Orthopedic Trauma Findings In Postmortems Conducted At MOI Teaching And Referral Hospital, Eldoret, Kenya

Dr. Walela Isaiah Wanyonyi *, Dr. Ayumba Barry, Dr. Nyabera, Saratiel***, Kibet Keitany******

* Orthopedic, Moi University
**Orthopedic, Moi University
***Orthopedic, Moi Teaching and Referral Hospital
****Orthopedic, Moi Teaching and Referral Hospital

DOI: 10.29322/IJSRP.15.03.2025.p15905
https://dx.doi.org/10.29322/IJSRP.15.03.2025.p15905

Paper Received Date: 16th January 2025
Paper Acceptance Date: 27th February 2025
Paper Publication Date: 6th March 2025

ABSTRACT

Background: Orthopedic trauma is a leading cause of morbidity and mortality, with significant regional variations. Road traffic accidents, violence, and suicides are major contributors, particularly among young adults aged 21-30, who are often involved in high-risk behaviors. Gender disparities exist, with males more commonly affected by traumatic injuries. In Kenya, trauma-related deaths contribute notably to the overall mortality rate, especially in areas like Eldoret. Postmortem examinations provide valuable insights into the causes and patterns of orthopedic trauma, aiding in the identification of high-risk factors. This data is crucial for developing targeted prevention strategies, improving trauma care, and optimizing resource allocation.

Objective: To describe orthopedic trauma findings in postmortems conducted at MTRH between May and October 2022.

Methods: This cross-sectional study included all deceased individuals due to trauma admitted to MTRH mortuary during the specified period; August 2023 to November 2023. Consecutive sampling was used until the desired sample size of 264 is attained. Records of admission from the Mortuary admission register and from this enlisted all deceased due to orthopedic trauma with complete information on mode of trauma. Data was collected from autopsy reports with verbal consent from the legal authority and pathologist, focusing on mode of trauma, injury patterns, and anatomical findings. Data was analyzed using descriptive statistics and chi-square tests.

Results: The study revealed significant patterns in orthopedic trauma-related deaths, including common injury locations such as the extremities and bony pelvis. It also highlighted the predominant mechanisms of injury, with road traffic accidents, violence, and suicides being the leading causes. Demographic characteristics, particularly the higher prevalence among males aged 21-30, were identified. These findings emphasize the need for targeted preventive measures and better trauma care, as well as efficient resource allocation in response to the prevalent trauma patterns.

Conclusion: The findings from this study enhance understanding of the patterns and causes of orthopedic trauma-related deaths, enabling the development of targeted preventive measures. These insights inform public health interventions by highlighting at-risk demographics and trauma mechanisms, guiding effective resource allocation, and promoting safety measures to reduce trauma mortality.

Recommendations: Implementing targeted injury prevention programs, especially for high-risk groups like young adults and motorcycle riders. Public health campaigns should focus on safety measures, such as helmet use and protective gear. Further research on gender disparities and specific injury patterns is essential to inform more effective, tailored trauma prevention strategies.

Keywords: Orthopedic trauma, postmortem, injury patterns, trauma prevention.

I. INTRODUCTION

Trauma accounts for 8% of global deaths, with a higher burden in developing countries (1). In Kenya, trauma contributes to 10.4% of deaths, surpassing HIV-related deaths (2). Postmortems are essential for determining the cause of death and aiding in medical education, though the detailed description of injuries is often lacking in death certificates (3). This hampers forensic medicine and public health education, as injury mechanisms are not adequately linked to the cause of death. Deaths from trauma are classified into three categories: immediate deaths at the scene, early deaths from hemorrhage, and late deaths from organ failure. The Kenyan government has implemented safety measures, including the National Transport Safety Authority and policies such as the Health Act, to reduce trauma-related deaths (4). Enhanced injury documentation is needed for better care and prevention.

II. METHODS

The study population included all deceased trauma patients admitted to the MTRH mortuary between August 2023 and November 2023. The total population was 264. It was based on the eligibility criteria. The bodies were treated as per established hospital guidelines and protocols.

