

ETHIOPIAN MEDICAL JOURNAL

ISSN0014-1755

DECEMBER 2020 VOLUME 58 SUPPLEMENT 3

- **Let's prevent Disability**
- **Let's Treat Timely**
- **Let's Rehabilitate Properly**
- **Let's Rate and Assess Permanent Impairment**
- **Let's Award Percentage Disability Scientifically!**



ORTHOPAEDICS IN ETHIOPIA



**ETHIOPIAN MEDICAL ASSOCIA-
TION**

P.O. Box 3472, Addis Ababa, Ethiopia

Tel. No. 251-15533742

www.emjema.org

emjeditor2018@gmail.com

Fax: 251-1-5533742

The Ethiopian Medical Journal is the official quarterly publication of the Ethiopian Medical Association. It is devoted to the advancement and dissemination of knowledge pertaining to medicine in Ethiopia and other developing countries.

EDITORIAL BOARD

Editor-in-Chief

Mirkuzie Wolde

Associate Editors-in-Chief

Yeshigeta Gelaw

Editors

Eyasu Makonnen

Abebe Bekele

Markos Tesfaye

Alemayehu Worku

Workeabeba Abebe

Tekalign Deressa

Wondwossen Amogne

Wendemagegn Enbiale

Esayas Kebede

Genet Gebremedhin

Fasika Amdeselasie

Fiker Bekele

Corresponding Editors

Kassa Darge

Charles Larson

Frances Lester

Paulos Quana'a

Solomon Tesfaye

Carmela G. Abate

Henry Blumberg

Russell Kempker

Journal Manager

Meaza Aklilu

ETHIOPIAN MEDICAL JOURNAL
December 2020 Volume 58 Supplement 3

EDITORIAL

Orthopedics in Ethiopia Biruk Lambisso Wamisho, Mirkuzie Woldie	155
---	-----

ORIGINAL ARTICLES

Bone mineral density (BMD) measurement using central dual energy X-ray absorptiometry (DEXA) in adult Ethiopians Alpha Seifu, Biruk L. Wamisho, Aden Ashenafi	157
---	-----

Management of idiopathic clubfoot by ponseti method: Tikur Anbessa Specialized Hospital five year experience Mengistu G Mengesha, Birhanu Ayana, Mengestie M Belay, Wubalem Zewde, Peter J.	163
---	-----

Ring tourniquet syndrome: A prospective study on predisposing factors, treatment techniques and outcomes in Ethiopia Mengistu G Mengesha, Biruk Lambisso	169
--	-----

Ipsilateral Fibula transfere in the management of segmental tibial defect secondary to Osteomyelitis: St Luke Hospital experience Wolisso Birhanu Ayana, Aselefech Gelan	175
--	-----

Musculoskeletal tumors at Addis Ababa University, Ethiopia: A 21 year analysis at the Orthopedics center, Tikur Anbesa Specialized Hospital Biruk Lambisso Wamisho, Amanuel Leulseged Wolde	181
---	-----

Pattern of pediatric femur shaft fractures in a tertiary hospital, Addis Ababa, Ethiopia Teshale Lodamo, Abiy Worku, Tilahun Desta, Tariku Shimelis, Natan Wondwossen Elssa	187
---	-----

Comparison of computerized and manual rating of permanent physical disability from musculoskeletal injury, Black-Lion Hospital, Ethiopia Biruk Lambisso Wamisho	193
---	-----

Prevalence of delayed presentation of open long bone fracture patients at two Ethiopian tertiary hospitals Samuel Hailu, Mengistu Gebreyohanes	201
--	-----

Assessment of negative pressure wound therapy follow-up and report initiative in Tikur Anbessa Specialized Hospital Bezawit Teferi, Biruk Lambisso, Geletaw Tessema, Tesfaye Guddisa, Loch Trimmingham	205
--	-----

Mask utilization and physical distancing practices as a preventive response to COVID-19 at a Tertiary Hospital, Ethiopia Natan Wondwossen Elssa, Abera Kumie, Natnael Habtamu Abegaz, Abel Tenaw Tassama, Yodit Abraham Yaynished, Tigest Abebaw Zewdie, Desalew Mekonnen	211
---	-----

EDITORIAL POLICY	217
-------------------------	-----

GUIDELINES FOR AUTHORS	223
-------------------------------	-----

ACKNOWLEDGMENT	228
-----------------------	-----

SUBSCRIPTION	228
---------------------	-----

NOTICE TO MEMBERS OF THE ETHIOPIAN MEDICAL ASSOCIATION	228
---	-----

Biruk Lambisso Wamisho, Mirkuzie Woldie. *Ethiop Med J*, 2020, Vol. 58, Supp. 3

EDITORIAL

ORTHOPEDECS IN ETHIOPIA

Biruk Lambisso Wamisho, MD, FCS^{1*}, Mirkuzie Woldie, MD, MPH²

The articles in this special issue were able to see the light of publication through the fund from the Government of Ethiopia, Ministry of Innovation and Technology- MInT (3rd round National Grant).

This EMJ volume came out at ever challenging times on us: COVID-19 and conflict at law enforcement. Both of these affected our orthopedic Surgeons and residents a lot: In the Orthopedic Department at AAU in the last 6 months (June-November,2020) there were 51 Covid positives. Mostly residents and patients were affected. In the five months semi-lock down and state of emergency, we had minimum number of traffic injuries and less flow of patients. So, we got some spare time to write these articles collected in this special edition.

In the past few years, Ethiopian Orthopedics has shown tremendous growth: The number of Orthopedic surgeons graduated from the trainings in the country is around 200 (163 graduated from Addis Ababa University (AAU) since 1987, 18 from St. Paul Millennium Medical School since 2015, 16 from Bahir Dar University (BDU) since 2015 and 8 from Mekelle since 2016). Gondar University started residency last year and Hawassa University will start this year. There are some 10 specialists who were trained abroad and some 10 expatriates. The Number of residents specializing has dramatically increased and joining this training became very competitive over the years: 75 in AAU, 40 each in St. Paul and BDU, 30 in Mekelle and 2 in Gondar University (GU). Orthopedic Trauma Sub-specialty is given only in the “Mother” Department at AAU and three fellows are currently in training. In addition to realizing the establishments of all Orthopedic Departments in Ethiopia using its curriculum and experience, this Department also gave birth to ESOT (Ethiopian Society of Orthopedics & Traumatology) (Registered on Jan 2, 2004).

Modern orthopedic practice in a large developing country of over 115 million inhabitants with high incidence of road traffic injuries (RTI) deep-rooted traditional bone setter (“Wogesha”) practice is very much demanding. Thanks to long-term international partners/collaborators like Surgical Implants Generation Network (SIGN), Arbeitsgemeinschaft für Osteosynthesefragen (AO), Australian Doctors for Africa (ADFA), Seattle Alliance Overseas (SAO), World Orthopedic Concern (WOC), etc, our practice, training and research efforts formed a formidable front to advance Ethiopian Orthopedics. The number of patients opting for new technologies & new procedures has also increased. But in all aspects, long way to go! A lot of hard work and improvement, especially ensuring availability of implants, instruments and orthopedic tools by manufacturing them in the country, is an assignment waiting.

Again, November was tough because of the recent low enforcement conflicts going on in the Northern part of our country. It made most of our member Surgeons very busy, some deployed to the fronts. With mixed spirits in both situations, we managed to prepare this volume.

In this Volume, we tried to cover wide range of orthopedic conditions in Ethiopia: Traumatic, Infectious, Degenerative and Neoplastic musculoskeletal diseases in both genders. Soft tissue and bone issues are addressed for both pediatric and adult populations we handle. Scientific digital rating of permanent disability is the main feature of this research project, funded by Ministry of Science & Technology-MInT (the then MoST). Of course, we also have an article related to COVID-19.

This is a project finalized in 4 years. Allow me to thank the three Minsters involved: H.E. Dr. Abiy Ahmed (the then Minster of MoST) for accepting my concept note to design and develop a software that rates permanent physical disability; H.E. Dr. Er. Getahun Mekuria (then Minster of MoST) for granting the fund and H.E. Dr. Abraham Belay current Minster of Innovation and Technology-MInT. Now, we have developed a comprehensive software that rates permanent physical disability and awards a percentage.

I thank my project team and all the contributors. I thank EMJ for considering our articles for publication. Enjoy reading the Articles.

¹Associate Professor of Orthopaedic Surgery, Addis Ababa University.

²Minister of Health.

*Corresponding Author E-mail:lburuklw@yahoo.com

ORIGINAL ARTICLE**BONE MINERAL DENSITY(BMD) MEASUREMENT USING CENTRAL DUAL ENERGY X-RAY ABSORPTIOMETRY (DEXA) IN ADULT ETHIOPIANS**Alpha Seifu M.D¹, Biruk L. Wamisho M.D. FCS¹, Aden Ashenafi²**ABSTRACT**

Introduction: Bone mineral density is the amount of inorganic mineral in bone tissue. Its' measurement is an important screening investigation done to diagnose patients with osteoporosis. Osteoporosis is a metabolic disorder characterized by low Bone mineral density resulting in increased incidence of fragility fractures.

Objectives: This study is an attempt to establish a normative Bone mineral density data for the Ethiopian population

Methods: This is a uni-center-based retrospective study. We reviewed the Bone mineral density of 345 Ethiopian individuals measured with a Dual-energy X-ray absorptiometry.

Results: The peak bone density in males was reached at the age of 20-29 years. The age-related decline in bone mineral density was about 0.62% per year at the lumbar spine and 1.01% per year at the femur neck from the age 30 to 70 years. The peak bone density in females was reached at the age of 20-39 years, the age r-related decrease in bone density was about 0.465% at the lumbar region and 1.41% at the femur neck region .

Conclusion: Although this study has outstanding draw backs we found that the Bone mineral density values of Ethiopian individual was higher than those established for Caucasian individuals. Its significance is in highlighting the importance of establishing a normative data so as to accurately diagnose, treat and follow osteoporosis.

Key words: Bone mineral density, osteoporosis, Ethiopian, DEXA scan, BMI

INTRODUCTION

Bone mineral density measurement is an important screening investigation done to diagnose, treat and follow patients with osteoporosis. It is also used to calculate the fracture risk in established osteoporosis cases. Although there are different methods of determining bone mineral density, the standard is using central dual energy X-ray absorptiometry as per the world health organization recommendation. Bone mineral density is essentially the amount of inorganic matter/ mineral in bone tissue. It is clinically measured by proxy according to optical density per square centimeter of bone surface upon imaging.

Osteoporosis is an endocrine/metabolic disorder characterized by low Bone mineral density (BMD) resulting in increased incidence of fragility fractures. Osteoporosis is becoming a serious public health concern as the world aging population is on the rise. However, the actual value obtained from the dual energy X-ray absorptiometry(DEXA) scan do not define osteoporosis and osteopenia. According to World Health organization WHO guidelines, the T-score, which is the difference between the measured BMD and the mean value of young adults expressed in standard deviation for a normative population of the same ethnicity is used to define the above mentioned conditions.

An individual is diagnosed with osteopenia is $-2.5 < T\text{-score} < -1$ and osteoporotic if the T-score is < -2.5 . (1)

However, there are limitations to using the DEXA scan and T-score results produced because most manufactures use the Caucasian adult population as a reference data. Multiple studies have shown, however, that BMD values differ between races and different ethnicities. Therefore, using a reference data established for a population other than our population of interest introduces a systematic error in defining osteoporosis.

The aim of this study was to measure the BMD of the proximal femur and lumbar spine of Ethiopian individuals in an attempt to establish a reference data for the Ethiopian population. In this retrospective study, we examined the results of 219 female and 126 male Ethiopian individuals aged from 20 to 102 years who had a DEXA scan done at a private wellness clinic in Addis Ababa. This study describes the first attempt to provide a guideline for distribution of normal BMD values in a sample of Ethiopian individuals.

¹ Department of Orthopedics, Addis Ababa University, ETHIOPIA.

² Nutritionist and Food Scientist, NutriSciCo-UK

*Corresponding Author E-mail: alphaali04@gmail.com

PATIENTS AND METHODS

For this retrospective study, the DEXA scan results of 345(219 female and 126 male) Ethiopian individuals was examined. All the subjects were of Ethiopian origin and within the age range of 20-102 years. The DEXA scan was done at a private wellness clinic in Addis Ababa over the last 03 years (2017-2020). The BMD of all the subjects were determined from the femur neck and lumbar spine by using DEXA scan using the fast scan mode. The manufacturer's instructions were followed. Subjects with known/ documented comorbidities like endocrine disorders and subjects with incomplete data were excluded from the study.

Verbal informed consent was obtained from each individual prior to scanning and their identity was concealed .SPSS VERSION 20 was used to analyze the data.

RESULTS

The 345 individuals (219 females, 126 males) were stratified by age and divided into five sub-groups for cross-sectional analyses. Mean values of height, weight and BMI, according to age, are given in Table 1.

Table 1: mean values of height, weight and Body mass index of the study population

male	N0	Height		Weight		BMI	
		Mean	SD	Mean	SD	Mean	SD
<20	0						
20-29	71	173.07	7.098	59.94	7.77	19.98	2.09
30-39	35	173.23	7.373	65.51	9.057	21.819	2.68
40-49	15	169.87	6.163	72.33	11.902	25.173	4.62
50-59	2	164.0	.000	51	.000	18.961	0E-7
60-69	0	0		0			
>70	3	165.0	.000	70	.000	25.711	0E-7

Female	No	Height		Weight		BMI	
		Mean	SD	Mean	SD	Mean	SD
<20	2	160	.000	40	.000	15.625	0E-7
20-29	68	162	5.356	52.85	7.971	20.132	2.829
30-39	28	163.5	6.155	61.86	29.834	23.452	12.835
40-49	25	164.08	10.255	69.28	14.424	25.485	2.613
50-59	33	160.48	7.467	73.42	25.809	28.419	9.598
60-69	48	162.23	5.744	68.35	12.012	25.973	4.427
>70	15	156.33	4.186	67.47	18.578	27.492	7.097

Table-2: correlation of sex, age and bone mineral density

Male	L2-L4			Neck of femur		Female	L2-L4			Neck of femur	
	AGE	N0	MEAN	SD	MEAN		SD	AGE	No	Mean	SD
20-29	71	2.013000	1.252	1.995	0.219	20-29	68	1.115	.15	1.398	0.3
			7		8			7	4		166
30-39	35	1.306810	.243	1.508	0.358	30-39	28	1.007	.18	1.808	0.3
					8			3	76		88
40-49	15	1.057750	.1016	0.972	0.322	40-49	25	1.041	.16	1.003	0.6
								79			8
50-59	2	1.088500	.0502	1.124	0.397	50-59	33	1.063	.46	1.167	0.6
								2			69
60-69	0					60-69	48	.9856	.44	0.9788	0.8
								78			52
>70	3	0.98930	0.576	0.898	1.083	>70	15	.814	.18	0.7815	0.7
			8					33			02

The peak bone mass in males at the lumbar spine and the neck of the left femur was reached at the age range of 20-29 years and was about $2.013 \pm 1.2527 \text{g/cm}^2$ and $1.995 \pm 0.2198 \text{g/cm}^2$, respectively. An age-related decrease in bone density began after the age of 30 in males. The average age-related decrease in bone density was about 0.62% per year at the lumbar spine and 1.01% per year at the neck of the femur from the age of 30 to 70.

The peak bone mass in females at the lumbar spine and the neck of the left femur was reached at the age of about 25 ± 5 and 35 ± 5 years and was about $1.1157 \pm 0.154 \text{g/cm}^2$ and $1.808 \pm 0.388 \text{g/cm}^2$, respectively. In this group, the age-related decrease in bone density was about 0.465% and 1.41% per year at the lumbar spine and the neck of the femur, respectively from 30 to 70 years.

Table 3:- Mean bone mineral density and standard deviation in women based on menopausal status

	L2-L4		Neck of Femur	
	Mean	SD	Mean	SD
Premenopausal	.851136	.1305652	1.001565217	.1391038938
Postmenopausal	.780911	.1655008	.9897236842	.4557849376

As shown in table 3, The BMD of the lumbar spine and the femoral neck declines in perimenopausal women as compared to women in their 30s and there

is a statistically significant decline in BMD after menopause.

Table 4: Prevalence of osteopenia and osteoporosis in adults aged 50 and older

		Normal	Osteopenia	Osteoporosis
Neck of femur	F	40%	54.5%	5.5%
	M	75%	25%	-
L2-L4	F	18%	40%	42%
	M	66.69%	22.22%	11%

Table 4 shows the prevalence of osteoporosis and osteopenia in our sample population. WHO guideline reference data for T-score was used for definition. Standard WHO definitions of osteoporosis and osteopenia were used.

DISCUSSION

This report is the first ever attempt to establish spine (lumbar vertebra) and hip (femur) BMD normative values using standard DEXA scan for a large group of adult Ethiopian males and females. The objective of the study was to determine normal BMD and establish age at peak bone mass for Ethiopian population in addition, to compare BMD values established for Caucasians with our findings. This study is meant to highlight the importance of establishing a separate Ethiopian reference data. Multiple studies have demonstrated that there are racial and ethnic differences in BMD values. Reference values for different Caucasian populations were found to be identical; however (2-6).

The BMD values in black subjects were found to be about 8-12% higher than in Caucasians. Whereas; Asian women have lower BMDs than both Caucasians and black subjects (7).

The peak BMD was established and the age related decrease in bone density was determined for our subjects. These values were then compared with multiple reference data's established for Caucasian women (2-6,8-10). Our results were consistent with the established findings although the rate of decrease in BMD was higher in Ethiopian females compared to American and Iranian females. This could be attributed to the lower mean BMI in Ethiopian women since low weight has been shown to be a predictor of rapid bone loss potentially due to the lack of peripheral estrogen production. Mean BMD values in our subjects were generally higher than those found in the American and Iranian data (1, 8, and 10). This can be attributed to differences in race as there are multiple studies showing black men and women have higher BMDs. (7, 11, and 12)

We also tried to see the decrease in BMD following menopause in our subjects. There was a decrease in mean BMD in our menopausal subjects which is consistent with findings in other studies (13, 14).

