Outcome of Orthopaedics Treatment of Lombok Earthquake Victim 2018: A Cross sectional study-lesson learned from Lombok earthquake

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Abstract

Background: In earthquakes, there is often an imbalance between overcrowding in hospitals and inadequate resources. The initial management of earthquake victims with musculoskeletal injuries is controversial; whether debridement, external or internal fixation, conservative or operative treatment in an acute onset disaster setting. This study aim is to determine the radiological and clinical outcome after orthopaedic treatment in the Lombok earthquake of 2018 for one year follow-up.

Result: Significant difference between ORIF (Open reduction internal fixation) and non-ORIF of the Union Rate result (P = 0.021) with ORIF group has a higher rate of Union than non-ORIF group, but the incidence of infection only appeared in the ORIF group (23.5%). There were significant differences in the clinical outcome of SF 36 general health (P = 0.042) and health changes (P = 0.039) and the ORIF group had lower mean general health and health change clinical outcomes than the non-ORIF group

Conclusion: The population group that received the ORIF procedure had better radiological outcomes than the non-ORIF group, however, the ORIF group had lower clinical outcomes of infection and SF-36 than the non-ORIF group. It is recommended to perform debridement and external fixation for open fracture type and conservative treatment for closed fracture in an acute onset disaster setting or evacuation in case immediate treatment is needed urgently. Definitive treatment in acute onset disaster setting should be prevented.

Background

The earthquake has a devastating effect on the region that experienced it and its inhabitants[1]. More than 500,000 earthquakes are documented annually in Indonesia, with around 3,000 victims, and resulting in deaths.[7–11] Indonesia, as one of the countries with the most active plate tectonic activity locations, is one of the five countries most frequently experiencing natural disasters in the last decade.[3]

Apart from deaths, earthquakes cause numerous nonfatal traumatic injuries as well as damage to infrastructure, including health care centers. Injuries caused by earthquakes often have a complex and varied pattern, and therefore cause sudden and serious crises for healthcare centers. [1] Several studies have examined the profile of injuries after earthquakes around the world, and most of these studies conclude that musculoskeletal injuries are the most frequent earthquake-related injuries. Of all of the musculoskeletal injuries recorded, fractures occur most frequently and represent more than 50% of injuries that result from earthquakes.[4–7]Apart from fractures, common injuries include musculoskeletal injuries, major soft tissue injuries, and crush injuries.[8] This indicates the important role of orthopedic surgeons in providing care for earthquake survivors.

In the early periods after acute onset disaster, the most urgent orthopedic protocols needed are external fixation, amputation, and debridement. In multiple trauma patients, it is necessary to adhere to the principle of "damage control", which emphasizes that surgical treatment is divided into two first stages: (1) minor and low-traumatic surgery to prevent complications, and (2) recovery operations performed after the patient's condition is stable.[9]

In the first few days after the earthquake (acute onset disaster period), when there was an explosion in the number of patient casualties to the health service, it is advisable to use the temporary stabilization method for the fracture. When this casualty explosion situation has normalized (decreased to a little or stopped completely), and when the life threatening conditions (shock, bleeding, unstable hemodynamics) have been eliminated, it is recommended to use the temporary method of functional stable osteosynthesis for the final fixation of the fracture.[9]

In cases of open fracture with severe soft tissue injury, which often occurs in earthquake victims, emphasis is placed on external fixation. This external fixation may be performed in acute trauma and may be modified secondary to post-traumatic reconstruction. External fixation has also been found to have a shorter surgical time than internal fixation, and has a lower risk of blood loss. However, in harsh conditions, such as natural disasters, using an external fixator can be a technical challenge due to limited resources. Often in the aftermath of an earthquake, surgery is avoided because of a lack of suitable equipment, an insufficient number of qualified surgeons, or a lack of proper training. Many surgeons choose the wrong implant or repair the fracture aggressively which results in complications of soft tissue infection and bone infection (osteomyelitis). On the other hand, it is known that the use of internal fixation for open fractures of the tibia and femur has a lower incidence of reoperation, with a lower risk of superficial infection, when compared to external fixation.[9] This suggests that the initial management of earthquake victims with musculoskeletal injuries is controversial; it remains unclear whether external or internal fixation is preferable for these cases.

On 5 August 2018, there was a 7 on the Richter scale earthquake on Lombok Island. This earthquake caused more than 500 deaths and more than 40,000 minor injuries. After an earthquake, often the health care infrastructure is damaged or destroyed.[8] In the case of the Lombok earthquake it had a unique pattern, in general when the biggest earthquake occurs (first hit) the next earthquake that appears is a small scale earthquake and slowly disappears, but the earthquake that occurred in Lombok in 2018 has a Quadruplet pattern of earthquakes hit with four times large earthquakes and small scale earthquakes in between, this causes uncertainty in the condition of the safety status of buildings and other health facilities. Therefore, the government collaborates with other non-government Organizations or institutions to build emergency health facilities into Container Operating Rooms and Field Hospitals.

