 78 MSI which required major procedures like debridement and fixations. Thus a different pattern of injuries with more MSI demands preparation to match this in case of a future disaster.

Proper health planning and budgeting is necessary. This is mainly to have reserve operation theatres with C-arms to purchase and stock external and internal fixation devices (implants) medicines, Fund allocation for referral centres, for above measures shall be done to be prepared for a future disaster if it occurs. Enlisting and updating volunteering surgeons, anaesthetists, paramedic, screened blood donors alongwith stocking of reserve blood collecting equipments in future is a must. Such preparation and equipping is crucial as once the disaster has struck then the effective management will be tough to accomplish. Treating other patients who came due to other common accidents should be planned.

### **Infection and decision on antibiotic use**

Reported Tsunami wound infections [72%] are multi bacterial including aerobic and anaerobic with atypical and drug resistant organisms. There were fewer incidences of common wound pathogens like Staphylococcus aureus [11,12]. Two works of Tsunami wounds implicate Gram negative bacteria [13,14]. The multi bacterial nature of Tsunami infections may be due to sea water contamination or due to true multi bacterial infection. From the available data the best possible combination in these victims before a culture arrives is Carbapenem Piperacillin and Tazobactam [12].

In the presented series, there were quite a number of contaminated and severe necrotizing wound with resistant infections due to sea water contamination. Most cultures

were negative suggesting anaerobic infection. For these severely infected cases intravenous tazacort<sup>®</sup> (Tazobactam and Piperacillin) were used. These cases had repeat debridement, amputations or disarticulations. an antibiotic may not be as effective in tsunami infections as against the routine pathogens in civilian injuries. Also when bacteria isolated from nature can themselves be resistant [12] it is inappropriate to hold the antibiotic principles of a particular country accountable for the drug resistance [13,14].

Pneumonitis which was common in Banda Aceh [2] was found in only one case of humerus injury. We had one panic attack patient like reported from Ulee Kareng centre of Banda Aceh. The preparedness of the health care with mock drills is already reiterated [15]. One work by touring surgeons visiting weeks after Tsunami on general treatment underwent by patients did not give any specific number of bony injuries in Sri Lanka [1]. Triage and basic resuscitation are vital. The Tsunami warning systems can also be linked to hospital networks to enable preparedness

### SUMMARY

A retrospective analysis of pattern of orthopedic injuries in a tertiary care centre of South India in survivors of Indian Ocean Tsunami 2004 was done. This study found a pattern of injury in Tsunami victims in South India including the worst affected district of Nagapattinam with more share of MSI (78/385). This was different from other reports and obviously insists that referral centres in these regions should prepare for the next disaster by stocking suitable consumables to treat MSI

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