We also examined our BMD data with regard to the prevalence of osteoporosis and osteopenia. Although WHO's diagnostic criteria for definition of osteoporosis and osteopenia was established for Caucasian women, we applied it to our subjects (1). Peak BMD and standard deviation are the two determining factors in calculating T-scores. The standard deviation and BMD values for both the femur neck and the lumbar spine in Ethiopian women was found to be larger than the American database. When the subjects' BMD and the standard deviation of the peak BMD remain constant, the Peak BMD increases with a decreasing T-score. This indicates that the threshold to diagnose osteoporosis increases.

When the American database is used, the prevalence of osteoporosis is lower. This point further emphasizes the relevance of establishing a national reference database.

There are several limitations to this study, it's a retrospective study done from data collected at a single center with multiple variables unaccounted for. It's also a cross-sectional study in nature and doesn't provide actual BMD changes over time. It is meant as an indicator towards the importance of establishing a national reference data with regards of diagnosis and treatment of osteoporosis for a country with an ever increasing life expectancy and a growing aged population.

REFERENCES

1. World Health Organization (1994) Assessment of fracture risk and its application to screening for post menopausal osteoporosis. Technical Report Series 843. 1994;4:368–438.
2. Kroger H, Heikkinen J, Laitinen K, Kotaniemi A. Dual-energy X-ray absorptiometry in normal women: a cross-sectional study of 717 Finnish volunteers. *Osteoporos Int* 1992;2:135–140.
3. Karlsson MK, Gardsell P, Johnell O, Nilsson BE, Akesson K, Obrant KJ. Bone mineral normative data in Malm6, Sweden: comparison with reference data and hip fracture incidence in other ethnic groups. *Acta Orthop Scand* 1993;64:168–172.
4. Burger H, van Daele PLA, Algra D, et al. The association between age and bone mineral density in men and women aged 55 years and over: the Rotterdam Study Bone Miner. 1994;25:1–13.
5. Truscott JG, Simpson D, Fordham NJ. A suggested methodology for the construction of national bone densitometry reference ranges: 1,372 Caucasian women from four UK sites. *Br J Radiol* 1997;70:1245–1251.
6. Mazess RB, Barden HS, Johnston C, et al. Spine and femur density using dual-photon absorptiometry in normal US white women. *Bone Miner* 1987;2:211–219.
7. Tobias JH, Cook DG, Chambers TJ, Dalzell N. A comparison of bone mineral density between Caucasian, Asian and AfroCaribbean women. *Clin Sci* 1994;87:587–591.
8. Mazess RB, Barden HS. Bone density of the spine and femur in adult white females. *Calcif Tissue Int.* 1999;65:91–99.
9. Mazess RB, Barden HS, Drinka PJ, Bauwens SF, Orwoll ESD, Bell NH. Influence of age and body weight on spine and femur bone mineral density in US white men. *J Bone Miner Res* 1990;6:645–652.
10. Omrani GR, Masoompour SM, Hamidi A, et al. Bone mineral density in the normal Iranian population: a comparison with American reference data. *Arch Osteoporos* 2006;1(1-2):29–39.
11. Chantler S, Dickie K, Goedecke JH, et al. Site-specific differences in bone mineral density in black and white premenopausal South African women. *Osteoporos Int* 2012;23(2):533–542.
12. Mgodi NM, Kelly C, Gati B, et al. Factors associated with bone mineral density in healthy African women. *Arch Osteoporos.* 2015;10:206.
13. Mazess RB, Barden HS. Bone density of the spine and femur in adult white females. *Calcif Tissue Int* 1999;65:91–99.
14. Looker AC, Johnston CC, Wahner HW, et al. Prevalence of low femoral bone density in older US women from HANES III. *J Bone Miner Res* 1995;10:796–802.
15. Anderson JJB, Henderson RC. Dietary factors in the development of peak bone mass. In: Burckhardt P, Heaney RP, editors. *Nutritional aspects of osteoporosis*. New York: Raven Press 1991;3–19.

16. Bonjour JP, Theintz G, Law F, Slosman D, Rizzoli P. Peak bone mass. *Osteoporos Int* 1994;4(suppl 1):7–13.
17. Mazess RB, Barden HS. Bone density of the spine and femur in adult white females. *Calcif Tissue Int* 1999;65:91–99.
18. Looker AC, Johnston CC, Wahner HW, et al. Prevalence of low femoral bone density in older US women from HANES III. *J Bone Miner Res* 1995;10:796–802.
19. Bonjour JP, Theintz G, Law F, Slosman D, Rizzoli P. Peak bone mass. *Osteoporos Int* 1994;4(suppl 1):7–13.
20. Molyvda-Athanasopoulou E, Sioundas A, Hatzioannou K. Dual energy X-ray absorptiometry reference data for Greek population. The impact on diagnosis of using various normal ranges for comparison. *Eur J Radiol* 2000;36(1):36–40.
21. Mazess RB, Barden HS, Drinka PJ, Bauwens SF, Orwoll ESD, Bell NH. Influence of age and body weight on spine and femur bone mineral density in US white men. *J Bone Miner Res* 1990;6:645–652.
22. Kroger H, Heikkinen J, Laitinen K, Kotaniemi A. Dual-energy X-ray absorptiometry in normal women: a cross-sectional study of 717 Finnish volunteers. *Osteoporos Int* 1992;2:135–140.
23. Karlsson MK, Gardsell P, Johnell O, Nilsson BE, Akesson K, Obrant KJ. Bone mineral normative data in Malmö, Sweden: comparison with reference data and hip fracture incidence in other ethnic groups. *Acta Orthop Scand*. 1993;64:168–172.
24. Burger H, van Daele PLA, Algra D, et al. The association between age and bone mineral density in men and women aged 55 years and over: the Rotterdam Study. *Bone Miner*. 1994;25:1–13.
25. Truscott JG, Simpson D, Fordham NJ. A suggested methodology for the construction of national bone densitometry reference ranges: 1,372 Caucasian women from four UK sites. *Br J Radiol* 1997;70:1245–1251.
26. Mazess RB, Barden HS, Johnston C, et al. Spine and femur density using dual-photon absorptiometry in normal US white women. *Bone Miner* 1987;2:211–219.
27. Ross PD, He Y-F, Yates AJ, et al. Body size accounts for most differences in bone density between Asian and Caucasian women. *Calcif Tissue Int* 1996;59:339–343.
28. Bhudhikanok GS, Wang M-C, Eckert K, Matkin C, Marcus R, Bachrach LK. Differences in bone mineral in young Asian and Caucasian Americans may reflect differences in bone size. *J Bone Miner Res* 1996;11:1545–1556.
29. Davis JW, Ross PD, Wasnich RD. Relation of height and weight to the regional variations in bone mass among Japanese-American men and women. *Osteoporos Int* 1995;5:234–238.
30. Edlestein SL, Barrett-Connor E. Relation between body size and bone mineral density in elderly men and women. *Am J Epidemiol* 1993;138:160–169.
31. Harris SS, Dawson-Hughes B. Weight, body composition, and bone density in postmenopausal women. *Calcif Tissue Int* 1996;59:428–432.
32. Ortolani S, Trevisan C, Bianchi ML, Gandolini G, Cherubim R, Polli EE. Influence of body parameters on female peak bone mass and bone loss. *Osteoporos Int*. 1993;3(Suppl 1):S61–S66.
33. Tobias JH, Cook DG, Chambers TJ, Dalzell N. A comparison of bone mineral density between Caucasian, Asian and AfroCaribbean women. *Clin Sci* 1994;87:587–591
34. Felson DT, Zhang Y, Hannan MT, Anderson JJ. Effects of weight and body mass index on bone mineral density in men and women: the Framingham Study. *J Bone Miner Res* 1993;8:567–573.
35. Dawson-Hughes B, Shipp C, Sadowski L, Dallal G. Bone density of the radius, spine, and hip in relation to percent of ideal body weight in postmenopausal women. *Calcif Tissue Int* 1987;40:3104.
36. El-Desouki M. Bone mineral density of the spine and femur in the normal Saudi population. *Saudi Med J* 1995;16:30–35
37. Chantler S, Dickie K, Goedecke JH, et al. Site-specific differences in bone mineral density in black and white premenopausal South African women. *Osteoporos Int* 2012;23(2):533–542.

ORIGINAL ARTICLE

MANAGEMENT OF IDIOPATHIC CLUBFOOT BY PONSETI METHOD: TIKUR ANBESSA SPECIALIZED HOSPITAL FIVE YEAR EXPERIENCE

Mengistu G Mengesha, MD^{1*}, Birhanu Ayana, MD², Mengestie M Belay, MD³, Wubalem Zewde, MD⁴, Peter J. , MD⁵

ABSTRACT

Background: Idiopathic clubfoot is one of common congenital musculoskeletal deformity worldwide. More than 80% of idiopathic clubfoot patients live in resource limited countries including Ethiopia. This study is aimed to assess experience of Ponseti treatment for idiopathic clubfoot in Tikur Anbessa Specialized Hospital.

Methods: A five-year retrospective study was conducted. Data analysed with SPSS version 24 and result summarized by texts, tables, and figures. The association between initial Pirani score and number of casts was assessed using the Pearson correlation coefficient with the level of significance set at $P < 0.05$.

Results: A total of 526 patients with mean age at presentation of 15.3 weeks were included. Male account for 387 (73.6%). More than two-third (70.7%) were born in the health facilities. Nearly half of them (47%) had bilateral involvement followed by right side (27.5%). In average, 5.94 corrective casts were needed to correct the deformity. According to Pearson correlation coefficient, a positive correlation was observed among number of casts to correct the deformity with initial pirani score and age at presentation ($r = 0.225$, $p < 0.001$; $r = 0.178$, $p < 0.001$). Among 587 feet for which tenotomy performed, only 186 tenotomy (31.7%) was done appropriately according to the criteria (HFCS > 1 and MFCS = 0).

Conclusions: Ponseti method of club foot treatment is effective in treating idiopathic club foot in our setup. Close monitoring of tenotomy decision based on pirani scoring should be made by consultant orthopedic surgeon in order to prevent unnecessary tenotomy.

Key words: Idiopathic Clubfoot, Ponseti treatment, Number of casting, Pirani scoring system

INTRODUCTION

Idiopathic club foot is common condition characterized by poor alignment of foot with involvement of both soft tissue and bony parts in adduction, supination, equinus, and varus(1–7). Worldwide incidence is approximately 1:1000 births and greater than 150,000 children born each year are affected (8–10).

More than 80% of children with idiopathic club foot are living in resource limited set up which makes treatment difficult for them (11,12). The incidence of clubfoot in Ethiopia is estimated to be 3,000-5,000 per year. It is the second most common pediatric condition causing physical disabilities among children in Gondar with estimated prevalence of 13.4% (12,13).

For long time, management of idiopathic clubfoot in Ethiopia was traditional Kite's manipulation and plastering which almost always ended up with a radical surgical posteromedial release which is completely stopped after introduction of Ponseti treatment (13).

Due to the fact that a surgically treated feet become weak, painful, stiff and arthritic that considerably impaired quality of life and high recurrence rate, Ponseti treatment technique become standard of care for clubfoot patients (13–15).

The Ponseti treatment was started at Tikur Anbessa Specialized Hospital (TASH) in 2005 and, in 2006, it is officially adopted as standard of care for all idiopathic clubfoot patients by orthopedic department. Then after, it become standard of management for all clubfoot patients throughout the country (12,13,16).

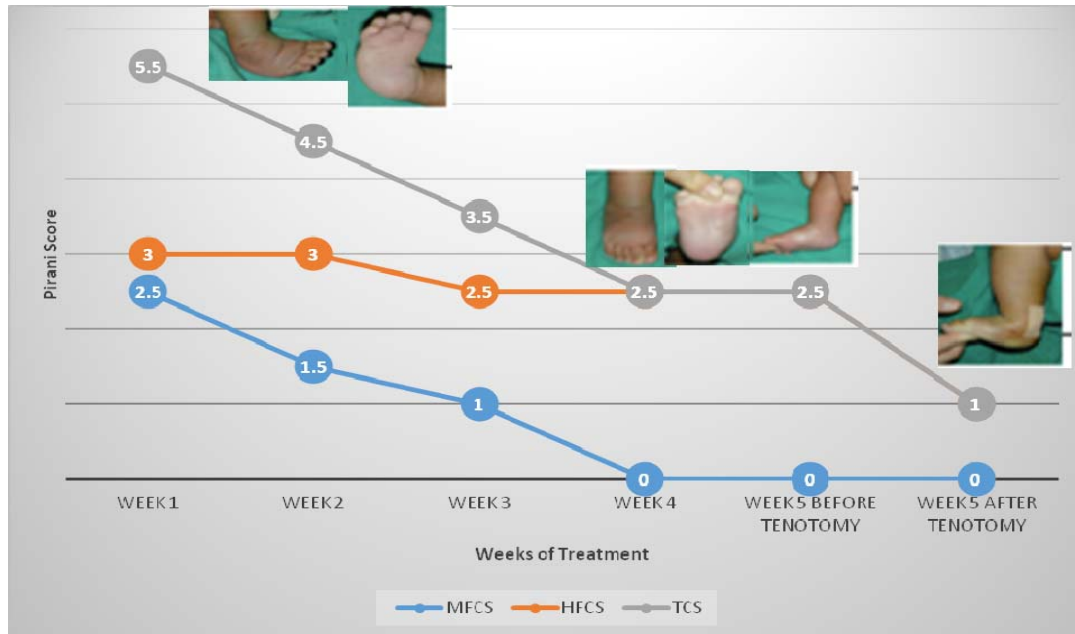
Most clubfoot deformities can be corrected with weekly manipulations and serial casting for 5 weeks followed by percutaneous achilles tenotomy to correct the equines deformity as first phase of treatment (2–4,17,18). Then second phase of treatment will continue with application of an abduction brace until the child age is 4 to 5 years to prevent relapse (3,4,15). Many researches show that Ponseti treatment is successful in up to 95% of the case (4,19,20).

¹Orthopedic surgeon at Hawassa University Comprehensive Specialized Hospital, FCS (ECSA). ²Consultant Orthopedic Surgeon, pediatric Orthopedic sub-specialist at Tikur Anbessa Specialized Hospital. ³Department of Physiotherapy, PhD candidate, Tikur Anbessa Specialized Hospital. ⁴Consultant Orthopedic Surgeon at Tikur Anbessa Specialized Hospital. ⁵Senior Consultant Orthopedics Surgeon, Department of Orthopedics and Traumatology Surgery, Norway.

*Corresponding Author E-mail: mengistugy@gmail.com

Severity of clubfoot deformity and improvement with the Ponseti management is objectively assessed with pirani scoring system which is easy and reliable. Studies show that initial pirani score has positive association with the number of corrective casts, prognosis, indication for tenotomy and outcomes (4,6,9,21,22). In general, based on the Pirani scoring system, at 4th week of the treatment, Mid Foot Contracture Score (MFCS) will be zero, while the Hind Foot Contracture Score (HFCS) will stay more than one.

When MFCS is 0 and the residual equinus is 0.5 or above, percutaneous tenotomy is indicated to speed up the correction of the hind foot equines deformity (**figure 1**). This study is aimed to report our experience at first phase of treatment of clubfoot in our set up even though our data may not completely answer all questions.



(MFCS- Mid Foot Contracture Score, HFCS- Hind Foot Contracture Score, TCS- Total Contracture Score)

Figure 1: Graph showing the correction trend of clubfoot deformities with MFCS, HFCS and TCS with estimated time of correction.

PATIENTS AND METHODS

A five-year retrospective study was conducted at Tikur Anbessa Specialized Hospital (TASH), Addis Ababa, Ethiopia. Four documents for each club foot patients were reviewed: patient medical chart, club foot patients' registry book, Pirani scoring sheet, and tenotomy logbook.

Club foot patients treated with Ponseti method and have completed chart were included in the study. Those patients with incomplete chart, syndromic club foot, neuropathic and late presenting club foot which was previously mentioned as neglected clubfoot (age above 2 years) were excluded.

Chart incompleteness was operationally defined as when one or more than one of the following important variables were missed: sex, age of treatment initiation, place of birth, feet affected, type of club foot, number of visits, Pirani score, and tenotomy status. Data was collected from the 4 documents using structured questionnaires which includes: sociodemographic characteristics, type of club foot, complications, initial and final Pirani score, number of casting, and tenotomy status.

The completed data was collected with Microsoft excel and exported to SPSS version 24 for data cleaning and analysis. Result was summarized by using texts, tables and figures. Pearson correlation coefficient with P-value < 0.05 was used to test the relationship among number of casting, need of percutaneous tenotomy and initial pirani score.

The study was conducted after getting ethical clearance from departmental ethical board.

RESULT

Sociodemographic characteristics:

A total of 1000 club foot patients were managed at TASH during the study period, of those, only 526 patients were idiopathic club foot with completed data and included for further analysis.

Among 526 children, 247 children (47%) were bilateral clubfoot followed by 146 children (27.8%) with right side club foot. Male patient accounts 387 (73.6%) with 2.78:1 male to female ratio. The mean age of the patients at presentation to clubfoot clinic was 15.3 weeks (1 - 92 weeks, SD of 20.53 weeks). More than two third (70.3%) of them were born in health facilities (clinics and hospitals) (**Table 1**).

Table 1: Sociodemographic characteristics of Idiopathic Clubfoot patients at TASH from 2010 to 2015.