In the setting of earthquakes, there is often an imbalance between overcrowding in hospitals and inadequate resources; this causes a decline in the standard of health services. When compared to an emergency unit in the usual setting, access to diagnostic testing or the operating room is often hampered both for conditions that are not life threatening, even if the condition is severe.[10] Until now, in Indonesia, there are still no guidelines regarding the management of musculoskeletal injuries after an earthquake. In order to provide input and outcomes, of course, an understanding of the clinical and radiological outcomes of orthopedic surgery in earthquake victims with injuries is needed, so that effective management strategies can be planned. Previously, there were no studies regarding clinical and radiological outcomes of musculoskeletal injuries after an earthquake. The aim of this study is to determine the profile of radiological and clinical outcomes of musculoskeletal injuries after the 2018 Lombok earthquake and to evaluate and compare outcome between immediate ORIF and Non ORIF procedur after one year follow up.

Methods

cross sectional study to evaluate clinical outcome and radiological after orthopaedic treatment during acute onset disaster Lombok earthquake 2018. We conducted this study in September 2019. We searched patients in 8 primary health care in North Lombok district and two primary health care centres in West Lombok district and we refer patients to North Lombok general hospital and performed a radiological evaluation.

Every patient met the inclusion and exclusion criteria, the inclusion criteria consist of orthopaedic injury and treatment related to Lombok Earthquake 2018, which is a minimum of 6 months after treatment, exclusion criteria consist of a patient who doesn’t have any severe comorbidities and patient refusing to participate in the study. We evaluated radiological outcome with a plain radiograph and categorise into Non-union, Malunion and Union, thereafter, we evaluated the clinical outcome with the sign of infection/no and SF 36 functional score. The independent variable is age, sex, diagnosis, fracture location and immediate ORIF or Non ORIF. In all the data collection we analyse bivariate data using Chi-square test, Fisher test, independent T-test, Mann-Whitney test and Multivariate data using one-way ANOVA and post-hoc analysis.

Results

The following is a table of demographic distribution, diagnosis and location of the injury, ORIF yes / no, Union rate and infection

Table 1
Demographic distribution risk factor and outcome infection and union rate

Demographic and clinical characteristic		n	%
Sex			
	Male	28	37.8%
	Female	46	62.2%
Age			
	Children (0–17)	10	13.5%
	Adult (18–64)	56	75.7%
	Elderly (> 65)	8	10.8%
Diagnosis			
	Open Lower Ext	19	25.7%
	Closed Lower Ext	39	52.7%
	Open Upper Ext	5	6.8%
	Closed Upper Ext	6	8.1%
	Spine	5	6.8%
Injury location			
	Lower	54	73.0%
	Multiple	5	6.8%
	Spine	5	6.8%
	Upper	10	13.5%
ORIF			
	No	23	31.1%
	Yes	51	68.9%
Union Rate			
	Union	34	45.9%
	Malunion	13	17.6%
	non union	27	36.5%
Infection			
	no	62	83.8%
	yes	12	16.2%

It can be inferred that the majority is female and adult age. The largest distribution of diagnosis was closed fractures of the lower extremities and the majority of unions and cases of infection reached 16,2%. In the diagnosis category, the most common diagnosis was closed fracture lower limb (52.7%) and the second was open fracture lower limb (25.7%), and this is also in accordance with the category of site injury.

Table 2
Comparison of risk factors with union rate and infection

Factor risk		Union (n = 34)		p-value	Infection (n = 12)		p-value
	n	n	(%)		n	(%)	
Sex							
Man	28	12	(42.9)	0.677[cs]	6	(21.40)	0.343 [cs]
Woman	46	22	(47.8)		6	(13.00)	
Age							
Children	10	3	(30.0)	0.551 [cs]	2	(20.00)	0.910 [cs]
Adult	56	27	(48.2)		9	(16.10)	
Elderly	8	4	(50.0)		1	(12.50)	
Diagnosis							
Lower limb closed fracture**	19	23	(59.0)	0.038*[cs]	0	(0.00)	0.001*[cs]
Upper limb closed fracture*	39	2	(33.3)		0	(0.00)	
Upper limb open fracture***	5	1	(20.0)		3	(7.70)	
Lower limb open fracture***	6	4	(21.1)		1	(16.70)	
Spine**	5	4	(80.0)		8	(42.10)	
Injury location							
Spine	5	4	(80.0)	0.283 [f]	0	(0.00)	0.342[cs]
Multiple fractures	5	3	(60.0)		1	(10.00)	
Lower limb	54	24	(44.4)		9	(16.70)	
Upper limb	10	3	(30.0)		2	(40.00)	
ORIF							
No	23	6	(26.1)	0.021*[cs]	0	(0.00)	0.011*[f]
Yes	51	28	(54.9)		12	(23.50)	
cs) chi square test; f) Fisher's test, *) significant with the p value < 0.05							
/*) categories combined in statistical tests							

The total open reduction internal fixation (ORIF) operation was 68.9% with a malunion rate of 17.6% and the Non-Union rate was 36.5% of all cases. In the comparison table of risk factors with union rate outcomes, it is found that the diagnosis risk factor had a significant relationship with the union rate (p = 0.038) and the risk factor for ORIF had a significant

relationship with the union rate (p = 0.021). In the comparison table of risk factors with infection outcomes, the analysis showed that the risk factors of diagnosis had a significant relationship with infection (p = 0.001) and the risk factors of ORIF had a significant relationship with infection (p = 0.011). The results of the analysis of risk factors on the Union rate found that the type of injury diagnosis had a significant relationship with the union rate (P = 0.038) where Open fracture upper limb had the highest non / malunion rate (80%) followed by open fracture lower limb (78.9%). Risk factors ORIF / non-ORIF procedure has a significant difference to the union rate (P = 0.021) with ORIF group had Non/Malunions rate lower (45.1%) than non-ORIF group (73,9%), this can be seen that although the mal / nonunion rate is higher in the non-ORIF procedure, however, the incidence of mal / non-union is large enough to nearly half of the total population receiving ORIF procedure.