Study Schema

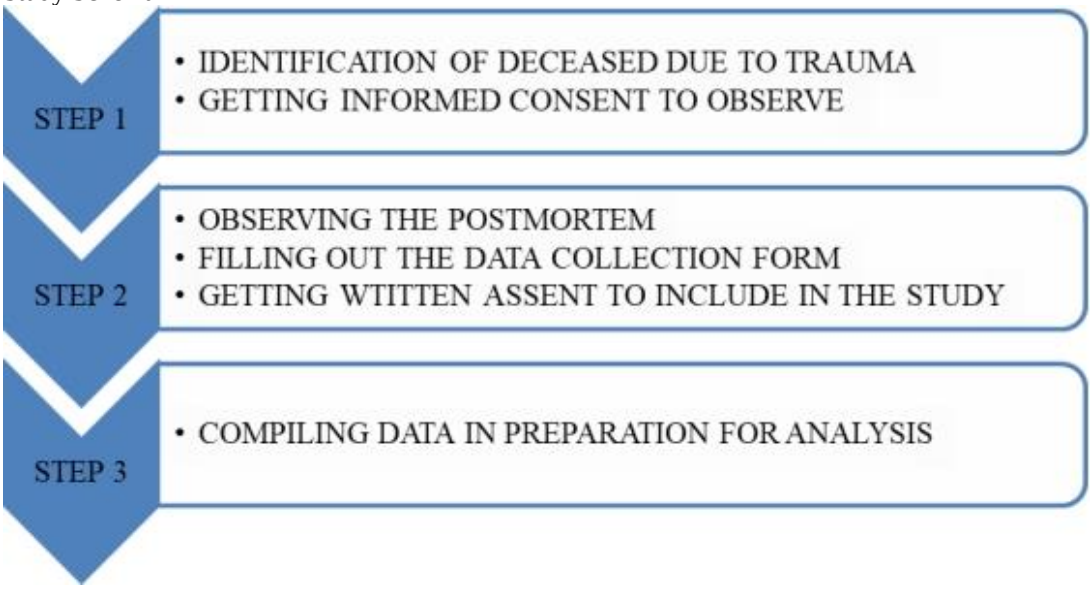

Figure 1: Study schema

III. RESULTS

The study findings are based on 264 bodies of deceased due to trauma admitted in MTRH mortuary between May 2022 and October 2022.

Demographic characteristics

Table 1: Demographic characteristics

	Total N=264
Age	
Mean(SD)	33.7 (12.0)
Range	10 – 72
Gender	
Male	169 (64.0)
Female	95 (36.0)
Mode of injury	
Motorcycle	83 (31.6)
Suicide	72 (27.4)
Vehicle	40 (15.2)
Assault	26 (9.9)
Workplace	23 (8.7)
Fall	19 (7.2)

The study population is predominantly male, comprising 64.0% of the total, with women accounting for 36.0%. The majority of orthopedic trauma cases are motorcycle-related, accounting for 31.6% of cases. Suicide is the second most common mode of injury, accounting for 27.4%. Other common injuries include assault, workplace incidents, and falls. The mean age of the population is 33.7 years, with a diverse representation across different age groups. The study highlights the significant male preponderance among individuals experiencing orthopedic trauma.

Pathological characteristics of orthopedic trauma contributing to death

Table 2: Pathological Characteristics

	Total N=264
Number fractures	
1	108 (40.9)
2	48 (18.2)
3	54 (20.5)
4	32 (12.1)
5	15 (5.7)
6	7 (2.7)
Number fractures	
Single site	108 (40.9)
Multiple sites	156 (59.1)
Skull	93 (35.2)
Spine	187 (70.8)
Lower limb	133 (50.4)
Upper limb	80 (30.3)
Pelvis	64 (24.2)
Ribs	54 (20.5)

The majority of fracture cases (40.9%) involve single fractures, followed by two (18.2%), three (20.5%), four (12.1%), and five and six (5.7% and 2.7%, respectively). Fracture sites are single-site (40.9%) and multiple-site (59.1%). Anatomical sites affected include the skull (35.2%), spine (70.8%), lower limb (50.4%), upper limb (30.3%), pelvis (24.2%), and ribs (20.5%).