Variables		Frequency (n = 526)	Percent (%)
Feet Affected	Right	146	27.8
	Left	133	25.2
	Bilateral	247	47
Sex	Male	387	73.6
	Female	139	26.4
Place of Birth	Home	154	29.3
	Hospital	235	44.7
	Clinic	137	26

Age of Presentation and Place of Birth

Those children with idiopathic club foot and born at home had a mean age of 27.98 weeks (95% CI: 24.14 – 31.82, $P < 0.001$) at time of presentation to clubfoot clinic. Whereas, Children who were born at health facilities had a mean presentation age of 10.22 weeks (95% CI: 8.65 – 11.78, $P < 0.001$). According to Pearson's correlation coefficient, there is association among place of birth with age of presentation to club-foot clinic and number of corrective casting ($r = 0.443$, $p < 0.001$; $r = 0.185$, $p < 0.001$ respectively).

Average Number of Casting, Initial Pirani Score and tenotomy status

The mean number of corrective casts for idiopathic club foot was 5.94 (minimum 3, maximum of 16 with SD of 3.01). For the tenotomy group (for whom tenotomy was done), an average of 5.86 (minimum 3, maximum 16 with SD of 2.98) corrective casting were needed; whereas, non-tenotomy group was corrected

with average of 5.22 (minimum 3, and maximum 7 with SD of 1.05) serial casting and manipulation. The overall mean number of initial pirani score was 4.67 (SD=2.06); which was 4.92 for tenotomy group and 4.1 for non-tenotomy group. According to Pearson correlation coefficient, a positive correlation is observed among initial pirani score and number of casting ($r = 0.225$, $p < 0.001$).

Age Category and Number of Casting

The average number of casting for newborn presented within the first 2 weeks of age was 5.36 (minimum 3, maximum 9, SD= 2.01) and 6.38 (minimum 5 and maximum 16, SD= 2.45) for children with the age of 5 – 24 weeks (**Table 2**). According to Pearson's correlation coefficient, there is association among initial age of presentation and number of corrective casting ($r = 0.178$, $p < 0.001$).

Table 2: Age Category of patient at presentation, Initial Pirani Score and Number of Casting of Idiopathic Club-foot patients at TASH from 2010 to 2015.

Age Group	Number of Children	Average Initial Pirani Score	Average No. of Casting
0–2week	99 (18.8%)	4.84	5.36
3–4weeks	114 (21.7%)	4.68	5.38
5-24weeks	202 (38.4%)	4.59	6.38
25-52weeks	73(13.9%)	4.52	7.12
53-103weeks	38 (7.2%)	4.31	7.81

Tenotomy Appropriateness:

Out of 526 children, 390 (74.1%) children had percutaneous tenotomy under local anesthesia. From 390 children (587 feet) for which tenotomy performed, only 186 tenotomy (31.7%) was done appropriately according to the criteria (HFCS >1 and MFCS = 0). For the rest 421 (68.2%) feet, tenotomy was done without respecting the criteria.

Complications of first phase Ponseti treatment of clubfoot:

The most common complication was recurrence of clubfoot deformity which was documented for 12 children (2.3%) followed by pressure ulcer for 7 (1.3%), rocker bottom deformity for 4 (0.8%) and complex clubfoot for 2 (0.4%) children.

DISCUSSION

Our finding reflected that bilateral involvement (47%) is significantly higher than unilateral involvement which is similar with the previous study done in Bangladesh and our country (13,16,20). It also showed that male (73.6%) were more affected than female with a ratio of 2.8:1. This is similar with a study done in Bangladesh (20), Gondar (13) and Italy (1) which shows predominant occurrence of clubfoot in males.

A two-third of clubfoot children (70.7%) were born at health facilities (clinic and hospital). This indicates they were directly linked to a clubfoot clinic and early treatment was initiated and the outcome was good for them when compared to those delivered at home.

Many Authors showed that Ponseti management is successful up to 95% of clubfeet management (4,22,23). The outcome of Ponseti treatment is dependent on place of birth, pirani score at initial presentation, age at presentation, number of casts to correct the deformity and tenotomy status (4,6,9,17,18,21,24,25). Age of patients at presentation to the clubfoot clinic has a positive correlation with place of birth ($r=0.443$, $p<0.001$). This finding explained by a clubfeet child born at home (mean age of presentation 27.98 weeks) were presented 2.74 times delayed to the clinic than those born at health facilities (mean age of presentation is 10.22 weeks). Late presentation to the clubfoot clinic was seen in our study which may be due to lack of public awareness about clubfoot and its management option and lack of enough trained personnel to manage club foot in each corner of the country. There was an association among place of birth and age of initial presentation with number of corrective casts ($r=0.185$, $p<0.001$, $r=0.178$, $p<0.001$ respectively).

A home delivered clubfoot child needs a higher number of corrective castings than those born at the health facilities which may be due to far from health facilities, or else family's' negative attitude toward modern medicine. In this study, mean number of corrective casts for idiopathic club foot was 5.94 which is nearly consistent with the study done by Pavone *et. al.* (1) estimated that an average 6.6 corrective castings is necessary before performing a tenotomy.

Ignacio Ponseti mentioned that Ponseti treatment of clubfoot should be initiated soon after birth in ideal set up (2,22). In our study, average number of corrective casting for those children presented within 2 weeks was 5.36 which is not significantly different from those come until age of 4 weeks (5.38). But after 4th week of age, there is a significant increase in the number of corrective casting which shows that the earlier the casting, the better the outcome. So, we can start plastering after 2 weeks of birth specifically for those low birth weight, premature, and child who can't breast feed well. There should not be hurry for casting with in the first week of life.

This study showed that a significant positive correlation among initial Pirani score and number of corrective casting ($r=0.225$, $p<0.001$) required to correct the deformity. There are different conflicting ideas in literature regarding the association of initial pirani score and number of corrective casts. Our study is supported by a study conducted in Manchester among 70 clubfeet with HFCS of 2.5 or 3 required higher number of casting (26). Related to this, a research conducted in India showed the more severe the initial deformity, the higher the pirani score, and then it needs a greater number of casts to obtain correction of deformity (9). The average number of corrective casting was higher for the tenotomy group (5.86 casts) than for the non-tenotomy group (5.22), the finding is similar to the study done in India(18). It also showed that 74.1% of the clubfeet children had a percutaneous tenotomy under local anesthesia, this reflects that out of 4 clubfeet children, 3 were having a tenotomy. From the total tenotomy performed in this study, only 31.8% were done when HFCS>1 and MFCS = 1. In 68.2% tenotomy was done even when MFCS is more than or equal to 1. This shows that there is over temptation to do tenotomy before midfoot contracture score is corrected which can lead to other complications. It could be explained that most of the time clubfoot clinic is run by junior orthopedic residents (year 1 and 2) and the decision for tenotomy readiness and final pirani scoring will be done by them.

This may lead for unnecessary tenotomy before the foot is ready. In ideal circumstances, tenotomy should be done when HFCS >1, MFCS= 0, talar head covered inside and ankle dorsiflexion remains less than 10 degrees above neutral position of the ankle (4).

The most common complication in our study was recurrence which is 2.2% followed by pressure ulcer 1.3%, rocker bottom deformity 0.8% and complex clubfoot accounting 0.4%. The recurrence rate finding is similar with a study done by Ford Powell *et. al.* (20) estimated that 2% of patients experienced recurrence. However, Pavone *et. al.* (1) registered recurrence rate among 3.7% of clubfeet patients due to poor compliance of the splint. But we are not able to compare our recurrence rate result with other findings due to the fact that scope of our study was restricted to first phase of clubfoot treatment and doesn't evaluate brace associated complication.

Limitation of the study: since most of patients' chart was having incomplete data, the study may not show the actual picture in our set up. But, in order to get complete data set, we use different data source including Club foot patient's chart (Pirani scoring sheet), club foot patients registry book, patients' medical chart and tenotomy logbook. It was also a single facility-based study which has difficulty to generalize for the whole population in Ethiopia.

Conclusion

This research show that Ponseti treatment is effective in our set up and average number of castings needed to treat the deformity was determined by place of birth, age of presentation, and initial pirani score. These shows that it is important to brought children with club foot earlier to club foot clinic for successful Ponseti treatment outcome with least possible manipulation and casting.

REFERENCE

1. Parone V, Testa G, Costarella L, Pavone G P. Congenital idiopathic talipes equinovarus: an evaluation in infants treated by the Ponseti method. *Eur Rev Med Pharmacol Sci* 2013;17(19):2675–9.
2. Ningthoujam Jungindro Singh, Sanjay Keshkar, Pampa De RK. Management of clubfoot by Ponseti technique-our experience. *IJPMR* 2011;22:12–6.
3. Malhar N Kumar CG. Modified Ponseti method of management of neonatal club feet. *Acta Orthop Belg* 2012;78(2):210–5.
4. Matthew B Dobbs, J R Rudzki, Derek B Purcell, Tim Walton, Kristina R Porter CAG. Factors Predictive of Outcome after Use of the Ponseti Method for the Treatment of Idiopathic Clubfeet. *J Bone Jt Surg* 2004;86-A (1):22–7.
5. Daniel Augusto Carvalhu Maranhão JBV. Congenital clubfoot. *Acta Ortop Bras* 2011;19(3):163–9.
6. Mejabi J O, Esan O, Adegbehingbe O, Orimolade E A, Asuquo J, Badmus H.D. The Pirani Scoring System is Effective in Assessing Severity and Monitoring Treatment of Clubfeet in Children. *Br J Med Med Res* 2016;17 (4):1–9.
7. Sharma Gaurav, Balkrushna Mangukiya, Prasad DV et al. Treatment of Idiopathic Congenital talipes equinovarus deformity by Ponseti technique in rural population. *Int J Med Res Heal Sci* 2013;2(3):363–6.

The Pirani score is good enough to estimate the average number of corrective castings and the need for tenotomy. But it needs strict follow up of residents and other staffs who are involved in deciding and doing tenotomy in order to assure ideal circumstances (MFCS =0 and HFCS >1) are fulfilled in order to prevent unnecessary and less effective percutaneous tenotomy.

Recommendation

Using pirani scoring for clubfoot patients' follow up should be continued and strict criteria should be followed before doing tenotomy to prevent unnecessary tenotomy. If possible, the final scoring should be done in the presence of pediatric orthopedic surgery consultants and decision for tenotomy should be made by consultant. Prospective study is paramount to see the indication for tenotomy.

ACKNOWLEDGMENT

The Authors would like to acknowledge Tikur Anbessa Specialized Hospital Orthopedic department for all support to conduct the study. We are also thankful for Nurses who were working in the clubfoot clinic for their collaboration during the data collection.

Competing of interest: The authors declare that the manuscript was approved by all authors and there are no competing interests. There is no external funding source for the study.

8. Omololu B, Ogunlade T. A. Pattern of congenital orthopedic malformations in an African teaching Hospital. *West Afr J Med* 2005;24(2):92–5.
9. Alok Aggarwal NG. The role of the Pirani scoring system in the management of club foot by the Ponseti method. *Int J Sci Res* 2016;5(6):1284–7.
10. Samantha E Parker, Cara T Mai, Matthew J Strickland et al. Multistate study of the epidemiology of clubfoot. *Birth Defects Res Part A - Clin Mol Teratol* 2009;85(11):897–904.
11. Jose A Morcuende, Lori A Dolan, Frederick R Dietz , Ignacio V Ponseti. Radical Reduction in the Rate of Extensive Corrective Surgery for Clubfoot Using the Ponseti Method. *Pediatrics* 2004;113(2):376–80.
12. Birhanu Ayana, Peter J Klungsoyr. Good results after Ponseti treatment for neglected congenital clubfoot in Ethiopia. *Acta Orthop* 2014;85(6):641–5.
13. Asmare Yitayeh, Berihun Fisseha. Health Condition Associated With Physical Disability Among Children in Ethiopia. *Int J Rehabil Sci* 2015;04(02):19–24.
14. Margaret A Honein, Leonard J Paulozzi CAM. Family history, maternal smoking, and clubfoot: An indication of a gene-environment interaction. *Am J Epidemiol* 2000;152(7):658–65.
15. Ning Lu, Li Zhao, Qing Du, Yakun Liu, Florin I. Oprescu JAM. From cutting to casting: impact and initial barriers to the Ponseti method of clubfoot treatment in China. *Iowa Orthop J* 2010;30:1–6.
16. Biruk L W. Management of Club foot at Tikur Anbessa Hospital; Addis Ababa, Ethiopia. *East Cent African J Surg* 2007;12(1):24–9.
17. Dyer P J, Davis N. The role of the Pirani scoring system in the management of club foot by the Ponseti method. *J Bone Jt Surg - Br* 2006;88(8):1082–4.
18. Anil Agarwal, Neeraj Gupta. Does initial Pirani score and age influence number of Ponseti casts in children? *Int Orthop* 2014;38(3):569–72.
19. Gray K, Pacey V, Gibbons P, Little D, Frost C BJ. Interventions for congenital talipes equinovarus (clubfoot). *Cochrane Database Syst Rev* 2012;(4).
20. Ford-Powell VA, Barker S, Khan MSI, Evans AM, Deitz FR. The Bangladesh clubfoot project: The first 5000 feet. *J Pediatr Orthop* 2013;33(4):40–4.
21. Porecha M, Parmar D. The Predictive Value of Pirani Scoring System in the Management of Idiopathic Club Foot by Ponseti Method. *Internet J Orthop Surg* 2008;11(2).
22. Lynn Staheli. Clubfoot: Ponseti Management. *Global HELP Publications*. 2009. 1–32.
23. Joshua Bridgens, Nigel Kiely. Current management of clubfoot (congenital talipes equinovarus). *BMJ* 2010; 340 (355): 308–312.
24. Mazlina Awang, Abdul Razak Sulaiman, Ismail Munajat MEF. Influence of age, weight, and Pirani score on the number of castings in the early phase of clubfoot treatment using Ponseti method. *Malaysian J Med Sci* 2014;21(2):40–3.
25. Vaishy AK, Arif M, Acharya D, Choudhary R, Seervi PM, Kumar R. Influence of Beginning Time of Casting for Clubfoot Treatment by Ponseti Method in Different Age Group Infants: A Retrospective Study. *Indian J Orthop* 2020;54(1):55–9.
26. Cristina Alves, Carolina Escalde, Pedro Fernandes, Delffin Tavares MC. Ponseti method: Does age at the beginning of treatment make a difference? *Clin Orthop Relat Res* 2009;467(5):1271–7.

ORIGINAL ARTICLE

RING TOURNIQUET SYNDROME: A PROSPECTIVE STUDY ON PREDISPOSING FACTORS, TREATMENT TECHNIQUES AND OUTCOMES IN ETHIOPIA

Mengistu G Mengesha, MD, FCS, ECSA^{1*}, Biruk Lambisso, MD, FCS²

ABSTRACT

Background: Ring tourniquet syndrome is not uncommon and patients will present with pain, swelling, ischemia, and finger wounds related to previous ring removal attempts. It may be due to application of undersized ring or related to swelling around a previously well-fitted ring.

Objective: This study aimed to describe epidemiologic features, predisposing conditions, and treatment outcomes of strangulated fingers.

Methodology: In this prospective observational study, we enrolled consecutive patients who presented to any of the three selected emergency departments at Tikur Anbessa Specialized Hospital, Alert trauma center and Hawassa University Comprehensive Specialized Hospital with ring tourniquet syndrome between January 01, 2017 and December 31, 2019. Data collected after getting ethical clearance.

Result: Among 33 patients enrolled, 52 % were female and the mean age was 24 (1.5 - 56) years. Eleven (33%) presented after wearing undersized ring, 7(21%) had trauma to the ipsilateral hand, wrist and/or forearm, and 7 (21%) were psychiatric. The mean duration of ring incarceration was 3 days (4 hours – 3 weeks). Thirty-one patients (93%) reported previous attempt of removal of the constricting agent. Twenty-two patients (69%) required destruction of the constricting object and 5 patients (15%) need ray's amputation of the finger. There were no reported major complications.

Conclusion: Ring tourniquet syndrome is not uncommon in our setting, and since most of the incarcerated rings required ring-destructive technique, the health personnel need at least ring or k-wire cutter to manage this condition.

Key words: strangulated finger, ring incarceration, Tourniquet Syndrome, ring devices,

INTRODUCTION

Incarceration of rings or other circumferential metal objects on fingers is not an uncommon complaint in the emergency department(1). Patients may present with finger pain, swelling, ischemia, and wounds related to previous ring removal attempts. Ring incarceration may be the result of application of an undersized ring or related to swelling around a previously well-fitted ring. Previously reported conditions associated with ring incarceration include trauma to the ipsilateral hand or wrist, edema secondary to a pregnancy or another general medical condition, deforming arthritis, and psychiatric illness (2–5). Finger necrosis due to incarcerated rings has been reported (5).

Treatments for incarcerated ring may be classified as ring-preserving or ring-destroying. Ring-preserving techniques may be preferred by patients due to sentimental or financial ring value and include elevation, lubrication, cold compress, and string and rubber-band techniques (6–10).

Ring-destroying methods include the use of a specialized ring or wire cutter or pliers (6,11). Pain, iatrogenic lacerations, and embedding of foreign materials have been reported with these techniques (2,3,12–14).

The conditions associated with ring incarceration, timing of patient presentation, approaches to incarcerated ring removal and, and outcomes of the treatment have not been described in an Ethiopian population. This study aimed to describe epidemiologic features, predisposing conditions, and treatment outcomes of strangulated fingers- otherwise known as ring tourniquet syndrome caused by rings and small ring-shaped devices. Additionally, we present our preferred approach to the management of incarcerated rings.

¹Orthopedic Surgeon at Hawassa University Comprehensive Specialized Hospital.

² Associate Professor of Orthopedic Surgery, Head of Department of Orthopedics, Addis Ababa University.