Results Analysis of risk factors for clinical outcome of infection. It was found that the diagnosis of injury had a significant difference in the incidence of infection (P = 0.0001),

The analysis results of risk factor data with SF-36 physical function (physical function) showed that the risk factors for diagnosis and location of the injury had significant differences with the SF 36 physical function (physical function quality of life) values, respectively P = 0.001 and P = 0.002.

In this tabulation graph, it is shown that the physical function in the spinal cord injury group and the highest in closed upper limb fractures and also the same for the location of the spinal fracture injury, the lowest physical function was in the upper limb injury location group.

From risk factor data analysis with SF-36 social functioning, it was found that the risk factors for diagnosis and injury location had a significant difference to the SF 36 social functioning (social function aspects of quality of life) value, respectively P = 0.042 and P = 0.012.

Table 3
Comparison of SF 36 between subjects with ORIF and without ORIF

	ORIF										P value
	No					Yes					
	Mean	Std. Dev	Median	Min	Max	Mean	Std. Dev	Median	Min	Max	
Physical function	49	30	50	0	100	32	28	25	0	80	0.071
Role limitation to physical health	35	32	25	0	100	31	26	25	0	75	0.670
Role limitation to emotional problems	57	35	67	0	100	42	29	33	0	100	0.158
Energy	61	22	65	0	95	50	23	50	0	100	0.103
Emotional well-being	65	21	68	0	100	52	22	54	0	80	0.051
Social functioning	64	26	63	0	100	57	29	56	0	100	0.403
Pain	53	25	55	0	100	46	28	51	0	100	0.415
General Health	52	19	50	0	95	40	15	43	0	55	0.042
Health Change	68	25	75	0	100	50	34	50	0	100	0.039

In this table, the analysis results show a psychometric description that ORIF action has a significant relationship in SF 36 General health (P = 0.042) and SF 36 health change (P = 0.039) and the median in the two groups non-ORIF is higher than

ORIF. The general health score has a higher mean value in the non ORIF group (52) than the ORIF group (40), for the health change group the mean non ORIF group (68) is also higher than the ORIF group (50).

Discussion

Demographics data

The female sex distribution is the majority in this study, possibly because women find it more difficult to save themselves when an earthquake occurs, but in the largest age distribution for adults this is a concern because the most affected group is the productive age group, so this has an impact on wheels people's economy. It is estimated that the total economic loss is IDR 7.7 trillion (528 million dollars) and 431,416 people have lost their homes. This study has a similar result from the epidemiological study conducted by Prabowo et al earthquake in Palu-Indonesia September 2018, the largest distribution age is adult. But the sex distribution is more common male (52,6) than female (47,4).[38,46]

The most common location of the injury is the lower limb, this is probably due to injuries while rescuing themselves and this exacerbates the economic and social burden of the affected community because the patient becomes unable to walk and returns to work as usual. Based on Indonesia central bureaus report (BPS) 2018–2019 of statistics that the majority of the population of North Lombok and West Lombok region are farmers and traders with general level of education is graduated from elementary school and junior high school (low education level).[49]

In this study, we found the total infection rate was 12 cases or 16.2%, the results showed that most infections were found in post-ORIF treatment patients at RSUDP NTB (Regional General Hospital of West Nusa Tenggara) as many as 4 cases (33%) and the second was found in post-ORIF action patients at KRI Hospital Dr. Soeharso (Indonesia warship floating hospital) has as many as 3 cases (25%). In an epidemiological study conducted by Prabowo et al in the 2018 Palu earthquake found that the highest incidence of orthopedic cases was lower limb fracture (64.5%) and the most common procedure performed were debridement (43.3%) and then ORIF (33.3%) but debridement and external fixation was only 3.3%. A systematic review study conducted by McKenzie et al on epidemiological studies and management of orthopedic injuries after earthquake disasters in developing countries found that 59% of the injuries that occurred were lower limb fractures and the most common procedure performed was debridement (33%). The high incidence of infection occurred in both hospitals (RSUDP NTB Hospital and KRI dr. Soeharso Hospital) maybe due to the lack of sterilization equipment, limited resources for wound treatment and aggressive methods of treatment to perform definitive treatment in acute phase disaster period in lombok.[8,46]