Association between the mechanism of injury and the orthopedic pathologic findings

Table 3: Pathological findings by mechanism of injury

	Motorcycle N=83	**Suicide N=72**	**Vehicle N=40**	**Assault N=26**	**Workplace N=23**	**Fall N=19**	**p-value**
Number of fractures							<0.001
1	7 (6.5)	72 (66.7)	3 (2.8)	8 (7.4)	12 (11.1)	6 (5.6)	
2	15 (31.3)	0 (0.0)	10 (20.8)	8 (16.7)	7 (14.6)	8 (16.7)	
3	29 (54.7)	0 (0.0)	8 (15.1)	9 (17.0)	4 (7.5)	3 (5.7)	
4	20 (62.5)	0 (0.0)	9 (28.1)	1 (3.1)	0 (0.0)	2 (6.3)	
5	8 (53.3)	0 (0.0)	7 (46.7)	0 (0.0)	0 (0.0)	0 (0.0)	
6	4 (57.1)	0 (0.0)	3 (42.9)	0 (0.0)	0 (0.0)	0 (0.0)	
Number fractures							<0.001
Single site	7 (6.5)	72 (66.7)	3 (2.8)	8 (7.4)	12 (11.1)	6 (5.6)	
Multiple sites	76 (49.0)	0 (0.0)	37 (23.9)	18 (11.6)	11 (7.1)	13 (8.4)	
Skull							<0.001
No	34 (20.0)	72 (42.4)	23 (13.5)	8 (4.7)	20 (11.8)	13 (7.6)	
Yes	49 (52.7)	0 (0.0)	17 (18.3)	18 (19.4)	3 (3.2)	6 (6.5)	
Spine							<0.001
No	28 (36.8)	0 (0.0)	15 (19.7)	11 (14.5)	18 (23.7)	4 (5.3)	
Yes	55 (29.4)	72 (38.5)	25 (13.4)	15 (8.0)	5 (2.7)	15 (8.0)	
Lower limb							<0.001
No	13 (9.9)	72 (55.0)	6 (4.6)	19 (14.5)	7 (5.3)	14 (10.7)	
Yes	70 (53.0)	0 (0.0)	34 (25.8)	7 (5.3)	16 (12.1)	5 (3.8)	
Upper limb							<0.001
No	52 (28.3)	72 (39.1)	22 (12.0)	15 (8.2)	14 (7.6)	9 (4.9)	
Yes	31 (39.2)	0 (0.0)	18 (22.8)	11 (13.9)	9 (11.4)	10 (12.7)	

Pelvis							<0.001
No	51 (25.5)	72 (36.0)	15 (7.5)	26 (13.0)	19 (9.5)	17 (8.5)	
Yes	32 (50.8)	0 (0.0)	25 (39.7)	0 (0.0)	4 (6.3)	2 (3.2)	
Ribs							<0.001
No	52 (24.9)	72 (34.4)	23 (11.0)	22 (10.5)	22 (10.5)	18 (8.6)	
Yes	31 (57.4)	0 (0.0)	17 (31.5)	4 (7.4)	1 (1.9)	1 (1.9)	

The distribution of fractures from various trauma causes varies significantly; a non-uniform distribution is indicated by a p-value < 0.001. While motorcycle and vehicle-related injuries typically result in multiple fractures, with motorcycle accidents showing a high percentage of fractures at multiple sites, including three or more fractures (54.7%), suicide cases typically involve a single fracture (66.7%). A combination of single and multiple fractures can also be seen in falls, assault, and workplace injuries; the number of fractures is higher in assaults and injuries involving vehicles. The significance of protective gear like helmets is highlighted by the notable prevalence of skull injuries in vehicle-related incidents (18.3%), motorcycle accidents (52.7%), and suicides (42.4%). The most frequent causes of spine fractures are falls (8.0%) and suicides (38.5%), indicating a higher risk of spine involvement in motorcycle accidents. Suicides rarely result in lower limb injuries, but falls (10.7%) and motorcycle accidents (53.5%) do. The most frequent causes of upper limb injuries are workplace injuries (11.4%) and motorcycle accidents (39.2%); falls do not result in any upper limb injuries. While no pelvic injuries were found in suicides or falls, they are more common in motorcycle accidents (50.8%) and vehicle-related incidents (39.7%). Although rib injuries were not reported in suicide cases, they are more common in motorcycle accidents (57.4%) and vehicle-related incidents (31.5%), showing that different trauma causes result in different injury patterns, with some injuries being more common depending on the incident's mechanism.

Distribution of orthopedic trauma deaths based on the NISS and AIS scoring

Table 4: NISS and AIS scoring

	Total N=264
NISS Score	66.0 (25.0-75.0)
NISS Score	
Not severe (<40)	83 (31.4)
Severe (>=40)	181 (68.6)
Survivability	
NP	211 (81.2)
PP	40 (15.4)
DP	9 (3.5)

The study found a high injury severity in the population, with 68.6% of cases classified as severe. Survivability was assessed, with 81.2% of cases classified as "Not Probable," suggesting a high probability of mortality. However, 15.4% of cases were considered probable, and 3.5% were considered definite.