*Corresponding Author E-mail: mengistugy@gmail.com

PATIENTS AND METHODS

This is a prospective observational study of consecutive patients who presented with rings or other ring-like metallic objects incarcerated on a finger between January 01, 2017 and December 31, 2019 to the emergency department of one of the three selected hospitals in Ethiopia: Tikur Anbessa Specialized Hospital (TASH), Hawassa university Comprehensive Specialized Hospital (HUCSH) and Alert Trauma Center (Addis Ababa). There were no exclusion criteria. Ethical approval was obtained from the departmental research committee, and informed consent for data collection was obtained from all participants themselves or family/guardians (for pediatric and psychiatric patients) including for use of their strangulated fingers' picture for further study and educational purposes.

Data was collected using a structured data extraction checklist prepared by the principal investigator from previously done researches and picture of all strangulated finger was taken. Patient and ring characteristics, timing of presentation, previous treatment attempts, predisposing conditions, and treatment methods were recorded by the treating orthopedic surgeon or residents. .

Two-week, 3-month and 6- month outcomes focusing on pain, stiffness, tendon injury, infection, and ischemia were assessed either in the outpatient clinic or by telephone encounter with the study team. Descriptive statistics were reported

RESULTS

Sociodemographic characteristics:

There were 33 eligible patients encountered at the study sites during the study period, all of whom agreed to participate and were enrolled. Seventeen (52%) patients were treated at Tikur Anbessa Specialized Hospital (TASH); 9 (27%) at Alert Trauma Center; and 7 (21%) at Hawassa University Comprehensive Specialized Hospital (HUCSH). Seventeen (52%) patients were female. The mean age was 24 (1.5 to 56) years, and 4 (12%) patients were younger than 10 years of age. The left hand was affected in 23 patients (70%), and the affected digits were the ring 20 (61%) followed by index 7 (21%) and middle finger 5 (15%). The incarcerated ring was an undersized ring in 13 (39%) cases, an engagement or wedding ring in 12 (37%) cases, and a ring - like metal object in 8 (24%) cases (**Table 1**)

Table 1: Socio-demographic characteristics of patients with ring tourniquet syndrome at three Ethiopian Hospitals (TASH, HUCSH and Alert Hospital) 2017 - 2019

Characteristics	Frequency (N=33)	Percentage (%)
Age groups (years)	<10	4
	11 - 18	7
	19 - 30	12
	31 - 45	8
	>45	2
Sex	Male	16
	Female	17
Side involved	Right	10
	Left	23
Digit involved	Ring finger	20
	Index finger	7
	Middle finger	5
	Little finger	1
Hospital	TASH	17
	HUCSH	7
	Alert Trauma centre	9
Types of rings incarcerated	Small (undersized)	13
	Engagement or wedding	12
	Ring - like metal object	8

Among the 8 patients with ring shaped object incarceration, 5 of them were difficult to remove with ring



Figure 1a: 32 year old psychiatric patient who presented 2 weeks after placing a ring - shaped object on to his little finger and required a ray's amputation.

destruction techniques and ultimately required ray's amputations (**Figure 1a & 1b**).



Figure 1b: 25 year old psychiatric patient who presented 1 week after placing a ring - shaped object on to his third finger and required a ray's amputation.



Figure 1c: 3 year old child who presented 3 hours after placing a ring- shaped object on to his third finger. The ring was removed using ring destructive techniques.

Clinical presentation and predisposing factors:

The mean patient-reported duration of ring incarceration prior to presentation was 3 days (4 hours to 3 weeks); with 18 patients (54.5%) presenting within 24 hours and 5 patients (15.2%) presenting more than a week after incarceration. Most patients (93%) reported multiple attempts at ring removal prior to presentation to one of study sites, performed by either the patient, a family member at home, or a health care provider at another health care facility.

The most common predisposing factors for ring incarceration were use of an undersized ring, which occurred in 11 patients (33%) followed by psychiatric illness and ipsilateral hand, wrist and/or forearm injury, each accounting 21% of cases. Swelling around a previously well-fitted ring occurred in 6 pregnant patients (18%) (**Table 2**)

Table 2: Clinical presentation and predisposing factors for ring tourniquet syndrome at three Ethiopian Hospitals (TASH, HUCSH and Alert Hospital) 2017 to 2019.

Characteristics	Frequency (N=33)	Percentage (%)	
Duration from ring incarceration to hospital arrival	< 1 day	18	54.5
	1- 3 days	7	21.3
	4 – 7 days	3	9
	>7 days	5	15.2
Previous attempt to remove the ring before hospital arrival	Yes	31	93
	No	2	7
Predisposing factors for ring incarceration	Psychiatric illness	7	21
	Pregnancy	6	18
	Injury to hand, wrist and/or forearm	7	21
	use of small (undersized) ring	11	33
	Child	2	6

Techniques of ring removal

Ring-preserving removal techniques including lubrication with KY jelly and compression with string or rubber band were successfully only for 6 patients (18.2%). The rest 22 (66.7%) patients needed ring-destructing technique using a ring or K-wire cutter

(**Figure-1c**), and the remaining 5 patients (15.1%) ultimately required ray amputation of the finger with embedded ring due to the difficulty of removing the ring with ring destructing techniques (**Figure-1a, 1b, and 2**).

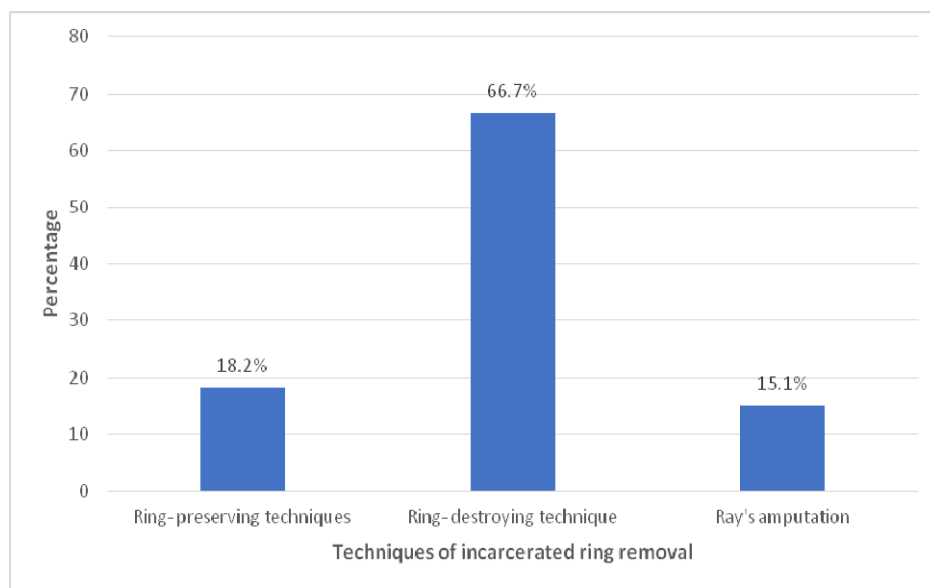


Figure 2: Distribution of techniques for ring removal among patients with ring tourniquet syndrome at three Ethiopian hospitals (TASH, HUCSH and Alert Hospital) 2017 - 2019.

Post ring removal management and patient follow up:

Patients were not hospitalized for the Ray amputations or any other ring removal techniques; all procedures were done as an outpatient. Ray amputations were performed under regional anesthesia using a wrist block. After ring removal, all patients were put on oral analgesics and first - generation cephalosporine or cloxacillin for 5 to 7 days based on the wound condition.

Two - week follow up data was collected at outpatient clinic visits and subsequent 3- and 6 - month follow up data was collected either in person or by phone interview. Thirty-two patients (97%) were completed their follow up until 6 months and one psychiatric patient was lost from follow up after 3rd month of his follow up.

There was no incidence of ischemia, tendon injury, range of motion impairment, or persistent pain; and all patients whose finger were preserved reported full function of the affected finger. Those patients for whom ray's amputation performed were also return back to their activity without any limitation. Nearly all patients (97%) were discharged from further follow up at 6 months.

DISCUSSION

Epidemiology, Treatment, and Outcomes

In this prospective observational study of ring incarceration, we aimed to describe the epidemiologic features and treatment outcomes of ring incarceration in our patient population. The patient characteristics and predisposing factors to incarcerated ring in our population were similar to those reported in other series (1,3,12,15); however, our cohort included a higher proportion of patients who presented after application of an undersized ring. This may be related to a trend among female students buying rings at nearby market and putting it to their finger without precautions. In order to prevent these unnecessary complications, youngsters should be counselled about the complication of wearing an undersized ring.

There are two types of incarcerated ring removal techniques. The first one is ring preserving which includes use of elevation and KY Jelly, string technique and rubber band techniques. This technique is the preferred for sentimental ring like promise or marriage ring. But it may not work for all incarcerated rings due to severe swelling or embedded nature of the ring. The second type of ring removal is ring destroying techniques reserved for those ring or ring like device which is difficult to remove with ring preserving techniques and it includes ring cutter, volt and k-wire cutter (1,3,4,6,7,9,12). In this study, ring-destroying techniques were required in the majority (83%) of incarcerated rings; we are not aware of any other data to compare these results. Compared to other studies, a smaller proportion of the patients presented within 24 hours after the onset of ring tourniquet syndrome. Previous study suggests that increased time to presentation and previous removal attempts are related to a higher likelihood of requiring a ring-destroying removal method which is also true in our setting (2,15).

No complications related to ring removal were observed in our cohort. Previously described factors associated with long-term outcomes after ring tourniquet syndrome include associated metacarpal or phalangeal fractures, severity of soft tissue injury, and flexor tendon laceration which is comparable with our study (14).

Unlike other studies, 8 (24%) of our patients presented so late after placing a ring -like metal devices on to their fingers, so that ray amputations were necessary. This ring- like device incarcerations were not commonly reported in the previous studies.

Authors' Preferred Technique

The choice of ring removal technique depends on several factors including: the nature of injury or strangulation, the status of the digit at the time of presentation (degree of swelling, presence of ischemia and soft tissue injury), degree of ring tightness, value of the ring, physical characteristics of the ring, and the patient's level of pain. It is advisable to administer either local anesthesia, conscious sedation, or another form of analgesia during incarcerated ring removal. When the affected finger has signs of ischemia (pain, capillary refill time >2secs, cyanosis or paresthesia), the ring should be removed urgently with a ring or k-wire cutter if available. Ring cutter, wire cutter, or pin cutter can be used to remove incarcerated rings, but it can be difficult to insert the cutter when a ring is deeply embedded in the skin of strangulated finger. When a ring is deeply embedded, it must be removed in pieces by cutting, and it may also be necessary to incise the skin bridge in the manner of a finger fasciotomy (3,6,12).

Some of our patients were presented too late after the ring tourniquet syndrome establishment and unnecessary multiple attempts to removing the ring in nearby health facility which leads to ray amputation of the strangulated digit as the only viable option to prevent further local and systemic infection. Wound dressing, antibiotics coverage, and tetanus prophylaxis should be administered after ring removal. Antibiotic duration depends on the nature of the wound, but generally we recommend at least 1 dose of intravenous antibiotics followed by 5 to 7 days of oral antibiotics. The drug of choice is first -generation cephalosporine or cloxacillin in order to cover the gram positive microorganisms which are the normal flora of the skin.

Limitations of the study: The sample size was modest, and the patients were enrolled at referral centers only, which may limit the generalizability of the findings. The number and types of ring-preserving removal attempts prior to use of a ring-destroying technique were not recorded, and no objective criteria were used to guide treatment plans.

Ring-removal techniques were chosen according to the judgment of the treating surgeon or resident physician and the preference of the patient. There was no specific functional outcome score used to assess patients' functional outcome during follow up time.

Conclusion

Ring Tourniquet Syndrome is not uncommon in our hospitals, and ipsilateral upper extremity trauma, pregnancy, use of small (undersized) rings and psychiatric illness are all associated with this condition. Evaluation of the patient's finger and understanding what type of ring is involved will be paramount when deciding the method of ring removal. The outcome after ring removal is good in our set up.

Recommendation

As most of the incarcerating rings -shaped object require destructive techniques of removal, treating facilities must be prepared for ring destruction set up before attempting ring preserving techniques.

Even with the destructive techniques, the incarcerated ring may be too difficult to remove and require a ray amputation so that is needs to prepare the tool and consult the patients.

ACKNOWLEDGEMENTS

The author would like to acknowledge all residents and consultants who were managing and following the study patients. The author is also thankful for Dr. Brett Shannon from John Hopkins University and Dr. Beth Hochman from American College of Surgeons (ACS) for providing advice and assisting in finding references.

Competing of Interest: There are no conflicts of interest among the authors and no external funding for this study.

REFERENCES

1. Charles R Cresap. Removal of a Hardened Steel Ring From an Extremely Swollen Finger. *Am J Emerg Med* 1995;13:318–20.
2. Anad Kumar, Huw Edwards, Surjit Lidder, Prabhakar Mestha. Dangers of neglect : partially embedded ring upon a finger. *BMJ Case Rep* 2013;1:1–3.
3. Alexander Moser, Aristomenis Exadaktylos Alexander Radke. Removal of a Tungsten Carbide Ring from the Finger of a Pregnant Patient : A Case Report Involving 2 Emergency Departments and the Internet. *Case Rep Emerg Med* 2016;2016.
4. Stephen L Kates. A Novel Method of Ring Removal From the Aging Finger. *Geriatr Orthop Rehabilitation* 2010;1(2):78–9.
5. Ramesh B A, Satish Kumar J. Ring Finger Necrosis Due to a Ring. *Indian J Surg* 2017;79(4):367–8.
6. Carolyn L Gardiner, Krista Handyside, Justin Mazzillo et al. A comparison of two techniques for tungsten carbide ring removal. *Am J Emerg Med* 2013;31(10):1516–9.
7. Mullett S T H. RING REMOVAL FROM THE OEDEMATOUS An alternative method. *J Hnad Surg* 1995;20(4):496.
8. Bruce B Shafiroff. Easy Removal of a Partially Embedded Ring.pdf. *Plast Reconstr Surg* 1979;841–2.
9. Jacobus Louw Eric Hodgson. An unconventional ring removal technique for hard-to-remove rings (Practical Pearl / Perle Pratique). *African J Emerg Med* 2012;2(2):81–3.
10. David Bosanquet, Gareth Roberts, Lucy Haydock Alun Yewlett. A technique for removing rings from swollen fingers. *Int J Clin Ski* 2010;4(1):15–7.
11. Shamsuddin SR, Hashim AA, Berahim N, Fauzi H, Wahab SFA, Abu Yazid. The use of dental drill in removing entrapped finger by metal ring in emergency department. *Med J Malaysia.* 2012;67(3):349–50.
12. Asim Kalkan, Ozkan Kose, Mahmut Tas, Gokhan Meric. Review of techniques for the removal of trapped rings on fingers with a proposed new algorithm. *Am J Emerg Med* 2013;31(11):1605–11.
13. Frank J Fasano, Reid H Hansen. Foreign body granuloma and synovitis of the finger : A hazard of ring removal by the sawing technique. *J Hand Surg Am* 1987;12(4):621–3.
14. Nicholas Crosby, John Hood, Graeme Baker, John Lubahn. Ring injuries of the finger : long-term follow-up. *Am Assoc Hnad Surg* 2014;2014(9):274–81.
15. Bo-Wei Zeng, Yi-Jie Guo C-CH. Embedded Ring Injury of the Middle Finger in an Amphetamine Abuser. *J Chinese Med Assoc* 2006;69(2):95–7.

ORIGINAL ARTICLE

IPSILATERAL FIBULA TRANSFERE IN THE MANAGEMENT OF SEGMENTAL TIBIAL DEFECT SECONDARY TO OSTEOMYELITIS: ST LUKE HOSPITAL EXPERIENCE WOLISSO.

Birhanu Ayana, MD^{1*}, Aselefech Gelan, HO²

ABSTRACT

Introduction: Large tibial defects following chronic osteomyelitis present a challenging problem to manage. The aim of the study was to report our experience and outcome of ipsilateral fibular transfer in the treatment of tibial defect due to Chronic Osteomyelitis.

Materials and methods: This is a retrospective review of patients who were treated with ipsilateral fibular transfer for large tibial defect due to chronic osteomyelitis between 2008 to 2012. There were nine patients with mean age of 14 years (range 6-34 years). The tibia defect length ranged between 6 and 14 cm with a mean length of 10cm. The outcome criterias were clinical bone union, radiographic union and graft hypertrophy. The transferred fibula was stabilized by a screw or transcalcaneal intramedullary Kistshner wire.

Results: Good outcome was obtained in all our patients with mean time to union of 17 weeks (range 12-36 weeks). The average follow-up time was 3 years. Centralized fibula showed union and hypertrophy on radiography. Non-union of distal junction observed in one patient which was treated with dynamic compression plate and grafted. Shortening of up to 3cm and mild limitation of ankle range of motion, but all patients were able to ambulate without difficulty.

Conclusions: The method was technically simple, easy to perform, short surgical time and does not require microsurgical skills. A use of ipsilateral fibular transposition is a very useful surgical procedure in reconstructing diaphyseal tibia bone defect due to chronic osteomyelitis in resource constrained environment.

Keywords: Chronic Osteomyelitis, tibial defect, Ipsilateral fibula transfer.

INTRODUCTION

Chronic Osteomyelitis is a major health problem in developing country. It is mainly associated with low socioeconomic level. Most of these cases are results of poorly treated acute hematogenous osteomyelitis or neglected due to lack of facility or expertise. In addition to this the condition could also be seen after traumatic injuries or as a complication of surgical procedure. The treatment of chronic osteomyelitis is mainly surgical requiring adequate surgical debridement of necrotic bone tissues and proper antibiotic administration. In most of the cases they present with big sequestration, poor involucrum formation requiring radical surgical intervention which as a consequence often results in large bone defect creating significant morbidity for the patient and threatening the viability of the affected limb (1,2,3).