Relationship between risk factors and clinical & radiological outcomes

The highest infection cases occurred in cases of open fracture lower limb (42.1%). This is consistent with the literature because open fracture injuries of the lower extremities are prone to infection leading to chronic osteomyelitis. in the risk factors group ORIF / Non-ORIF, there was a significant difference in the incidence of infection (P = 0.011). The population group that received ORIF procedure, cases of infection was 23.5% and in the population group that did not receive ORIF procedure, cases of infection were 0%. This suggests that the ORIF procedure is a major risk factor for causing infection. This is in accordance with the guidelines issued by the AO and WHO that in a disaster emergency condition, if an area cannot be ascertained, the availability of a referral hospital for optimal orthopedic surgery, adequate surgical and nursing teams, complete sterile equipment and adequate postoperative care recommended only external fixation debridement for open fractures, casting with plaster of Paris and skin / skeletal traction for closed fractures. [21, 37]

A guideline issued by the AO-ICRC and WHO states that all cases of closed fracture are closed reduction to minimize complications, especially infection, even though this management results in prolonged management of the patient.

Articular and periarticular fractures where ORIF action is required are proven to be more profitable to be postponed in disaster conditions and should only be done in good health facilities and adequate sterility. The use of internal fixation in limited health facilities causes high infection rates. Therefore, ORIF procedure should only be carried out in good health facilities, good and safe clean water facilities, sterile equipment, orthopaedic surgery teams, sound nursing teams and physiotherapist and postoperative care teams. For open fracture cases, the guidelines expressly prohibit primary initial management with internal fixation at any level of health care facilities, because the principle of open fracture management in a disaster condition is to stabilize the fracture so that it has a safe environment for wound care, wound healing and closure. primer from the wound in the easiest and safest way.[9,21,37]

The experience of Médecins Sans Frontières in the 2010 Haiti earthquake stated that external fixation in a sudden onset disaster can be the definitive therapy and is best adapted in the context of a major disaster in 1–2 weeks of the initial phase of the disaster. In the initial phase of a disaster, definitive operation with internal fixation is not recommended because in that phase there can be a collapse of both the structural facilities and functional human resources, facilities and infrastructure for health services as well as the management of human resources for medical personnel who deal with the injured victims of the earthquake which jumped at one time causing fatigue and can reduce post-traumatic patient care. In the case of natural disasters due to earthquakes, we cannot predict how long aftershocks will last and experts estimate that two weeks after the initial earthquake is a critical time for stabilization of the patient's condition, both with conservative plaster of Paris, external fixation and Sskeletal traction. In the third weeks, definitive surgery can be done with the condition that qualified health facilities, a team of doctors, a team of nurses and the availability of complete sterile equipment to adequate postoperative care and rehabilitation. If these facilities cannot be reached in the area either with a field hospital or a floating/emergency hospital, it is advisable to evacuate outside the area where the referral hospital for orthopedic and trauma service centers is available.[21,36,37]

On the other hand, we know that almost all type B referral hospitals in Lombok regions have suffered serious damage and the main referral hospital, namely the West Nusa Tenggara regional general hospital, serves orthopedic trauma cases with excess capacity and treatment in the hallway and hospital parking lot, when the service lasts the third day. After the initial earthquake, suddenly a large aftershock occurred which caused the hospital management to stop surgical services in the operating room at that time. The systematic review research conducted by McKenzie et al. states that it is unrealistic to treat definitive internal fixation in conditions immediately after an earthquake / acute onset disaster. The focus of action on the surgical team that is initially present at the disaster site is to carry out disaster triage, control bleeding, debridement of wounds, stabilization of soft tissue, so that the Damage Control Orthopaedic surgery protocol in disaster conditions is the treatment of choice and the key to management of orthopedic case treatment in acute onset disaster setting.[8], This has been proven in the experience of the IDF medical team in handling the earthquake in Pakistan in 2005 and Haiti in 2010 installing external fixation follow-up 2 weeks after the action showed no sign of infection and the team from the Israel defense force waited 2 weeks after the initial disaster and waited until the preparations were made. A sufficient number of medical teams, nurses, equipment, sterilization and new wound care then perform definitive action with internal fixation, the initial team that comes only performs external fixation, plaster of Paris (casting) and amputation.[8,44,45]

The patient group with ORIF had lower SF-36 in general health and health change values than the non-ORIF group, and in the previous discussion, it had been proven that action ORIF increases the risk of postoperative infection. For cases of spinal cord injury, both in the injury location category and the diagnosis was found to have a low value on the SF-36 physical function, role limitations due to emotional problems and social functioning, and all spinal cases in this study were post-posterior stabilization surgery and decompression in the first two weeks following the earthquake. Research conducted by Sudaryo et al. Prospective cohort study on the quality of life of patients who experienced the 2009 Padang earthquake showed a significant reduction in quality of life with QLA scores in the earthquake-injured group and the most common injured group were limb fractures and dislocations[47]. the probable causative of the lower score of SF-36 in ORIF group than the non-ORIF group is due to the general effect of the earthquake injury in this study. Orthopaedic injury affects

mostly productive age and from Indonesia Central Bureau of Statistics (badan pusat statistik) 2018–2019 data stated that in north Lombok region majority the employee of people is peasant, farmer and merchant, and this brings about loss of job due to orthopaedic injury. This result is similar to the result from study Stroebe et al about chronic disaster impact in the Netherlands that stated that earthquakes can have negative health consequences for inhabitants over time, especially people that experience repeated damage or earthquake. Another study conducted by Gallardo et al about systematic review and meta-analysis data of Medium- and long-term health effects of earthquakes in high-income countries found an increased mortality rate for all causes, myocardial infarction and stroke from the first month to up to 3 years after an earthquake. Our theory that the effect of the Lombok earthquake that quadruplet type (four big attacks of earthquake) still persists for at least 3–4 years afterward.[49,50,51]