Table 5: NISS and AIS scoring by mechanism of injury

	Motorcycle N=83	**Suicide N=72**	**Vehicle N=40**	**Assault N=26**	**Workplace N=23**	**Fall N=19**	**p-value**
NISS Score	75.0 (66.0-75.0)	25.0 (25.0-50.0)	75.0 (66.0-75.0)	52.0 (43.0-66.0)	50.0 (30.0-75.0)	54.0 (33.0-75.0)	<0.001
NISS Score							<0.001
Not severe (<40)	8 (9.6)	54 (75.0)	1 (2.5)	5 (19.2)	9 (39.1)	6 (31.6)	
Severe (>=40)	75 (90.4)	18 (25.0)	39 (97.5)	21 (80.8)	14 (60.9)	13 (68.4)	
Survivability							<0.001
NP	71 (86.6)	71 (100.0)	35 (89.7)	15 (57.7)	7 (30.4)	11 (61.1)	
PP	8 (9.8)	0 (0.0)	4 (10.3)	10 (38.5)	12 (52.2)	6 (33.3)	
DP	3 (3.7)	0 (0.0)	0 (0.0)	1 (3.8)	4 (17.4)	1 (5.6)	

The study reveals significant differences in NISS scores across different injury categories, with the median score for motorcycles being 75.0, suicide being 25.0, vehicles being 75.0, assault being 52.0, workplace being 50.0, and fall being 54.0. The p-values show significant differences in the severity of injuries across different categories. Survivability also varies significantly across different injury mechanisms, with the median score for motorcycles being 75.0, suicide being 25.0, vehicles being 75.0, assault being 52.0, workplace being 50.0, and fall being 54.0.

Table 6: Pathological findings by NISS score

	Not severe (<40) N=83	Severe (>=40) N=181	p-value
Number of fractures			<0.001
1	76 (70.4)	32 (29.6)	
2	7 (14.6)	41 (85.4)	
3	0 (0.0)	54 (100.0)	
4	0 (0.0)	32 (100.0)	
5	0 (0.0)	15 (100.0)	
6	0 (0.0)	7 (100.0)	
Number of fractures			<0.001
Single site	76 (70.4)	32 (29.6)	
Multiple sites	7 (4.5)	149 (95.5)	
Skull			<0.001
No	70 (40.9)	101 (59.1)	
Yes	13 (14.0)	80 (86.0)	
Spine			0.95
No	24 (31.2)	53 (68.8)	
Yes	59 (31.6)	128 (68.4)	
Lower limb			<0.001
No	72 (55.0)	59 (45.0)	
Yes	11 (8.3)	122 (91.7)	
Upper limb			<0.001
No	77 (41.8)	107 (58.2)	
Yes	6 (7.5)	74 (92.5)	
Pelvis			<0.001
No	83 (41.5)	117 (58.5)	
Yes	0 (0.0)	64 (100.0)	
Ribs			<0.001
No	82 (39.0)	128 (61.0)	
Yes	1 (1.9)	53 (98.1)	

The study found a significant association between the severity of the National Institute of Sports Medicine (NIS) score and the number of fractures. In the "Not severe (<40)" group, 70.4% had a single fracture, while 95.5% of the "Severe (>=40)" group had fractures at multiple sites. Higher NISS scores correlated with more extensive pathological findings, including more fractures and greater anatomical involvement. Skull fractures were common in severe trauma, with 86.0% of patients having them. Spinal injuries occurred similarly in both "Not severe" and "Severe" groups, with no significant difference (p-value = 0.95). However, significant differences were found in the prevalence of lower limb, upper limb, pelvic, and rib injuries between the two groups. Severe trauma patients had a higher prevalence of lower limb (91.7%), upper limb (92.5%), and pelvic (100%) injuries, while none of the "Not severe" patients had pelvic injuries. Rib injuries were notably more prevalent in severe trauma cases (98.1%) compared to non-severe cases (1.9%), with a significant p-value of <0.001.