Tibia is a commonest site of osteomyelitis due to the characteristics of its metaphyseal blood supply and its subcutaneous anatomical location. Secondary bone loss after radical surgical debridement of the necrotic bone is unavoidable.

The clinical management of large segmental tibia defect in association of compromised vascularity, scarring tissue due previous multiple surgical interventions and malalignment of the limb presents a challenging condition for the treating orthopedic surgeon. Different types of surgical procedures have been practiced to manage big tibia defect (2,4 -7).

The use of ipsilateral fibular transfer with its vascular preservation is one of a applicable method for the reconstruction of large segmental tibia bone defects secondary to chronic osteomyelitis. The transfer of the ipsilateral fibula to the tibia defect was first suggested by Hahn in 1884 (6) and later, was used successfully by Huntington in 1903(7). Subsequently, the procedure have been used widely for reconstruction of large segmental tibia defects by several authors in cases of posttraumatic and post-infective, congenital deformity and tumors defects reconstruction (8-12). We describe here tibialization of fibula procedure for the treatment of tibia defect more than 6cm. So, the aim of this study was to report our experience and discuss the outcome of nine consecutive patients who had been treated with ipsilateral fibular transfer in our setting.

¹Department of Orthopedics Surgery, Colleague of Health Sciences, Addis Ababa University.

²St. Luke Catholic Hospital, Orthopedic Surgery Unit, Wolisso.

*Corresponding Author E-mail:ayanabirhanu@gmail.com

To the best of our knowledge, this is the first report on the outcome of this procedure to treat large tibia defects due to chronic osteomyelitis in Ethiopia.

PATIENTS AND METHODS

This was a retrospective review of nine consecutive patients with segmental tibial defect treated by ipsilateral fibula graft at St. Luke Catholic Hospital, woliso, between 2008 and 2012. These patients were identified from prospectively maintained data. Ethical clearance was obtained from hospital review board. There were seven male and two female with a mean age of 14 years (range 6 - 34 years). Seven patients had chronic hematogenous osteomyelitis of tibia and two patients had post-traumatic osteomyelitis (Table 1).

All were subjected to clinical evaluation and routine laboratory investigations and the X-rays of the affected leg before any surgical intervention. The common clinical presentation were chronic discharging sinuses, exposed bone, varies degree of skin defect over the involved leg and radiologically dead bone (sequestra), pathological fractures and poor new bone formation (figure 1a and figure 2a, b). The duration of the illness was more than three months in all our cases.

The management was provided in two stage protocol. The initial stage of treatment were radical surgical debridement of dead necrotic issues which includes soft tissue, bone and removal large segment of dead bone (sequestrectomy). Dead space resulting from surgical debridement was filled with polymethylmethacrylate (PMMA) beads impregnated with antibiotics (thanks to ORTHOCUAM Italy providing Beads) and temporary immobilization of the limb was provided with plaster of Paris or external fixation. Most of the patients had more than two procedures before fibula graft except one who was presented with large tibia defect without active sign of infection clinical and radiological. All patients have received an antibiotic course at least for 6 weeks.

Following the initial stage of treatment the segmental defect of the tibia ranged from 6 cm to 14 cm (mean 10cm). Through clinical evaluation, laboratory investigations and radiological evaluation was performed to confirm control of infection before bone reconstruction. Common laboratory tests used includes white blood count, erythrocyte sedimentation rate, and hemoglobin level. We did not perform C - reactive protein due to lack of facility. Bone reconstruction stage was proceeded once there is no evidence of persistence of infection clinical and radiological.

Operative technique

The reconstruction was performed after 6- 8 weeks of the last procedure and no evidence of infection clinically as well as on x-ray evaluation was noticed. We used separate incisions for both tibia and fibula. First, the tibia was exposed through the previous surgical scar, antibiotics beads removed, both proximal and distal ends of defects were identified, adequately exposed the ends, medullar canal well seen, freshened, and the gap was measured. Thru a lateral incision the fibula was exposed subperiosteally, above the level of proximal tibia segment and distal tibia segment.

The muscle and neurovascular structures in the anterior compartment were retracted anteriorly and the fibula was shifted into the defect of tibia and stabilized with two to three 4.5 mm cortical screws or cancellous screws in three patients and intramedullary Kirschner wires in six cases (figure 1b & 2c). The fibula was incorporated near to normal axis of the tibia and into medullary canal to allow biological and mechanical advantage for healing. None of the junctions were bone grafted primarily. The wound were sutured by layer and a long leg plaster cast was applied with the knee in slight flexion and the ankle in neutral position. Drainage was left in situ for 48 hours.

Post-operatively patients were instructed not weight bear for the first eight weeks then after progressive protected partial weight bearing was allowed based on radiological evidence of bone union and a long leg circular cast was changed to patellar bearing cast. Full weight bearing was encouraged once good healing was observed on both anteroposterior and lateral radiography.

During the follow up period all cases were regularly evaluated clinically and radiologically for bone union. Complications like nonunion, recurrence of infection, implant failure, fracture of transposed fibula were assessed. The knee, ankle range of motion, limb length discrepancy and others associated deformities were also assessed.

RESULTS

Bone healing was observed in all our cases. The mean duration of healing was 17 weeks (range 12-36 weeks). The patients were followed from 2 to 5 years after fibular transposition with mean follow up 3 years (range 2 - 5 years).

One patient developed nonunion in the distal junction and was managed using dynamic compression plate (DCP) with bone graft and sound union achieved. He was the only adult patient we had. Shortening of 3cm noticed in one patient and while in others shortening were not significant. Axial alignment overall was good. All our case had good range of motion the knee joint with mild stiffness of ankle joint.

The transferred fibula showed hypertrophy in all nine patients (Figure 1c) and (Figure 2b). No flare up of infection noticed in any of cases during the follow up period. No patient had compartment syndrome or neurovascular damage. All were able to resume their day to day activities and routine work.

Table 1: Clinical details and results for the patients treated with ipsilateral fibular graft

Cases	Age(yr)	Gender	Cause	Defect	Time of union
1	6	M	Hematogenous osteomyelitis	6cm	12weeks
2	13	F	Hematogenous osteomyelitis	10cm	18weeks
3	15	M	Post-traumatic osteomyelitis	12cm	20weeks
4	12	M	Hematogenous osteomyelitis	9cm	14weeks
5	11	M	Hematogenous osteomyelitis	12cm	13weeks
6	11	M	Hematogenous osteomyelitis	14cm	14weeks
7	13	F	Hematogenous osteomyelitis	13cm	15weeks
8	8	M	Hematogenous osteomyelitis	8cm	12weeks
9	34	m	Post-traumatic osteomyelitis	10cm	36weeks



Figure 1a: preoperative X-ray of leg showing Chronic osteomyelitis of tibia with sequestrum and tibia defect following sequestrectomy



Figure 1b: Radiograph showing tibialization of fibula fixed with screw (c) healing with fibular hypertrophy



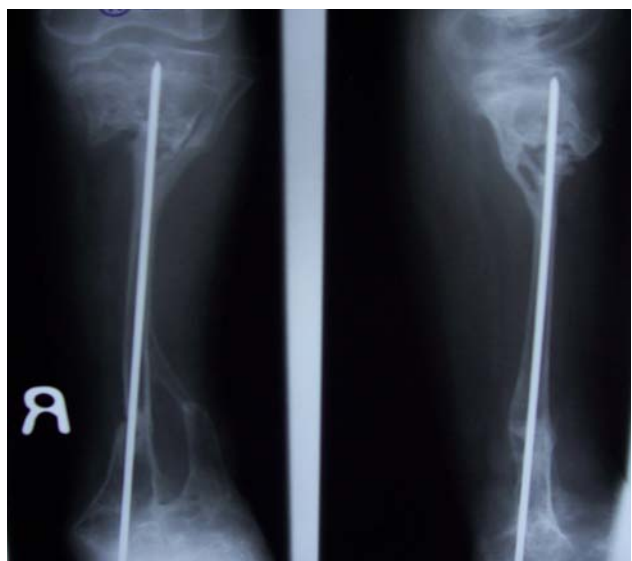
A

Figure 2a: Picture shows exposed bone with discharge and

b: Plain radiograph showing dead bone of tibia with pathological fracture



B



C



D

Figure 2c: Plain radiograph showing reconstruction of segmental tibia defect with ipsilateral fibular graft and fixed with Kirschner wire.

DISCUSSION

Large tibia defects due to chronic osteomyelitis are common in developing countries especially in children due to inadequate management and late presentation. It represent a challenging problem for the treating surgeon and patients (1, 2, 6, 10). The basic principles in the treatment of any long bone infection is based on radical debridement of all compromised tissue, early provision of vascularized soft tissue cover with elimination of dead space followed by delayed reconstruction (2,3,13,17). Different types of surgical procedures have been used to treat large defect of tibia, which includes free vascularized fibula graft from contra lateral leg, non-vascularized fibular graft and Ilizarov technique.

The use of Ilizarov procedure it is believed to be a time-consuming surgical technique with high rate of complications and prolonged external fixation time. In addition availability of fixator and expertise is another concern in developing countries like Ethiopia (4,14). Vascularized transfer of fibula from the contra lateral leg creates further morbidity to the normal limb, is a prolonged surgical procedure, needs microsurgical expertise with special equipment and has high rate of fatigue fracture (5, 10,15). The use of non-vascularized fibular graft from contra lateral leg is often limited by risk of nonunion, high incidence of stress fracture, and infection and donor site morbidity (16).

The use of ipsilateral fibula transfer to treat large tibial defect have been used by several authors both in children and adults with good outcome (7-9,17-19). The transposed fibula ensures continued vascularization of the graft in a poorly vascularised fibrotic bed. The transfer of a large graft of fibula raised on a pedicle of peroneal and anterior tibial muscles and peroneal vessels, and fixing the graft to the tibia along its posterior long axis proximally and distally, produces a sound mechanical and biological advantage for union. Chacha and his colleagues on their experimental and clinical studies have shown the viability of ipsilateral fibular graft and reported good outcome in all their cases (2, 17).

We had good outcome in salvaging the limbs in all of our patients by using ipsilateral fibular graft. The healing of both junctions proximal and distal was obtained in all our patients with sound hypertrophy of transferred fibula. The transposition of fibula to the proximal and distal tibia segment was performed in one stage reconstruction in all patients fixing with screw or intramedullary K-wire stabilization through calcaneus maintaining as much as possible anatomical axis of the limb. We preferred one stage reconstruction procedure because all our patients had good skin condition with minor scar tissue and free of infection. Huntington in contrast performed the procedure in two stage to enhance the healing process (7).

We believe one stage reconstruction avoids risk of repeated surgery, hospital stay and cost effective. Similarly Tuli used single stage procedure to reconstruct the tibia defect by fixing the fibula into long axis of the leg to provide biological and mechanical advantage of healing (18). According Agiza the fibula undergoes hypertrophy and it becomes an integral part of the static supporting architecture of the leg when it is subjected to weight bearing stress (8). Similar observation noticed in all our patients. Shortening of the limb was noticed with mild ankle stiffness, but functional limitation was not significant and was compensated by shoe raise. This is probably related to growth plate damage of the tibia as the consequence infection in our pediatric cases. Similar finding was reported in other studies (2, 20).

REFERENCES

1. Spiegel DA., Penny JN. Chronic Osteomyelitis in Children. *Techniques in Orthopaedics*® 2005;20(2);142-152.
2. Rasool M. The treatment of tibial defects following chronic pyogenic haematogenous osteomyelitis in children. *SA Orthop J* 2008; 7(1): 34-43.
3. Tetsworth K, Cierny G. Osteomyelitis debridement techniques. *Clin Orthop* 1999; 360:87-96.
4. Paley D, Catagni MA, Argnani F, et al. Ilizarov treatment of tibial nonunions with bone loss. *Clin Orthop* 1988; 241:146-165.
5. Minami A, Kasashima T, Iwasaki N Kato H Kaneda. Vascularised fibular grafts. *J Bone Joint Surg [Br]* 2000; 82-B: 1022-5.
6. Langenskiöld A. Hahn's operation for pseudarthrosis after osteomyelitis of the tibia in children. A report of three cases. *Acta Orthop Scand* 1983; 54:714-720.

Several other studies have reported their success by this procedure to treat large tibial defect due to different causes (9, 11, 18-20). Kassab et al emphasized the importance infection control, good skin condition and stable nutritional status for successful fibular transposition (12).

The use of ipsilateral fibula transfer provides various benefits. The procedure does not require specialized reconstructive technique and instruments. The transfer of large segment of fibula with its vascular supply and muscle attachment provides excellent condition for good healing and infection control. The procedure is limited to the same limb side, so that contra-lateral donor site morbidity is avoided.

The Transference of ipsilateral fibular graft for the treatment of large tibia bone defect due to chronic osteomyelitis is an important choice for salvaging the limb. The Surgical technique does not require special skill and implants to perform. It is technically easy with short operative time and hospital stay. There is no donor site morbidity compared to vascularized fibular transfer from contra lateral leg and it can be performed in resource limited setup. For better outcome the treating surgeon should have due consideration of good soft tissue condition, presence of infection, and socioeconomic factors.

ACKNOWLEDGEMENT

We would like to thank St Luke Catholic Hospital and orthopedics unit for their full support. We would also like to thank Sr Ascale Matron of the hospital for her support and taking care of the patients. Our special thanks go to ORTCUAM Group Italy for providing all necessary equipment and medical supply for the patients.

Competing of interest

There is no conflict of interest.

7. Huntington TW. Case of bone transference. Use of a segment of fibula to supply a defect in the tibia. *Ann Surg* 1905; 41:249–51.
8. Agiza AR. Treatment of tibial osteomyelitic defects and infected pseudarthroses by the Huntington fibular transference operation. *J Bone Joint Surg [Am]* 1981;63:814–819.
9. Campanacci M, Zanoli S. Double tibiofibular synostosis (fibula pro tibia) for non-union and delayed union of the tibia. End result review of one hundred and seventy-one cases. *J Bone Joint Surg* 1966; 48 (1):44–56.
10. Dinh.P, Hutchinson B.K, Zalavras.C, Stevanovic M.V. Reconstruction of Osteomyelitis Defects. *Seminars in Plastic Surgery* 2009; 23:108–1183.
11. Puri A, Subin BS, Agarwal MG. Fibular centralisation for the reconstruction of defects of the tibial diaphysis and distal metaphysis after excision of bone tumours. *J Bone Joint Surg Br* 91:234–239.
12. Kassab.M, Samaha.C, Saillant.G. Ipsilateral fibular transposition in tibial nonunion using Huntington procedure: a 12-year follow-up study. *Injury, Int. J. Care Injured* (2003) 34, 770–775
13. Daoud A, Saighi-Bouaouina A. Treatment of sequestra, pseudarthroses, and defects in the long bones of children who have chronic hematogenous osteomyelitis. *J Bone Joint Surg [Am]* 1989;71: 1448–1468.
14. R. M. Atkins, P. Madhavan, J. Sudhakar, D. Whitwell. Ipsilateral vascularised fibular transport for massive defects of the tibia. *JBJS(Br)* 1999 81-B(6): 1035-40.
15. Al-Zahrani S, Harding MGB, Kremli M, Khan FA, Ikram A, Takroni T. Free fibular graft still has a place in the treatment of bone defects. *Injury* 1993; 24:551–4.
16. Morsi E: Tibial reconstruction using a non-vascularised fibular transfer. *Int Orthop* 2002; 26:377–380.
17. Chacha PB, Ahmed M, Daruwalla JS. Vascular pedicle graft of the ipsilateral fibula for nonunion of the tibia with a large defect. *J Bone Joint Surg Br* 1981;63:244–53.
18. Tuli SM. Tibialization of the fibula: a viable option to salvage limbs with extensive scarring and gap nonunions of the tibia. *Clin Orthop Relat Res* 2005;431:80-4.
19. Rahimnia A, Fitoussi F, Penneçot G, Mazda K. Treatment of Segmental Loss of the Tibia by Tibialisation of the Fibula: A Review of the Literature. *Trauma Mon.* 2011; 16(4):154-32.
20. Khan M. Z. G. M., Downingt N. D, Henry A. P. J.. Tibial reconstruction by ipsilateral vascularized fibular transfer. *InJury* 1996; Vol. 27, No. 9: 651-654

ORIGINAL ARTICLE

MUSCULOSKELETAL TUMORS AT ADDIS ABABA UNIVERSITY, ETHIOPIA: A 21 YEAR ANALYSIS AT THE ORTHOPAEDIC CENTER, TIKUR ANBESA SPECIALIZED HOSPITAL

Biruk Lambisso Wamisho, MD, FCS¹, Amanuel Leulseged Wolde, MD^{2*}

ABSTRACT

Introduction: The burden of cancer is on the rise, according to WHO's report the number of new cases is said to increase by about 70% over the next two decades. Musculoskeletal tumors refer to abnormal growths involving bone and the surrounding soft tissues. In Ethiopia, like that of rest of sub-Saharan nations estimates for the incidence of musculoskeletal tumors is increasing.

Objective: This study aims to show the stages of presentation and overall burden of musculoskeletal tumor cases seen at Tikur Anbessa Specialized Hospital Orthopaedic center from 1989 G.C up to 2009 G.C.

Methods: The source of information is the Orthopedic Center at Tikur Anbessa Specialized Hospital which is the Country's largest and major diagnostic and treatment center for musculoskeletal tumors. The patients demographics and selected variables are recorded from their medical records onto Ms.Excel and then analyzed using IBM SPSS(V.24). The database spans from 1989 G.C up to 2009 G.C

Result: There is a trend of rising case numbers, from less than ten cases in 1989 to more than a 100 cases per year in 2007 and 2008 each. Overall, the leading musculoskeletal tumors are soft tissue sarcomas at 66.3% followed by Osteosarcoma 18.5% which is the leading primary bone tumor in the study duration.