Referring to the results of the analysis above, the researcher suggests definitive measures for spinal cord injuries that require immediate surgery in the acute phase of a disaster, so it is better to evacuate victims to a referral center for qualified orthopedic services, having standard spine surgery and ICU wards, both in terms of facilities and human resources for orthopedic medical rehabilitation specialists and a team of orthopedic nurses. In an analysis of the 2005 earthquake in Pakistan, as many as 194 spinal cord injury patients were treated at one time at the Rawalpindi medical college and its allied hospital, the majority of injuries to the lumbar area were 61.85% and as many as 41% of patients had paraplegia, many victims did not receive treatment and rehabilitation accordingly so that there were several cases of paraplegic patients with large decubitus ulcers in the sacral area (20%), so they underline from the experience of the 2005 Pakistan earthquake that the management of the spine should be comprehensive. So that the establishment of a spinal injury management center at a referral hospital in the earthquake disaster area or evacuation to the nearest hospital outside the earthquake-hit area whose services and human resources are not affected by the earthquake disaster and ICU services and post-operative handling and proper rehabilitation is an inevitability for acute earthquake disaster conditions.[48]

Research implications and follow-up research plans

In conclusion, the risk factors that influence the union rate status, infection and SF-36 functional score are age, diagnosis, location of injury and ORIF action. Direct ORIF action in the initial phase of a disaster is a risk factor that can be intervened to reduce the morbidity that will occur due to infection, infection causing new problems and causing the need for repeated operations in patients, then by the AO-ICRC-WHO in its management guide, in the initial acute disaster phase is conservative management of closed fractures (POP, scalp traction etc.) and external fixation for open fractures.[9,21,37].

This research implies that the government, in this case, the Ministry of Health of the Republic of Indonesia, National Disaster Management Authority Indonesia and association organizations, in this case, the Indonesian Orthopedic Association, should make guidelines for the management of actions for orthopedic cases in disaster conditions, given the high number of natural disasters that occur annually in Indonesia (earthquake) which are namely earth, landslides, floods) and manmade disasters such as victims of bombs, terrorist attacks, collapsed buildings. This management guide follows adaptations or references from the management guidelines previously prepared by AO-ICRC-WHO and other textbooks specializing in disasters, and adapting to local wisdom, culture, culture and characteristics of the Indonesian society, therefore the researcher recommends the need for research on post-earthquake clinical outcomes in other locations such as the Aceh tsunami earthquake, the Yogyakarta earthquake, the Palu earthquake and the Banten tsunami earthquake. Researchers saw that there was no comprehensive research on follow-up clinical and radiological outcomes after orthopedic action in acute disaster conditions and the importance of developing management guidelines together with other surgical colleges regarding initial and advanced management in conditions of mass disasters.

Limitation

A major limitation of this study is the limited amount of samples that we collected because of the scattered victims of the earthquake on the outer side of the region. We only conducted a cross-sectional study then it was difficult to investigate

risk factors and outcomes and had some bias. There is a limitation of literature that follows clinical and radiological outcomes after a disaster we couldn't make a similar comparison with this study.

Conclusion

The largest distribution of age was adult age and the most distribution of injuries was closed fractures of the lower extremities and the second was open fractures of the lower limbs. The population group that received the ORIF procedure had better radiological outcomes than the non-ORIF group, however, the ORIF group had lower clinical outcomes of infection and SF-36 general health and health changes than the non-ORIF group. It is recommended to perform debridement and external fixation for open fracture type and conservative treatment for closed fracture in an acute onset disaster setting or evacuate in case that needs urgent immediate treatment. Definitive treatment in acute onset disaster settings should be prevented due to the risk of infection.

Abbreviations

ORIF : Open Reduction Internal Fixation, AO : Arbeitsgemeinschaft für Osteosynthesefragen, ICRC : International Committee of the Red Cross, WHO : World Health Organization

Declarations

Ethical approval: Ethical approval clearance from ethics committee board Faculty of Medicine, Universitas Indonesia with protocol number 19-04-0441.

Ethics and consent to participate : Written informed consent was obtained from the patient for publication of this research article and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request**.**

Availability of data and materials: All data generated or analyzed during this study are included in this published article.