Table 7: Pathological findings by Survivability (AIS score)

	NP N=211	PP N=40	DP N=9	p-value
Number of fractures				0.001
1	83 (77.6)	19 (17.8)	5 (4.7)	
2	28 (59.6)	15 (31.9)	4 (8.5)	
3	50 (94.3)	3 (5.7)	0 (0.0)	
4	29 (90.6)	3 (9.4)	0 (0.0)	
5	15 (100.0)	0 (0.0)	0 (0.0)	
6	6 (100.0)	0 (0.0)	0 (0.0)	
Number of fractures				0.42
Single site	83 (77.6)	19 (17.8)	5 (4.7)	
Multiple sites	128 (83.7)	21 (13.7)	4 (2.6)	

Skull				0.32
No	132 (78.6)	30 (17.9)	6 (3.6)	
Yes	79 (85.9)	10 (10.9)	3 (3.3)	
Spine				<0.001
No	36 (47.4)	31 (40.8)	9 (11.8)	
Yes	175 (95.1)	9 (4.9)	0 (0.0)	
Lower limb				0.47
No	108 (83.7)	18 (14.0)	3 (2.3)	
Yes	103 (78.6)	22 (16.8)	6 (4.6)	
Upper limb				0.47
No	152 (83.1)	25 (13.7)	6 (3.3)	
Yes	59 (76.6)	15 (19.5)	3 (3.9)	
Pelvis				0.23
No	158 (80.2)	30 (15.2)	9 (4.6)	
Yes	53 (84.1)	10 (15.9)	0 (0.0)	
Ribs				0.16
No	164 (78.8)	36 (17.3)	8 (3.8)	
Yes	47 (90.4)	4 (7.7)	1 (1.9)	

The study found no significant correlation between the number of fractures and survivability (AIS score), indicating that fracture distribution does not impact patient survivability. Similarly, no significant association was observed between skull injuries, lower limb injuries, upper limb injuries, pelvic injuries, or rib injuries and survivability, with p-values ranging from 0.16 to 0.47. However, a significant association was found between spine injuries and survivability (p-value <0.001), with patients suffering from spine injuries showing lower survivability rates compared to those without spine injuries.

IV. DISCUSSION

Demographics of the deceased with orthopedic trauma

Traumatic deaths, constituting 10% of global deaths, are on the rise, particularly in developing nations, with road traffic accidents, homicide, and suicide being the leading causes. Young adults, particularly the 21-30 age group, are most affected, contributing significantly to the workforce. Gender disparities exist, with males being more vulnerable to trauma fatalities. Effective interventions, including tailored injury prevention programs, public health awareness, and collaboration among healthcare and public health sectors, are essential for addressing these issues. Further research into specific causes, lifestyle factors, and targeted safety strategies is necessary to reduce trauma-related deaths and improve public health outcomes (5).

Characteristics of orthopedic trauma contributing to death among the deceased

Orthopedic trauma research reveals distinct injury patterns tied to various causes of death. Motorcycle accidents are linked to head and rib fractures, emphasizing the need for helmet use and protective gear. Car crashes contribute significantly to fatalities, with thoracic injuries being the leading cause of death. Suicide cases often involve cervical spine fractures, while assaults are associated with thoracic spine injuries. The study highlights the importance of targeted prevention strategies, such as promoting helmet use, addressing mental health issues, and tailoring public safety interventions. Understanding regional and demographic factors is essential for developing effective trauma care and prevention measures.

Relationship between mode of injury and the orthopedic injuries observed in autopsy

The data highlights a gender disparity in motorcycle accidents, with 64% of victims being male, possibly due to higher male ridership and risk-taking behavior. The injuries in motorcycle accidents are diverse, with head, face, and neck injuries comprising 27.24% of cases, underscoring the importance of helmet use. Other common injuries include femur fractures (20.5%), spine (14.18%), thorax (12.69%), and pelvis (8.21%). Comparing this data with another study reveals similar injury patterns (6). This research aids forensic investigations, informs public health initiatives, and provides insights into gender-specific injury trends, guiding preventive measures.

Distribution of orthopedic trauma deaths based on the NISS and AIS scoring among bodies admitted

The study reveals that 68.6% of cases involve severe injuries, with 81.2% classified as having “Not Probable” survivability, indicating high mortality rates. A small percentage (3.5%) of cases was classified as "Definite" survivability. These findings stress the need for tailored patient care based on injury severity and survivability. In comparison, other studies show the predictive value of the New Injury Severity Score (NISS) in mortality assessment, particularly in severe trauma cases (7, 8). NISS is more accurate in predicting outcomes and guiding clinical decisions, especially in priority patients requiring immediate attention.