Conclusion: There is a need for establishing or strengthening population-based Musculoskeletal tumor registry in the whole of Ethiopia to implement executive and evidence-based national and regional cancer control programs.

Key Words: Musculoskeletal Tumors, Tumor Burden, Bone tumors in Ethiopia

INTRODUCTION

According to a systematic analysis from the global burden of disease cancer collaboration, cancer is already the second leading cause of death worldwide. In 2015 there were 17.5 million cancer cases worldwide and 8.7 million deaths. The number of cases also increased by 33% between 2005 and 2015, which was seen to correlate with mainly the aging population and population growth.(1)

Although the trend in mortality has shown some decline in the developed world, there has been an increase in mortality in the developing nations, predominantly the Sub-Saharan Africa region including Ethiopia. The shortage of resources to establish state of the art treatment centers and inadequacy of activities directed at prevention strategies have led to poor outcomes. (1-5)

Musculoskeletal tumors refer to abnormal growths involving bone and the surrounding soft tissues. These are classified based on their nature as benign or malignant.

While benign bone tumors occur more frequently than the malignant bone tumors, malignant tumors are associated with high mortality and morbidity.(6) The tumors could arise primarily from the bone, cartilage, or soft tissues in the extremities or they could be secondary deposits more commonly found in bone of the extremities. Common origins for Secondaries include thyroid, lung, renal, gastrointestinal, breast, and prostate cancer.(6)

Although Statistics show bone tumors to be relatively less common when compared to the leading causes of cancer like lung cancer and breast cancer (6); the precise incidence of musculoskeletal tumors remains largely unknown in this part of the world. This could be due to the fact that many of the patients don't present to the hospital or present late due to lack of awareness about the disease, poverty, social, religious, traditional beliefs, practices by bone setters among the population and fear of reconstructive surgeries like amputation. At the institution level lack of expertise, equipment, and proper records keeping may be the responsible factors. (7,8)

¹ Associate Professor, Orthopedic Center, Tikur Anbessa Specialized Hospital, AAU, Addis Abeba, Ethiopia.

² Orthopedic Surgery resident, PGY 3, Orthopedic Center, Tikur Anbessa Specialized Hospital, AAU, Addis Abeba, Ethiopia.

*Corresponding Author E-mail: amanuel.leulseged@aau.edu.et

Treating these tumors requires the coordinated efforts of an orthopaedic surgeon, radiologist, pathologist, radiation oncologist, and medical oncologist to address the spectrum of musculoskeletal tumors.(9) This poses huge challenge for developing nations where resources are scarce, professional personnel are limited and majority of cases are late presenters and have complications. In Ethiopia, like that of rest of sub-Saharan nations estimates for the incidence of musculoskeletal tumors is increasing; Bone tumors and tumor-like lesions have been found to occur mainly between the first and fourth decades of life. It is therefore clear that these tumors have a potentially devastating effect on the most productive segment of the population; (7,8,10,11)hence, there is need to allocate more health resources toward prevention, diagnosis, and treatment of these tumors as the most tumors have a better prognosis when diagnosed and treated earlier.

Objective

The objective of this study was to review the burden of musculoskeletal tumor cases seen in the 21 years between 1989 up to 2009 at the Orthopaedic center in Tikur Anbessa Specialized hospital, Addis Abeba University, the largest referral center in Ethiopia. It evaluates the various histological types along with their relative frequency with respect to age, gender and geographical distribution. This study is believed to fill the epidemiology data gap on musculoskeletal tumors within the specified time period.

PATIENTS AND METHODS

Methods: -

Source of Data: -

The source of information is the Orthopedic Center at Tikur Anbessa Specialized Hospital which is the Country's largest and major diagnostic and treatment center for musculoskeletal tumors.

Data collection and Analysis

The patients demographics and selected variables are recorded from their medical records onto Ms.Excel and then analyzed using IBM SPSS (V.24). The database spans from 1989 G.C upto 2009 G.C.

Variables

The following variables were included.

1. Demographic Data: name, sex, residential address/Region/
2. Tumor-Related Data: date of diagnosis, actual diagnosis, Stage of disease
3. Source of information: Hospital number

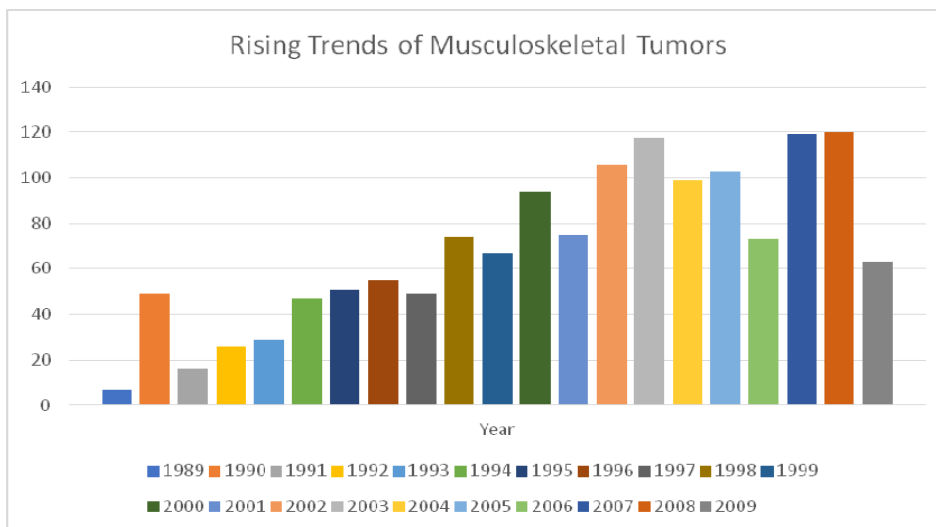
Inclusion and exclusion criteria for the registration

In this study hematologic malignancy cases are excluded.

RESULTS

1. Frequency

In this study a total of 1,424 cases have been registered excluding those with leukemia. Among these cases the majority were male 57% (809) and females account for the 43% (615). There is a trend of rising case numbers, from less than ten cases in 1989 to more than a 100 cases per year in 2007 and 2008 each.



The mean age at diagnosis was 35, with age ranging from 3 to 95. *Soft tissue sarcomas* are the most common diagnosis in this 21 year period, accounting for 66.3% of the cases seen.

During this 21 year period the majority of cases seen were from *Addis Abeba* 36.3% followed by the *Oromia region* 29.1%.

Table1:- Case distribution across the different regions of the country

Address	Frequency	Percentage	Population size/2008
Addis Abeba	516	36.3	3,146,999
Oromia	414	29.1	28,066,993
Amhara	224	15.7	20,136,006
Tigray	65	4.6	4,565,000
SOUTH PNNs	158	11.1	15,745,002
Somali	8	0.6	4,559,997
Afar	4	0.3	1,448,997
Gambella	4	0.3	258,999
Harari	19	1.3	209,000
Benshangul-Gumuz	2	0.1	656,000
Dire Dewa	9	0.6	428,000
Unknown	1	0.001	-
Total	1,424	100	79,221,000

Overall the leading musculoskeletal tumors are *soft tissue sarcomas at 66.3%* followed by *Osteosarcoma 18.5%* which is the leading primary bone tumor in the study duration.

Table 2:- The Frequency of Top five musculoskeletal tumors overall 1989 -2009 G.C

No	Diagnosis	Frequency	Percentage
1	Soft tissue sarcoma	944	66.3
2	Osteosarcoma	263	18.5
3	Ewing's Sarcoma	82	5.2
4	Chondrosarcoma	5	5
5	Multiple Myeloma	15	1

In men the leading five musculoskeletal tumors are Soft-tissue sarcomas(66.7%), osteosarcoma(19.8%), Ewing's Sarcoma(6.3%), chondrosarcoma(4.4%) and GCT(1%).

Table 3:-The Frequency of Top five musculoskeletal tumors in Men from 1989 -2009 G.C

No	Diagnosis	Frequency	Percentage
1	Soft tissue sarcoma	540	66.7
2	Osteosarcoma	160	19.8
3	Ewing's sarcoma	51	6.3
4	Chondrosarcoma	36	4.4
5	GCT	8	1

In women the leading five musculoskeletal tumors are Soft-tissue sarcomas(70.2%), osteosarcoma(16.8%), chondrosarcoma(5.7%), Ewing's sarcoma(5%), multiple myeloma(1.5%).

Table 4 :- The Frequency of Top five musculoskeletal tumors in Women from 1989 -2009 G.C

No	Diagnosis	Frequency	Percentage
1	Soft tissue sarcoma	432	70.2
2	Osteosarcoma	103	16.8
3	Chondrosarcoma	35	5.7
4	Ewing's sarcoma	31	5
5	Multiple Myeloma	9	1.5

DISCUSSIONS

This retrospective study describes the pattern and frequencies of musculoskeletal tumors evaluated at a tertiary referral center in Ethiopia, spanning a period of more than two decades.

Musculoskeletal tumors comprise of soft tissue and bone tumors. Compared to the commonest causes of malignancy they represent less than 1% of all adult and 15% of pediatric malignancies, with an estimated annual incidence of 6,000 to 7,000 for soft tissue sarcomas and 2,750 bone sarcomas in the United States. Mortality from these tumors ranges from 30% up to 45%, highest being in those between 15 to 19 years. (6)

At the Orthopedic center in Tikur Anbessa Specialized Hospital, we have observed a trend of rising case numbers, from less than 10 cases in 1989 to more than a 100 cases per year in 2007 and 2008 each.

In this study a total of 1,424 cases have been registered excluding those with leukemia. Among these cases the majority were male 57% and females account for the 43%.

The male preponderance is similar to other studies and registries in the continent. Our male to female ratio is 1.31 slightly lower but comparable to the studies by ON Salawu et al and MM Inuwa et al who reported 1.6:1 and 1.7:1 male to female ratios respectively. (7,8,12)

The mean age at diagnosis was 35, with age ranging from 3 to 95. Soft tissue sarcomas are the most common diagnosis in this 21-year period, accounting for 66.3% of the cases seen.

During this 21-year period the majority of cases seen were from Addis Abeba 36.3%, the nation's capital, followed by the Oromia region 29.1%. Osteosarcoma is the most common primary bone sarcoma in the young and adult population, with peak in incidence between the first and second decades. It is commonly found in the metaphyseal area of bone, around the knee joint (50%) followed by the proximal humerus (25%).(6) Quite in agreement to other studies, Osteosarcoma is the leading primary bone tumor in this study comprising 18%(263) of the total number 1,424 cases. (7 , 8 , 1 2 , 1 3)

In most cases of musculoskeletal tumors exact cause is unknown. Among the identified risk factors history of radiation therapy, chronic wounds and infection, having a foreign body in situ and genetic alterations can be mentioned.(6)

This study is first of its kind in highlighting the burden of musculoskeletal tumors in Ethiopia. The results have brought to light many factors.

First, the scarcity of data on one of the challenging tumors to treat i.e musculoskeletal tumors is an alarming reflection of the very limited priority these conditions are being given. In our search for literature, we have only come across three published studies related to musculoskeletal tumors in Ethiopia. All of these are from one center, Tikur Anbessa Specialized hospital. One of the major challenges is late or delayed presentations; an unpublished institutional review done at the orthopaedic center at Tikur Anbessa Specialized Hospital reveals that 83.9% of cases that present to the department are of late or advanced nature. In the study of Obafemi Joel Aina et al and other studies, late presentations in a resource limited setting result in unfavorable outcomes and pose serious challenges for managing these conditions. (7,8,14)

Therefore, a large window of opportunity exists in which delays to diagnosis and treatment can be shortened and unnecessary loss of life prevented. Reaching out to the community at large and awareness creation should be at the forefront of prevention strategies.

We also need to deal with the bottlenecks at the institutional level like;- delay in admission, long and multiple appointments, shortage of beds, lack of biopsy options, sample processing delays, weak interdepartmental collaboration, lack of an orthopedic oncology dedicated unit.

According to the UK guidelines for management of bones sarcomas, cancer control strategies should target early detection and diagnosis of symptomatic disease as one essential component of the strategy. As this will lead to improved survival outcomes and less extensive surgery.(11)

The other factor we observed was the lack of population or institution-based musculoskeletal tumor registries, which could help generate the very much needed information to guide policy making.

Major strengths of this review include it being done at the largest referral center in the country, it encompassing more than two decades of data which was collected by the efforts of the principal author. There were also some limitations. The representativeness of the review might be small as it's from a

single center and majority of patients are from closer regions and were able to travel to the tertiary center. Those in the periphery unable to travel for treatment are not included. Second, poor documentation and absence of a registry system translates to underestimation of actual number of patients seen and missing out on valuable, comprehensive data. The form of treatments they received and outcomes of these patients is also difficult to trace.

The ongoing efforts to establish an orthopedic oncology unit by training reconstructive surgeons abroad and providing CME's on musculoskeletal tumors by the orthopedic center at Tikur Anbessa specialized hospital is highly commendable and should be adopted by all orthopedic centers in the nation.

Conclusions

The burden of cancer is increasing in developing countries;however Cancer in general, and musculoskeletal tumors in particular have received low priority for health care services in Sub-Saharan Africa. (1,2,4,5)

According to Tikur Anbessa specialized hospital, Orthopedic Center an unpublished review data shows that 100 tumor related surgeries are done per year, accounting for about 7% of all procedures. With the widespread practice of traditional medicine in Ethiopia, patients usually come when the tumors have reached irreversible stages. At Tikur Anbessa Specialized Hospital, Orthopedic center 83.9% of cases that present to the department are of late or advanced nature. Which is also observed in other studies and late presentations in a resource limited setting result in unfavorable outcomes and pose serious challenges for managing these conditions. (7,8,14)

This study, despite the limitation of being retrospective and not being population-based, attempts to demonstrate the wide spectrum of musculoskeletal tumors that present to Tikur Anbessa Specialized Hospital along with the statistical figures. However, the lack of a population-based bone tumor registries and reliable census figures in the nation has brought about great underestimation of incidence and prevalence of musculoskeletal tumors. According to the WHO it takes initiative and political commitment on behalf of the African nations to invest in the programs with a dedicated budget and required staff, at the same time looking for support from international public health agencies and donors to strengthen such government-based initiatives. (4)

The availability of a high-quality population-based musculoskeletal tumor registration system is an important component of any evidence-based cancer control program. Tumor registries are also useful for studying the risk factors of cancer with respect to culture, dietary patterns, and other environmental factors and the very limited prior efforts to study the causes of cancer in this population. Therefore, developing a Musculoskeletal tumor registry in the whole of Ethiopia should be given due emphasis.

Recommendations

It is our belief and recommendation that having a population based Musculoskeletal tumor registry program in place nationally is of utmost importance. Due to its impact on the lives of so many, by guiding policy making to allocate resources for these conditions most of which are treatable if diagnosed early and rapid intervention instituted.

To that end the Orthopedic Center at Tikur Anbessa Specialized Hospital is ready to work with all stakeholders in the development of such registry programs across the nation.

ACKNOWLEDGMENT

The authors would like to acknowledge the Orthopaedic Center staff and residents, the Department of Oncology at Tikur Anbessa Specialized Hospital, CHS AAU and ICRC Ethiopia for funding data collection.

Competing of Interest

No Conflicts of interest.

REFERENCES

1. Fitzmaurice C, Allen C, Barber RM, et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: A Systematic Analysis for the Global Burden of Disease Study Global Burden of Disease Cancer Collaboration. *JAMA Oncology*. 2017; 3 : 524–48.
2. Okobia M. Cancer Care in sub-Saharan Africa – Urgent Need for Population-based Cancer Registries. <http://www.ajol.info/index.php/ejhd/article/view/9848>
3. Jemal A, Bray F, Forman D, et al. Cancer burden in Africa and opportunities for prevention. *ACS* 2012; 118 : 4372–84.
4. Parkin DM, Ferlay J, Hamdi-Cherif M et al. Cancer in Africa Epidemiology and prevention, What did we learn in the last 50 years. *IARC* 2003; 153 :268-276
5. Parkin DM, Bray F, Ferlay J, Jemal A. Cancer in Africa 2012. *Cancer Epidemiol Biomarkers Prev*. 2014;23(6):953–66.
6. M.Malawer M, Sternheim A. Operative techniques in orthopedic surgical oncology. In: M.Malawer M, C.Wittig J, Bickels J, editors. Philadelphia: LIPPINCOIT WILLIAMS & WILKINS; 2012. p. 418.
7. Salaw ON, Babalola OM, Ed A, Mejabi JO, Fadim AA. Musculoskeletal tumors of the extremities: Challenges and outcome of management in a Nigeria Tertiary Hospital [Internet]. www.ajmhs.org/printarticle.asp?issn=2384.
8. Inuwa M, Zakariyau L, Ismail D, Friday E, Ibrahim A, Mohammed A. Overview of extremity musculoskeletal neoplasms at the Ahmadu Bello University Teaching Hospital Zaria, Nigeria. *Ann* <http://www.annalsfrmed.org/text.asp?2017/16/3/141/209087>
9. Patrick C., Toy., Robert K., Heck Jr. Campbell's operative orthopaedics . In: Frederick M, James H, S. Terry Canale, editors. 13th ed. Philadelphia: Elsevier; 2017. p. 918–93.
10. Ferreira N, Marais LC. Osteosarcoma presentation stages at a tumour unit in South Africa. *South African Med J* 2012;102(8):673–6.
11. Gerrand C, Athanasou N, Brennan B, et al. UK guidelines for the management of bone sarcomas. <http://clinicalsarcomaresearch.biomedcentral.com/articles/10.1186/s13569-016-0047-1>
12. Samoyo PTK, Nkya GZ, Minja FG, Temu RJ. Clinicopathological guide to malignant bone tumours: A retrospective analysis of the cancer registry at Kilimanjaro Christian Medical Centre in northern Tanzania. *East Cent African J Surg*. 2018 Feb 28;22(2):24.
13. Bajpai J, Khanna N, Vora T, Gulia A, Laskar S, Puri A, et al. Analysis of bone and soft-tissue sarcomas registered during the year 2012 at Tata Memorial Hospital, Mumbai, with clinical outcomes [Internet]. Available from: www.indianjcancer.com/printarticle.asp?issn=0019509X;year=2018;volume=55;issue=1;spage=37;epage=44;aulast=Bajpai
14. Aina OJ, Adelusola KA, Orimolade AE, Akinmade A. Histopathological pattern of primary bone tumours and tumour-like lesions in Ile-Ife, Nigeria. *Pan Afr Med J*. 2018 Apr 2;29.