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Author's contribution: IHD, AFK, YP and RF contributes in the study concept or design, data collection, analysis and interpretation, oversight and leadership responsibility for the research activity planning and execution, including mentorship external to the core team. AK and DP contribute in the study concept or design, data collection, analysis and interpretation. FA contributes to the study concept or design, data collection, analysis and writing the paper. All authors read and approved the final manuscript

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Figures

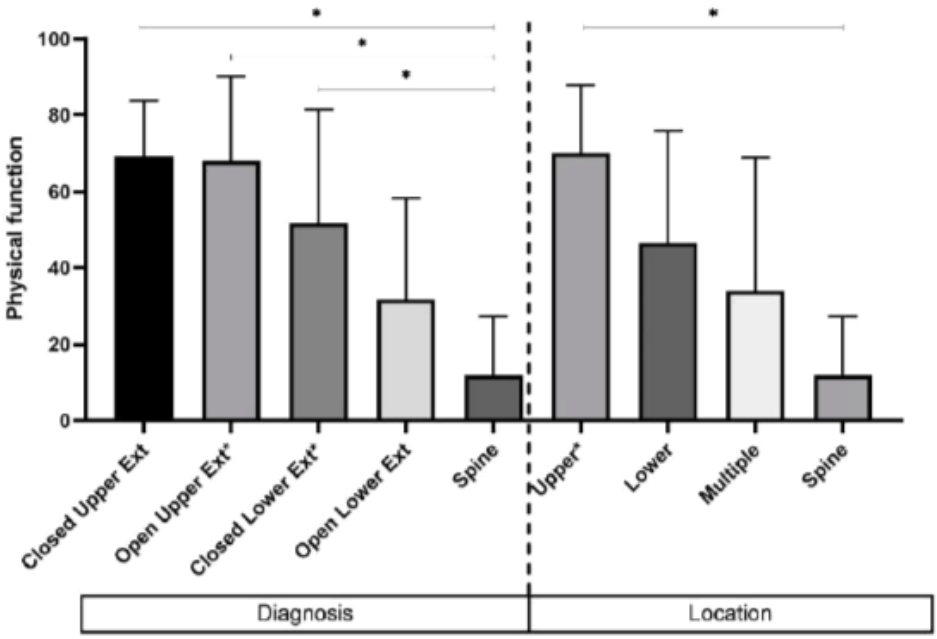

Figure 1

comparison of diagnosis and location of injury with SF 36 physical function

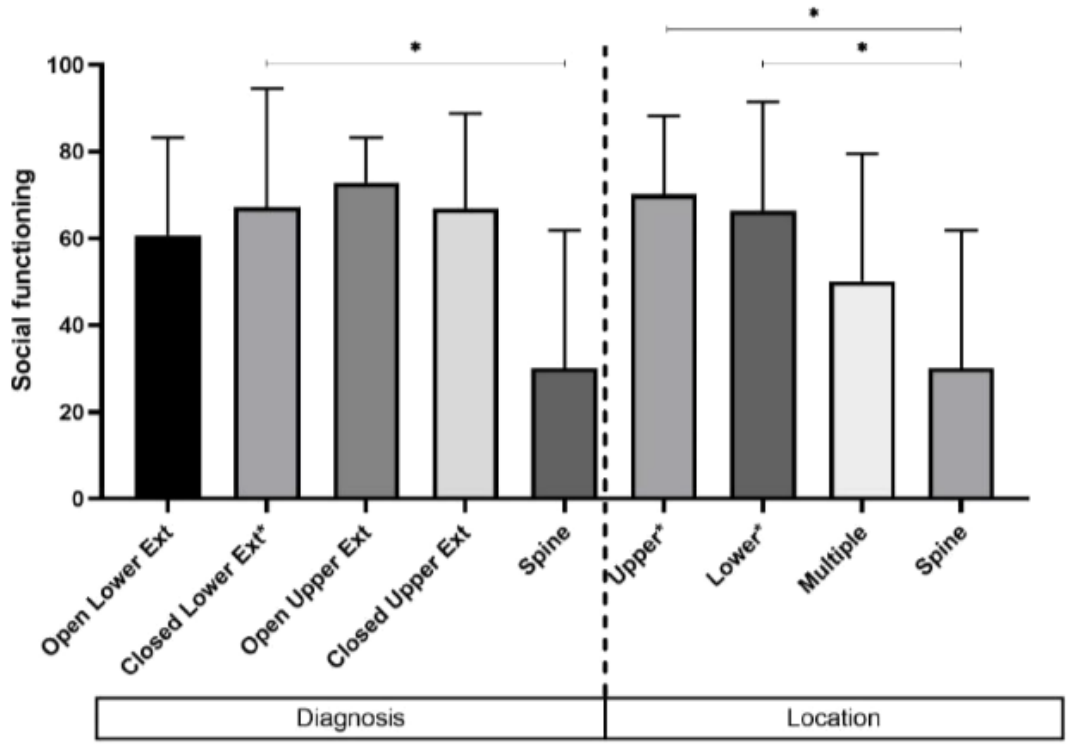

Figure 2

Comparisons of diagnosis and location of injury to SF 36 social function (social function)

In the graphic above, can be inferred that the group of diagnosis and location of spinal cord injury has the lowest social function