Implications for Care

The study highlights the need for tailored care based on the severity of injuries and survivability predictions. With 68.6% of cases involving severe injuries and 81.2% classified as "Not Probable" survivability, healthcare providers must prioritize palliative care for high-mortality cases and aggressive interventions for those with a higher likelihood of recovery (8). The use of the New Injury

Severity Score (NISS) enhances mortality prediction, guiding clinical decisions and resource allocation, particularly for severe trauma patients. Effective care should focus on immediate medical attention for critical cases, while addressing long-term rehabilitation for patients with better survivability prospects.

CONCLUSION

This study emphasizes the need for targeted interventions to address the high prevalence of orthopedic trauma-related deaths, particularly in the 21-30 age group. It highlights the importance of protective measures, understanding gender disparities, and tailoring suicide and assault-related strategies. A comprehensive approach to prevention and care is crucial.

RECOMMENDATIONS

The study emphasizes the importance of global collaboration, targeted injury prevention programs, and further research to reduce orthopedic trauma deaths. It highlights the need for age-specific programs, especially for the 21-30 age group, and addresses gender disparities in trauma prevention. Advocacy for motorcycle safety, tailored intervention strategies for suicide and assault-related fatalities, and anatomical specificity in injury management are key areas for improving outcomes. Forensic and public health integration is crucial for effective preventive measures. The study also emphasizes a nuanced approach to prognosis, resource allocation, and the validation of injury severity scoring systems like NISS and AIS for better trauma care.

REFERENCES

[1] World Health Organization. Violence and injuries: the facts. 2021. Available from: https://apps.who.int/iris/bitstream/10665/44288/1/9789241599375_eng.pdf
[2] Saidi H, Mutiso BK, Ogengo J. Mortality after road traffic crashes in a system with limited trauma data capability. J Trauma Manag Outcomes. 2014;8(1):1-6.
[3] Gathecha GK, Githinji WM, Maina AK. Demographic profile and pattern of fatal injuries in Nairobi, Kenya, January–June 2014. BMC Public Health. 2017;17(1):1-7.
[4] The Health Act {Kenya Gazette Supplement No. 69 (Acts No. 5)}. Protecting Kenyans in the formal and informal sectors of employment. Kenya Government Printer; 2019. Available from: www.kenyalaw.org
[5] Beck B, Smith K, Mercier E, Gabbe B, Bassed R, Mitra B, et al. Differences in the epidemiology of out-of-hospital and in-hospital trauma deaths. PLoS One. 2019;14(6):e0217158. Available from: https://doi.org/10.1371/journal.pone.0217158
[6] Rohilla RK, Kumar S, Singh R, et al. Demographic study of orthopedic trauma among patients attending the accident and emergency department in a tertiary care hospital. JOIO. 2019;53:751–757. Available from: https://doi.org/10.4103/ortho.IJOrtho_161_19
[7] Javali RH, Patil A, Srinivasarangan M. Comparison of injury severity score, new injury severity score, revised trauma score and trauma and injury severity score for mortality prediction in elderly trauma patients. Indian J Crit Care Med. 2019;23(2):73. Available from: http://dx.doi.org/10.29322/IJSRP.12.05.2022.p12551
[8] Li H, Ma YF. New injury severity score (NISS) outperforms injury severity score (ISS) in the evaluation of severe blunt trauma patients. Chin J Traumatol. 2021;24(05):261-265. Available from: https://mednexus.org/doi/10.1016/j.cjtee.2021.01.006.

AUTHORS

First Author - Dr. Walela Isaiah Wanyonyi, MBChB, MMed (Ortho) Registrar, Moi University. E-mail: isah513@gmail.com.
Second Author - Dr**.** Ayumba, MBChB, MMed (Surg), FCS (ECSA), MMed (Ortho), Lecturer and Consultant Surgeon, Department of Orthopaedics and Rehabilitation, School of Medicine, College of Health Sciences, Moi University, P.O. Box 4606- 30100, Eldoret. E-mail: brayumba.2014@gmail.com
Third Author – Dr Saratiel Nyabera, Department of Orthopedics. Moi Teaching and Referral Hospital P.O Box 3-30100, Eldoret., E-mail: saratielnyabera@mtrh.go.ke.
Fourth Author: Kibet Keitany, Department of Pathology. Moi Teaching and Referral Hospital P.O Box 3-30100, Eldoret., E-mail: kibetkeitany@mtrh.go.ke.

Correspondence Author – Dr. Walela Isaiah Wanyonyi, MBChB, MMed (Ortho), Department of Orthopaedics and Rehabilitation, School of Medicine, College of Health Sciences, Moi University, P.O. Box 4606- 30100, Eldoret,. E-mail: isah513@gmail.com.