Teshale Lodamo, Abiy Worku, Tilahun Desta, Tariku Shimelis, Natan Wondwossen Elssa.
Ethiop Med J, 2020, Vol. 58, Supp. 3

ORIGINAL ARTICLE

PATTERN OF PEDIATRIC FEMUR SHAFT FRACTURES IN A TERTIARY HOSPITAL, ADDIS ABABA, ETHIOPIA

Teshale Lodamo, MD¹, Abiy Worku, MD¹, Tilahun Desta, MD¹, Tariku Shimelis, BA, Msc², Natan Wondwossen Elssa, MD³

ABSTRACT

Introduction: Femoral shaft fractures represent the most common pediatric orthopedic injury that requires admission to the hospital. The epidemiology of femur shaft fractures is well described in literature from developed countries. However, abundant studies are not available on pediatric femur shaft fractures in resource-limited areas like the sub-Saharan Africa.

Objective: To determine pattern of pediatric femur shaft fractures at Addis Ababa Burn Emergency and Trauma Hospital.

Methods: Institution-based retrospective cross-sectional study was used. All medical records of pediatric patients with femur shaft fractures, who were treated between September, 2015 and August, 2018 were reviewed. Medical records with incomplete data were excluded. Data abstraction format was applied to collect data. The data was then entered and analyzed using SPSS version 20.0.

Result: Ninety-one patients who had femur shaft fractures were reviewed in the study. Males were 67 (73.6%). The most commonly affected age group was 6-12 years in 40(44%); the mean age being 8.8 years. Majority of the fracture were due to fall (41.8%). Most fractures occurred in June to August (36.3%). Left side was involved in 45(49.5%) cases. Eighteen patients (19.8%) had associated injury; head injury being the commonest, 7(38.9%). Closed fracture was the commonest type 84(92.3%). Traction followed by spica was the commonest treatment modality (28.6%). The mean length of hospitalization was 15.3 days.

Conclusion: The most affected age group was 6-12 years. Fall accidents predominated as the etiology. Most of the fractures were closed type. Conservative management was mostly used.

Key Words: Pediatric, femur shaft, fracture, pattern

INTRODUCTION

The Arbeitsgemeinschaft für Osteosynthesefragen (AO) definition of pediatric femur shaft is the area between the greater trochanter and the distal metaphyseal area (1). Femoral shaft fractures represent the commonest pediatric orthopedic injury that requires admission to the hospital (2, 3). The impact of pediatric femur shaft fracture is substantial physically, socially and psychologically to the affected children as well as the parents (4, 5).

Study findings in a Cameroonian tertiary center shows that 20% of pediatric fractures came across at surgical department are femoral fractures (6). Pediatric femoral fractures involve the shaft in 70% of cases (7). They are common amongst male (3, 8-12). In an English epidemiologic study done between 1991 and 2001, the fracture rate in boys was greater than that of girls, ranging from a ratio of 1.6:1 at the age of 11 to a ratio of 4.7:1 at the age of 14 (10).

In another study done in Israel, boys to girl's ratio were 2.4: 1 (11). The incidence of the pediatric femoral shaft fractures is bimodal; the first peak is between the age of 2 and 4, the second peak is throughout adolescence (3, 8).

Causes of pediatric femoral fractures differ for different age groups of children. In sixty to eighty percent of cases the etiology of infants' and toddlers' femur fracture is abuse (13-15). Whereas, in school age children and adolescents, femoral fractures are mostly caused by road traffic injuries – ranging from 26% to 90% – and fall down injuries – ranging from 33% to 49%. (10, 12, 16-18) Stress fractures of pediatric femoral shaft are rare (19). So are pathologic pediatric femur fractures (20). An analysis of seasonal variation in many studies shows pediatric fractures are frequent during the summer; the time when schools are closed and children are involved in various physical activities (21).

¹Department of Orthopedic Surgery, St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia. ²St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia. ³Department of Orthopedic Surgery, School of Medicine, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia.
 *Corresponding Author E-mail: tilahundesta84@yahoo.com

A study done in Sweden showed that the incidence of pediatric femur shaft fractures is highest in March and August. In March sports accidents are responsible for the increase in incidence and in August the increase is caused by traffic accident (9). Multiple factors contribute to determine the best treatment modality: including the age of the child, the weight, the available resources, the fracture pattern and the presence of other life threatening trauma (22).

A panel of surgeons, from the American Academy of Orthopedic Surgeons, critically evaluated existing literature and attempted to devise treatment recommendations based on current best evidence (23). In a retrospective cross sectional study done in Brazil, non-operative management was choice of treatment for children below 6 years of age and operative management for those above 6 years of age (3). In a prospective cohort study done in Cameroon, conservative treatment was used in 87% of the cases (6).

Regarding Ethiopia, there is limited published data. A prospective study was done on treatment of adult (older than 16 years) femur shaft fracture using Perkins traction at Addis Ababa Tikur Anbesa Hospital (24).

Abundant studies are not available on pediatric femur shaft fractures in resource-limited areas such as the sub-Saharan African region (25). The authors' could not manage to find any published research on epidemiology of pediatric femur shaft fracture in Ethiopia.

PATIENTS AND METHODS

The study was done at St. Paul's Hospital Millennium Medical College (SPHMMC), Addis Ababa Burn Emergency and Trauma (AaBET) hospital, Addis Ababa, Ethiopia. It was institution-based retrospective cross-sectional study. All children treated in the hospital for femur shaft fractures in the three year period from September, 2015 to August, 2018 were eligible for recruitment into study. Patients' age should be between birth and 14 years. Patients with isolated hip fractures or physeal injuries were not included in this study.

Fracture is said to be closed when there is no physical contact between the fracture or the fracture hematoma and the outside environment. When the fracture was not described whether it was closed or open in a patients' medical record, it was considered as closed fracture. The data was collected using data collection templates. Five age groups were created to categorize the patients. Little modification of the categories

proposed by Kasser and Beaty was used. Group I: Birth to 6 months, group II: >6 months to 2 years, group III: >2 years to 6 years, group IV: >6 years to 12 years, group V: >12 years to 14 years.

The following data was collected using the template: socio-demographic data, causes of fracture, fracture type (Closed vs. Open), season in which fracture occurred, mode of treatment, duration of hospitalization. Data collection was done by trained orthopedic residents.

The collected data was checked for completeness. Then it was fed to SPSS version 20.0 and analysis was made. Data entry was conducted by a trained data clerk. Afterwards, the patterns of the femur shaft fracture were described using descriptive statistics.

The template was tested before the actual data collection in order to avoid any ambiguity. There was daily supervision. Patient medical records with unclear, incomplete data were not included in the study.

Ethical approval was attained from Institutional Review Board (IRB) of SPHMMC. Administration of Aabet Hospital asked to get permission to retrieve and review patients' medical records. Patients' medical data were kept confidential.

RESULTS

Ninety one patients with a total of 94 fractures met the inclusion criteria. The mean age of patients with pediatric femoral shaft fracture was found to be 8.8 years, with SD of 3.82 years and the median was 9 years. The age of patients ranged from 6 months to 14 years. Majority of the patients i.e. 40 (44%) were in >6 years to 12 years age group, followed by 29(31.9%) patients in >12 years to 14 years group.

There was male predominance with 67(73.6%) males and 24(26.4) females. The male to female sex ratio was 2.8: 1. Most of the patients 50 (54.9%) came from Oromia region. (Table 1).

Mechanism of injury: The commonest mechanism was fall 38(41.8%), followed by RTA 35(38.5%). RTA was leading cause fracture in >6 years of age (44.9%). Eight patients (8.8%) were found to have pathologic fracture as an etiologic factor. Six of them were caused by chronic osteomyelitis and two were due to bone tumor (Table 2).

Table 1: Sociodemography of Pediatrics patients with femur shaft fracture in SPHMMC, AaBET Hospital, Addis Ababa, Ethiopia (2015 - 2018)

Characteristics	Frequency	Percent (%)
Sex		
Male	67	73.6
Female	24	26.4
Total	91	100
Age Group		
Birth to 6 Months	1	1.1
>6 Months to 2 Years	2	2.2
>2 Years to 6 Years	19	20.9
>6 Years to 12 Years	40	44.0
>12 Years to 14 Years	29	31.9
Total	91	100
Address : Region		
Addis Ababa	26	28.6
Oromiya	50	54.9
Amhara	8	8.8
SNNPR	3	3.3
Somali	2	2.2
Afar	1	1.1
Benshangul-Gumuz	1	1.1
Total	91	100

Table 2: Mechanism of injury of Pediatrics patients with femur shaft fracture in SPHMMC, AaBET Hospital, Addis Ababa, Ethiopia (2015 - 2018)

Mechanism of Injury	Frequency	Percent (%)
Road Traffic Injury	35	38.5
Fall down Injury	38	41.8
Bullet Injury	2	2.2
Struck by falling object	4	4.4
Pathologic Fractures	8	8.8
Hit by stone	2	2.2
Other	2	2.2
Total	91	100

Seasonal distribution: Majority of the fractures 33 (36.3%) occurred in a season of Sene-Nehassie/Pagume (June to August: this is a season in Ethiopia when children are out of school). Number of patients with femur shaft fractures seen annually increased from 19 in 2008 E.C to 46 in 2010 E.C.

Side affected: Left femur was involved in 45 (49.5%) patients and right femur in 43(47.3%) patients. Three patients had bilateral femur shaft fracture.

Associated injury: In addition to femur shaft fracture 18(19.8%) patients had another injury. Majority, 7(38.9%) had head injury. (Table 3)

Table 3: Associated injury of Pediatrics patients with femur shaft fracture in SPHMMC, AaBET Hospital, Addis Ababa, Ethiopia (2015 - 2018)

Associated Injury	Frequency	Percent (%)
Head	7	38.9
Pelvis, acetabulum	1	5.6
Upper limb	4	22.2
Lower limb	6	33.3
Total	18	100

Type of fracture: Most of the fractures 84(92.3%) were closed. (Figure 1)

Mode of definitive treatment: Overall, traction followed by hip spica was the most frequently 26 (28.6%) used treatment method. The second was Rush rod 25(27.5%). (Figure 2)

All patients in age group I and II were treated conservatively (hip spica). In age group III traction followed by hip spica was the commonest method. SIGN intramedullary nail was the most frequently (41.4%) used treatment method in age group V. (Table 4)

Length of hospitalization: Duration of hospitalization ranges from 3 days to 90 days. The mean was 15.3.

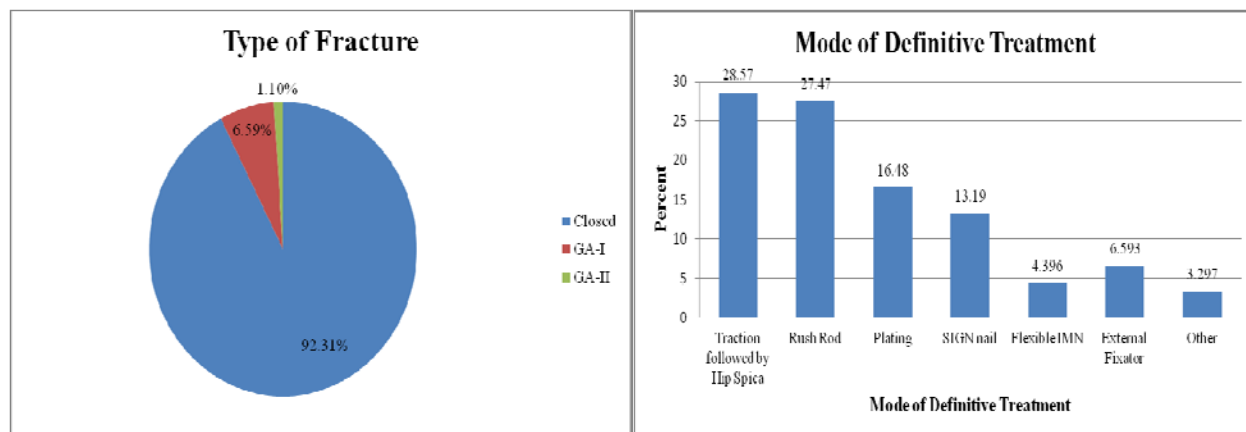


Figure 1: Type of fracture of Pediatrics patients with femur shaft fracture in SPHMMC, AaBET Hospital, Addis Ababa, Ethiopia (2015 - 2018).

Figure 2: Mode of treatment of Pediatrics patients with femur shaft fracture in SPHMMC, AaBET Hospital, Addis Ababa, Ethiopia (2015 - 2018).

Table 4: Therapeutic pattern by age category of Pediatrics patients with femur shaft fracture in SPHMMC, AaBET Hospital, Addis Ababa, Ethiopia (2015 - 2018)

	Mode of Treatment (%)							
	Traction followed by Hip Spica	Rush Rod	Plating	SIGN nail	Flexible IMN	External Fixator	Other	Total
Group I: Birth to 6 Months	100							100
Group II: >6 Months to 2 Years	100							100
Group III: >2 Years to 6 Years	84.2				5.3	10.5		100
Group IV: >6 Years to 12 Years	15	42.5	30		2.5	5	5	100
Group V: >12 Years to 14 Years	3.4	27.6	10.3	41.4	6.9	6.9	3.4	100

DISCUSSION

The study involved a total of 91 patients and the result showed that male to female ratio was 2.8: 1. Other similar studies have also shown male preponderance in pediatric femur shaft fractures (3, 9, 10, 11). The mean age for pediatric femur shaft fracture in this study was 8.8 years and it is within the range that other studies have found (3, 11). The commonest age group for pediatric femur shaft fracture was 6 years to 12 years. However, other studies showed bimodal age distribution (12).

The main mechanism of injury was fall (41.8%), consistent with findings obtained in Cameroon (2, 6). The study done in England also reported that falls accounted for majority of femur shaft fractures (10). The study result showed that incidence of pediatric femur shaft fracture has its peaks in Sene-Nehassie/Pagume (June to August).

This may be explained by Sene-Nehassie being a season in Ethiopia when students are out of school. Children during this season (particularly July and August) are frequently involved in different sport activities, play different games. This probably increases risk of fracture. The study done in Sweden found that fracture peaks in March and August. In March sports accidents are responsible for the increase in incidence and in August the increase is caused by traffic accident. (9).

The annual number of pediatric patients with femur shaft fractures seen in our hospital increased from 19 in 2008 E.C (2015 / 2016) to 46 in 2010 E.C (2017 / 2018). This could be due to increased awareness of the community and local health facility to refer to our hospital, which was opened recently in August 2015. The other explanation could be relative advancement of the hospital service over the last three to four years.

In this study 18 patients had associated injuries, in addition to the femoral fracture. Head injury was the commonest 7 (38.9%). Six patients had lower limb injuries. The study done by Rajesh K et.al. showed similar finding: head injury was the commonest associated injury, followed by tibial fracture (26). Similarly head trauma was the commonest injury (16%) associated with femur shaft fractures in Saudi Arabian trauma center (27).

This study result indicated that majority of femur shaft fractures 84(92.3%) were closed. The proportion of open fracture (7.7%) was comparable with similar studies (3).

Non operative treatment was the most commonly applied method of treatment (28.6%) in this study. This could be lack of adequate appropriate instruments. Similar study from Cameroon showed that non-operative treatments are the commonest choice of treatment (6). Whereas, a study in Brazil revealed that the choice of treatment varies depending on the age of patients (3).

In our study duration of hospitalization was long. The mean was 15.3 days. This could be due to multiple reasons; including lack of operating time and table, lack of standard fixation method, lack of active disposal of patients from the emergency OPD to the ward or to the OR. A study from Sweden reported that duration of hospitalization has decreased from 26 days to 5 days in 18 years period as operative treatment became rampant (9).

Limitation of the study: The study was retrospective by reviewing patients' medical records. Incomplete data from chart was a problem in obtaining information. There was no report of child abuse as a cause of pediatric femur shaft fracture in this study; however, in literatures it is not uncommon to get fractures secondary to child abuse (13-15).

REFERENCES

1. Slongo TF, Audige L, Group AOPC. Fracture and dislocation classification compendium for children: the AO pediatric comprehensive classification of long bone fractures (PCCF). *J Orthop Trauma* 2007; 21(10 Suppl): 135-160.
2. World Report on Child Injury Prevention World Report on Child Injury Prevention 2008. Geneva: World Health Organization; 2008.
3. Hoffmann CR, Traldi EF, Posser A. Epidemiological study of children diaphyseal femoral fractures. *Rev Bras Ortop Engl Ed* 2012; 47(2): 186-190.
4. Hinton RY, Lincoln A, Crockett MM, Sponseller P, Smith G. Fractures of the femoral shaft in children. Incidence, mechanisms, and sociodemographic risk factors. *J Bone Joint Surg Am* 1999; 81(4): 500-509.
5. Sela Y, Hershkovich O, Sher-Lurie N, Schindler A, Givon U. Pediatric femoral shaft fractures: treatment strategies according to age, 13 years of experience in one medical center. *J Orthop Surg* 2013; 8: 23-25.
6. Tochie JN, Guifo ML, Yamben MN, Moulion R, Farikou I. A Prospective Cohort Study of the Therapeutic Patterns, Challenges and Outcomes of Paediatric Femoral Fractures in a Cameroonian Tertiary Center. *Open Orthop J* 2017; 11: 29-36.
7. Flynn JM, Schwend RM: Management of pediatric femoral shaft fractures. *J Am Acad Orthop Surg* 2004, 5:348-359.