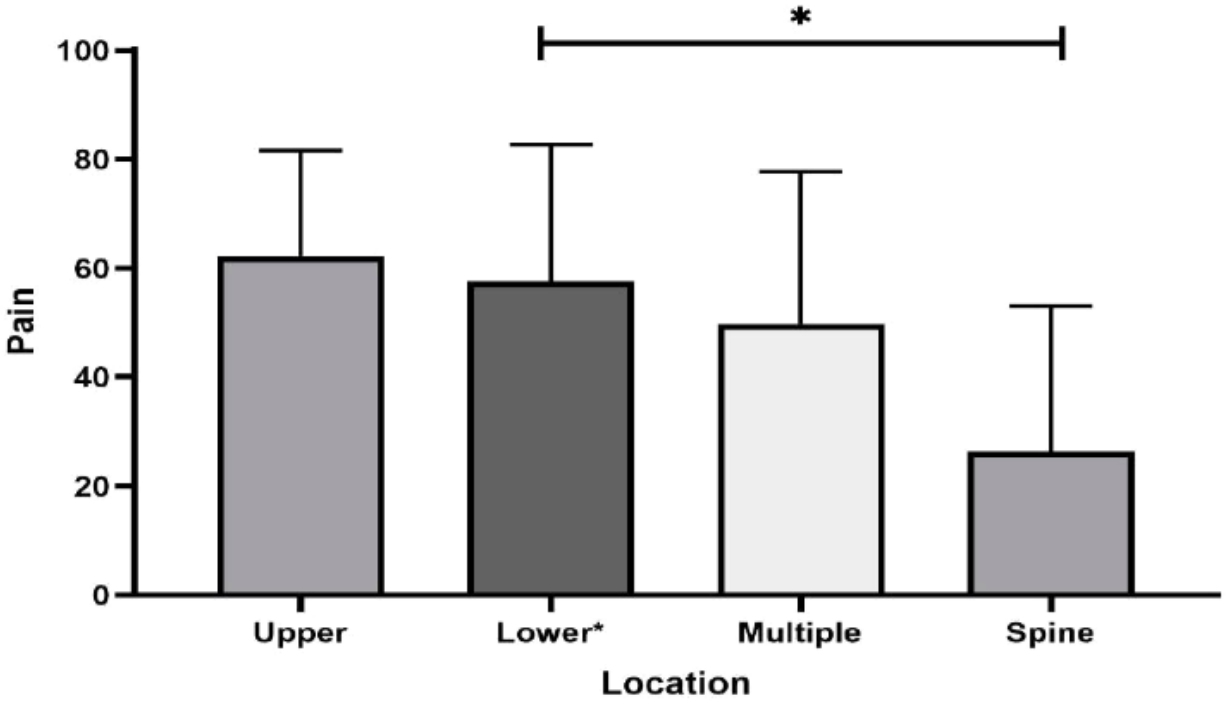

Figure 3

graphic comparison of injury location to SF 36 pain

From the results of graph analysis, it was found that the upper limb injury location had the mildest pain and the most severe pain in the spine injury group

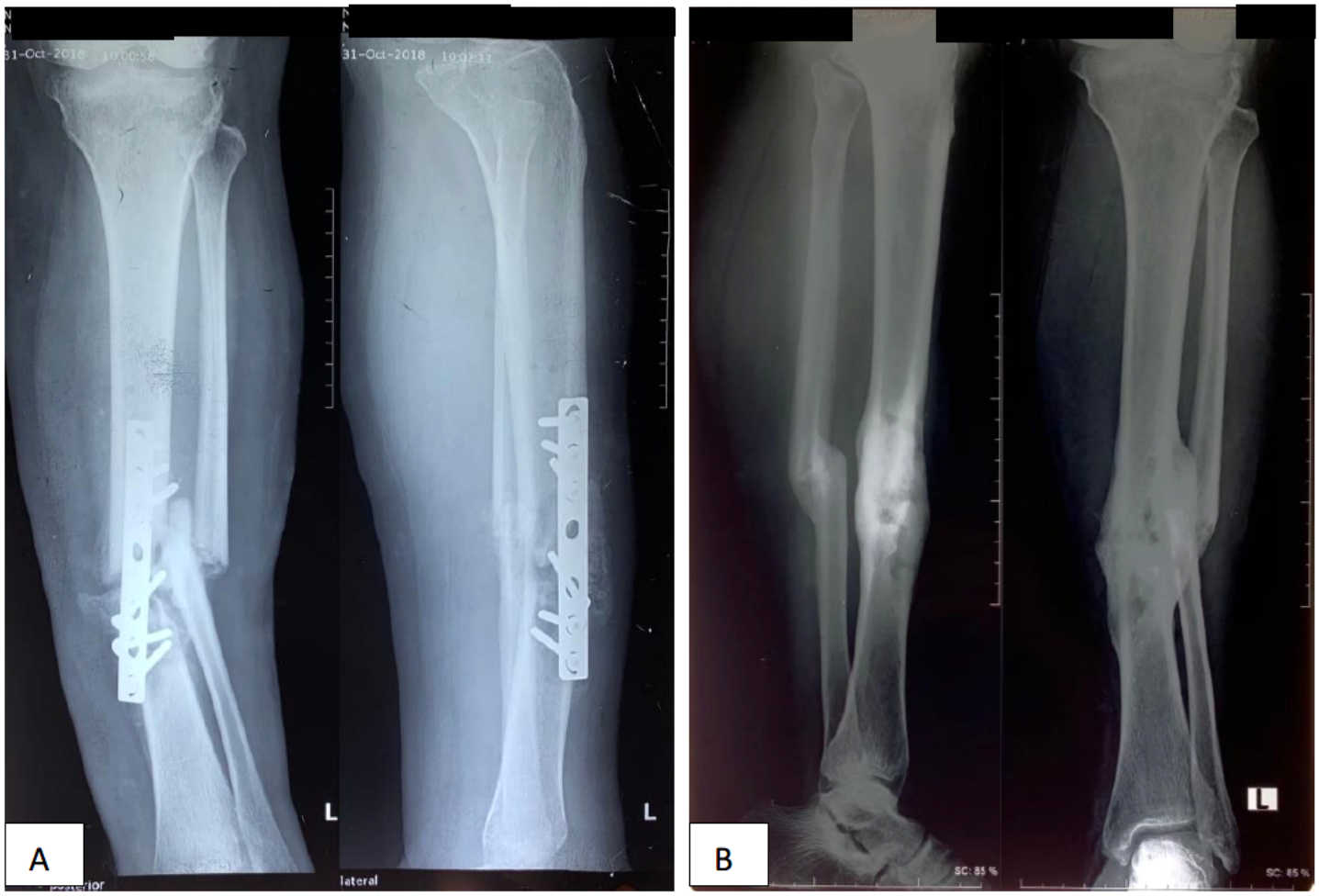

Figure 4

sample case of malunion from study with open fracture tibia-fibula directly performed ORIF in acute onset disaster, A 2 months post-operative x-ray. **B** one-year post-operative x-ray

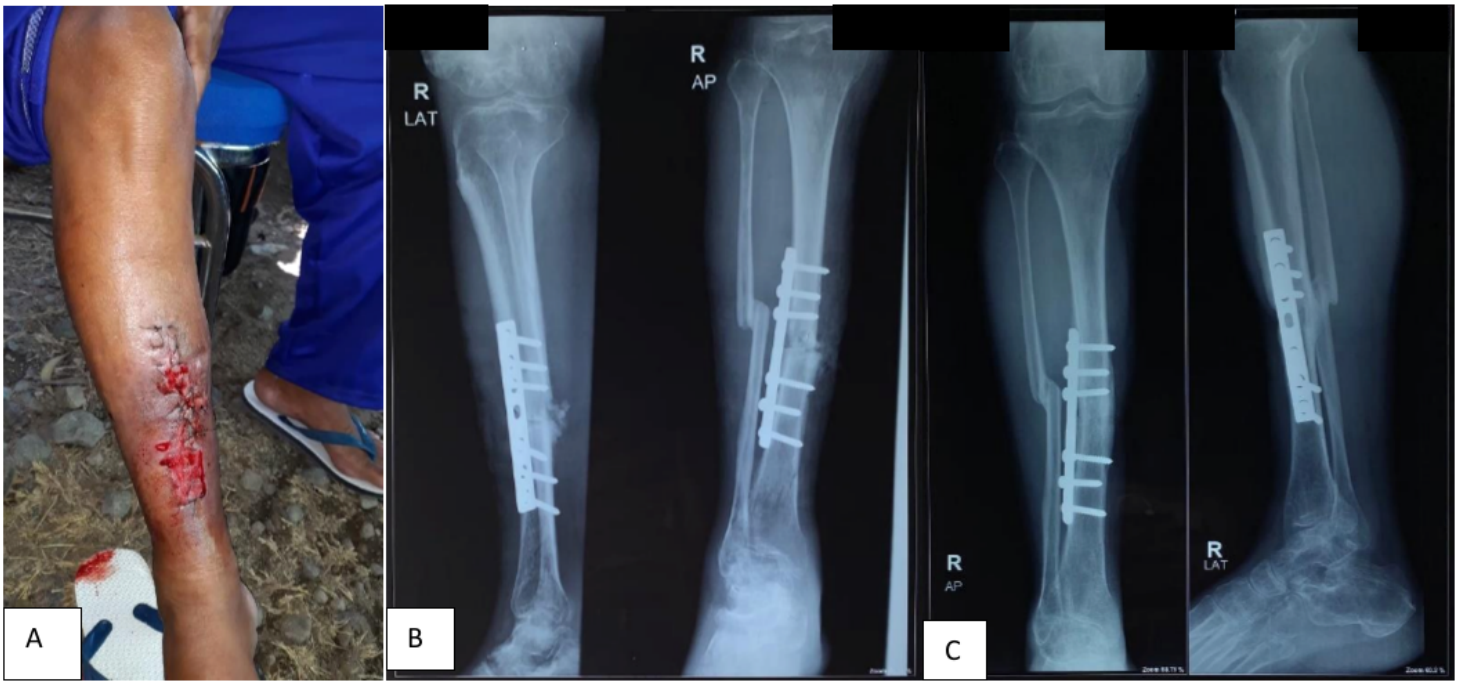

Figure 5

sample case of infection from study with open fracture tibia-fibula directly performed ORIF in acute onset disaster, **A**. Current clinical picture, **B**. one-month post-operative x-ray, **C.** one-year post-operative X-ray