Conclusion: The pediatric patients with femur shaft fracture at AaBET hospital were mainly males. The mostly affected age group was between 6 years and 12 years. Majority were from Oromia region. The commonest etiology was fall down injury. Closed type of femoral shaft fractures is predominant.

The season with most incidences was June to August. The number of patients seen annually was increasing. Head injury was the most common associated injury. The treatment most used was conservative.

Recommendations: Development of safety guidelines: safe playing ground for children at home and school to prevent fall accidents. Implement road traffic policies which can decrease road traffic injuries. We recommend increasing surgical treatment option, establishing orthopedic services in other hospitals to reduce duration of hospitalization. We also recommend deployment of Electronic Health Record System to prevent losses of important health information.

ACKNOWLEDGEMENT

We would like to thank the Department of Orthopaedics and Traumatology, SPHMMC, AaBET Hospital. Our thanks also extend to all the residents, nurses and the supportive staff from the chart documentation room for assisting us during the period of data collection.

Competing of Interest: There is no conflict of interest to declare.

Funding: The research was funded by St. Paul's Hospital Millennium Medical College.

8. Brown D, Fisher E. Femur fractures in infants and young children. *Am J Public Health* 2004; 94(4): 558-560.
9. Von Heideken J, Svensson T, Blomqvist P, HaglundÅkerlind Y, Janarv P-M. Incidence and trends in femur shaft fractures in Swedish children between 1987 and 2005. *J Pediatr Orthop* 2011; 31(5): 512-519.
10. Bridgman S, Wilson R. Epidemiology of femoral fractures in children in the west midlands region of England 1991 to 2001. *J Bone Joint Surg Br* 2004; 86(8): 1152-1157.
11. Sela Y, Hershkovich O, Sher-Lurie N, Schindler A, Givon U. Pediatric femoral shaft fractures: treatment strategies according to age - 13 years of experience in one medical center. *J Orthop Surg Res* 2013, 8: 23-28.
12. Mughal MA, Dix-Peek SI, Hoffman EB. The epidemiology of femur shaft fractures in children. *SA Orthop J* 2013; 12(4): 23-27.
13. Beals RK, Tufts E. Fractured femur in infancy: The role of child abuse. *J Pediatr Orthop* 1983; 3(5): 583-586.
14. Blakemore LC, Loder RT, Hensinger RN. Role of intentional abuse in children 1 to 5 years old with isolated femoral shaft fractures. *J Pediatr Orthop* 1996; 16(5): 585-588.
15. Coffey C, Haley K, Hayes J, Groner JI. The risk of child abuse in infants and toddlers with lower extremity injuries. *J Pediatr Surg* 2005; 40(1): 120-123.
16. Daly KE, Calvert PT. Accidental femoral fracture in infants. *Injury* 1991; 22(4): 337-338.
17. DeLee JC, Clanton TO, Rockwood CA Jr. Closed treatment of subtrochanteric fractures of the femur in a modified cast-brace. *J Bone Joint Surg Am.* 1981; 63(5): 773-779.
18. Akinyoola A L, Orekha O O, Taiwo F O, Odunsi A O. Outcome of non-operative management of femoral shaft fractures in children. *Afr J Paediatr Surg* 2011; 8: 34-39.
19. Harvey AR, Bowyer GW, Clarke NMP. The management of paediatric femoral shaft fractures. *Curr Orthop* 2002; 16(4): 293-299.
20. Ortiz EJ, Isler MH, Navia JE, Canosa R. Pathologic fractures in children. *Clin Orthop Relat Res* 2005; 432: 116-126.
21. Cheng JC, Ng BK, Ying SY, et al. A 10-year study of the changes in the pattern and treatment of 6,493 fractures. *J Pediatr Orthop* 1999; 19(3): 344-350.
22. Kocher MS, Sink EL, Blasler RD, et al. American Academy of Orthopaedic Surgeons clinical practice guideline on treatment of pediatric diaphyseal femur fracture. *J Bone Joint Surg Am* 2010; 92(8): 1790-1792.
23. Treatment of pediatric diaphyseal femur fractures: Evidence-based clinical practice guideline, American Academy of Orthopaedic Surgeons, 2015.
24. Bezabih B, Wamisho BL, Maxime JM. Coles Treatment of adult femoral shaft fractures using the Perkins traction at Addis Ababa Tikur Anbessa University Hospital: The Ethiopian Experience. *Int surg* 2012; 97: 78-85.
25. Onche I, Igo A. Femoral shaft fractures: management and outcome in Nigerian children. *Afr J Paediatr Surg* 2007; 4(1): 33-36.
26. Ambulgekar RK, Kandolkar P, Kale M. To assess the epidemiology of fracture shaft of femur in children age more than 3 years and less than 13 years. *Natl j med dent res* 2016; 5(1): 12-15.
27. Mohammedthani TS, Alfraid TA, Sonbol AM, Almulla AA, Hetaimish BM, Alrashidi YA. Prevalence of Femoral Shaft Fracture and Associated Injuries among Children after Road Traffic Accidents in a Saudi Arabian Trauma Center. *J Musculoskelet Surg Res* 2018; 2(2): 66-70.

ORIGINAL ARTICLE

COMPARISON OF COMPUTERIZED AND MANUAL RATING OF PERMANENT PHYSICAL DISABILITY FROM MUSCULOSKELETAL INJURY, BLACK-LION HOSPITAL, ETHIOPIA

Biruk Lambisso Wamisho, MD, FCS

ABSTRACT

Introduction: Whole Person Disability (WPD) evaluation is a difficult task done finally after treatment of an injured person. To avoid subjectivity, to exercise transparency and to calculate quickly, computer software applications are of potential use. Rating calculations shall be well reproducible and reliable.

Objective:

This study aims at comparing Permanent Physical Disability Rating using the software developed and doing it manually to award percentage WPD to applicants with Musculoskeletal (MSK) injury.

Methods:

Prospective study of all MSK injured applicants of permanent whole person disability evaluation was performed in Black-Lion Hospital (TASH) from Sept 2017-Sept 2019. Evaluation of Permanent Physical disability from injury was done after the time of Maximum Medical Improvement (MMI). A questionnaire, request letters, board letters, software database, and the Hospital's charts were used to gather information. Analyses and statistical testes were done.

Results: Only a fifth of the applicants were female. Majority of applicants came from Addis Ababa (219, 54.75%). Peak age group affected was 20-29 years (151, 37.75%). Road Traffic Crushes (256, 64%) & falls (57, 14.25%) caused most of the injuries. Mostly, law enforcement personnel requested the evaluation (155, 38.75%). Most, (260, 65%) were TASH patients and 102 (25.5%) of applications came from Private Hospitals in the Capital. Lower limb was the most injured region (258, 49.2%). Occurrences of multi-injury and poly-trauma respectively were (85, 20.8%) & 20(5%). There was only fair agreement (71%) between the two rating methods with Cohen's Kappa $K=0.217$.

Conclusions: Software based computerized WPD rating is better than manual method.

Keywords: Permanent Physical Disability, MSK injury, %WPD, WPI, MMI, Computerized Rating

INTRODUCTION

In Ethiopia, according to WHO estimate, around 18% of the country's population has some disability. W.H.O also defines disability as any restriction of ability to perform an activity in the manner or within the range considered normal for a human-being. It is a gap between what a person can do and he needs to do. American Medical Association (AMA) defines Disability, as a condition that interferes with individual's activities of daily living. Calculated disability-percentages are used to estimate the degree to which an individual's capacity to carry out daily activities are diminished (1). Such calculation has to be done carefully, comprehensively and in a transparent scientific way.

The two models of disability are the Medical and the Social models; Concept of Impairment vs. Disability derives from what is often referred to as the Social Model of Disability.

The Social Model is in opposition with the Medical Model of disability. This view states that a physically impaired person becomes disabled as a result of the society (2). These days, issues related to disability are crucial Human Rights agenda. Women with disabilities are discriminated against on two grounds: gender and disability, and often they have less access to essential services such as health care, education and vocational rehabilitation (3).

Changes in lifestyle, urbanization and socio-economic developments in recent decades have caused changes in disease and disability patterns due to rise in incidence of non-communicable disease and injury among the youth in developing countries (4, 5). Globally, injury has become a recognized health problem with a steadily increasing trend.

¹Associate Professor of Orthopaedic Surgery, Addis Ababa University.
Corresponding Author E-mail: lbiruklw@yahoo.com

According to WHO and World Bank projections, injury is likely to account for 20% of the disease burden on the world population by 2020, with road traffic accidents (RTA) alone being the third leading cause (6-11). Recent increases in injury are observed. This is mainly due to explosive increases in Industrialization, Urbanization and motorization in counties like ours (12-17). Pattern of musculoskeletal disability differ from place to place and from time to time. Promoting Research and Empowering patients to participate in their care and implementing cost-effective preventive measures to improve prevention and treatment of disease is a priority in any health system (18-20).

National Surveys are crucial to identify magnitude and pattern of different major causes of physical disability in a country: E.g. Injuries from traffic, construction, machines, chemicals radiation, natural disaster and conflicts. This helps to introduce planned interventions and gives an insight to policy makers. In Ethiopia, injury is a major health problem accounting for more than a quarter of all surgical admissions, deaths or disabilities (21-23). In the past decade, Sub-Saharan Africa reported to have 42% increases in the road fatalities and road traffic accidents are the commonest causes of trauma in urban Ethiopia with 199 fatalities per 10,000 registered vehicles per year. Traffic injuries in Ethiopia account for the deaths of 37.28 persons per 100,000. This is 2.8% of the total deaths in the country, placing Ethiopia 12th in the world. (24-25).

One way to evaluate the final outcome of a treatment is to assess the remaining disability at the end of treatment. Hence, this study could additionally give an insight to the acceptability of the different MSK injury treatments offered to the WPD applicants when they were patients.

METHODS

Setting: This is prospective study, part of a multi thematic national project funded by Ethiopian Ministry of Innovation & Technology (MiNT). Addis Ababa University, College of Health Sciences, School of Medicine, Department of Orthopedics, Disability Rating Board, Black-Lion Hospital.

Participants: Applications for MSK permanent disability were received by our Hospital from all over Ethiopia. Most ratings are done at MMI, which is 1 year after injury and we included only those. The following were the other inclusion criteria: Every eligible applicant that came for routine permanent physical disability evaluation by the Orthopaedic board of TASH and awarded a written percentage WPD in the period Sept 2017-Sept 2019. .

After the manual rating was done on Thursday board meetings of 3-5 Orthopaedic consultant experienced in disability rating, computerized re-rating, using same injury variables and structures was done using the software developed by the project in the Department. Both percentages were recorded separately. Discrepancies were settled at board's discussion. We addressed only permanent physical MSK disability, other forms of disabilities like mental and sensory disability were not included.

Sampling: All applicants with awarded percentage WPD were taken. If percent is not given, they are not.

Measures: Data on socio-demographic variables, causes of injury, who requested the evaluation, anatomic region affected, and details of final percentage disability awarded was collected.

How do Orthopaedic boards perform permanent MSK disability rating?

This is an experienced group of 3-5 highly senior Orthopaedic staff surgeons who have been rating physical disabilities for over three decades. The permanent whole person disability evaluation was done after the time of (Maximal Medical Improvement) MMI, which is after 12 Months post-surgery or post-injury. Referred applicants from all over the country were also evaluated. After clinical and imaging evaluation, manual rating was done and percentage WPD was given to the applicant in a printed, stamped formal letter. Every patient's percentage WPD was re-rated using a computer software developed by the project. Discrepancies and combined ratings in poly and multi-trauma were discussed with the board. Additional information was gathered directly from the consenting patients, board letters, request letters, software database, and the Hospital's charts as well.

The Disability Rating Computer Software: This is an Ethiopian Software developed by our project funded and inaugurated by Ministry of Innovation and Technology (M In T). It rates and awards percentage physical disability related to the lower limb (L.L) or the whole person (WPD). The software will soon be used nationally.

Ethical approval: Ethical clearance was secured from our College's IRB.

Statistical analysis: The data were collected using epidata version 3.1 and analyzed with SPSS version 12. Descriptive analysis and statistical agreement testes were done. A P-value of less than .05 at CI 95% was considered statistically significant.

RESULTS

Most applicants in this study were men (317, 79.25%). The age range was 1-82 years making age average 33 years. Patients came from all regions of Ethiopia, Addis Ababa- the capital contributing for more than half (219, 54.75 %). The other socio-demographic characteristics of the applicants are presented on **Table 1**. Treatment place for most (260, 65%) was Black-lion Hospital (TASH) and the remaining (140, 35%) WPD evaluation applications were filed for patients we never treated or followed at all. Of these, 102 (25.5%) of applications came from Private Hospitals in the Capital and the remaining requests came from other government & private Hospitals scattered all over Ethiopia.

Fig 1 shows only 8 (2%) requests were personal applications. The predominant (256, 64%) cause of Permanent physical MSK disability was Road Traffic Crash (RTC). **Figure-2** presents the remaining major causes of physical disability from injury we identified: Falls from height, construction or while walking (57, 14.25%); machine injuries (40, 10%), assaults with bullets, stone or stick (21, 5.25%) and injury from falling heavy object (18, 4.5%) were the major causes.

Table-2 depicts the Anatomical regions injured and the complexity as well. Most injuries (303, 74.2%) were isolated. Multiple injuries accounted for 85 (20.8%) of the applications and 20 (5%) applicants had poly-trauma. Eight poly-trauma claimants also had multiple injury. Lower extremity region remains the most injured region in WPD claimants (258, 49.2%) while upper limb was injured in (178, 34%) of applicants. Pelvis and Acetabulum injury was encountered in 48 (9.2%) of the assessments.

Figure-3 portrays the agreement in awarded WPD percentage using both rating methods: computerized and manual. Both methods agreed and awarded same percentage (within + 2% the WPD) in 284 (71%) of the evaluations. This is only a fair agreement with Cohen's Kappa statistical coefficient = 0.34. The Chi-square statistic is 4.79 with P-value .029. This difference between the two rating methods is statistically significant at $p < .05$.

Table 1: Socio-demographic characteristics of WPD evaluation applicants with MSK injury. Sept 2017 - Sept 2019, Black-lion Hospital (TASH), Ethiopia

Variable	Frequency (N=400)	Percentage (%)	
Sex of patients	Male	317	79.25%
	Female	83	20.75
Age Categories of the Applicants	<10 Years	10	2.5%
	10-19	22	5.5
	20-29	151	37.75
	30-39	79	19.75
	40-49	67	16.75
	50-59	27	6.75
	60-69	15	3.75
	70-79	5	1.25
	>80 Years	1	0.25
Address: (Administrative Regions/Cities in Ethiopia)	Addis Ababa	219	54.75%
	Oromia	95	23.75
	Amhara	58	14.5
	SNNPR	15	3.75
	Tigray	5	1.25
	Afar	3	0.75
	Somali	1	0.25
	Dire Dawa	1	0.25
	Harari	1	0.25
	Benshangul-Gumiz	1	0.25
	Gambella	1	0.25

Table 2: Anatomical region & multiplicity of MSK injury in applicants of WPD evaluation and rating. Sept 2017 - Sept 2019, Black-lion Hospital (TASH), Ethiopia

Variable		Frequency	Percentage (%)
Multiplicity of Injury *(N=408)	Isolated Fracture	303	74.2%
	Multiple Fractures	85	20.8%
	Poly-Trauma	20	5%
Anatomical MSK region/s Injured (N=520 Regions)	Lower Limb	258	49.2%
	Upper Limb	13	34%
	Pelvis & Acetabulum	8	9.2%
	Shoulder Griddle	6	4.6%
	Spine	5	1.7%
	Rib Cage	4	1.3%

*N.B. Eight poly-trauma applicants also had multiple injuries.

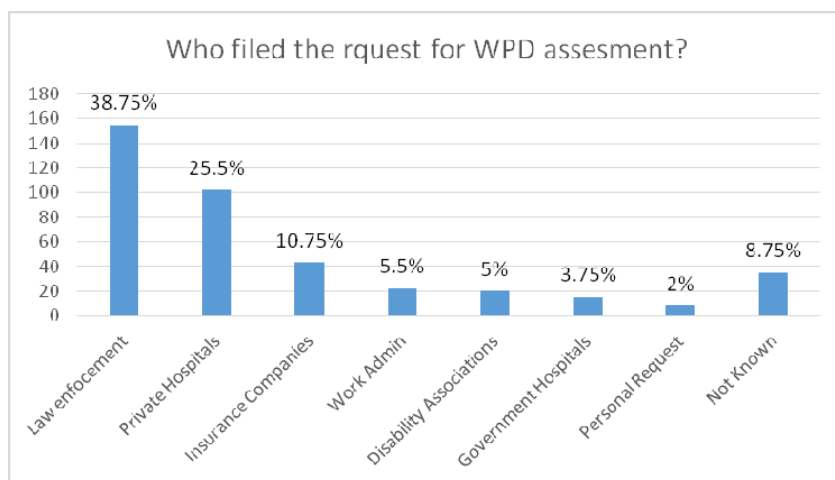


Figure 1: Distribution of who requested WPD evaluation of applicants with MSK injury. Sept 2017 - Sept 2019, Black-lion Hospital (TASH), Ethiopia

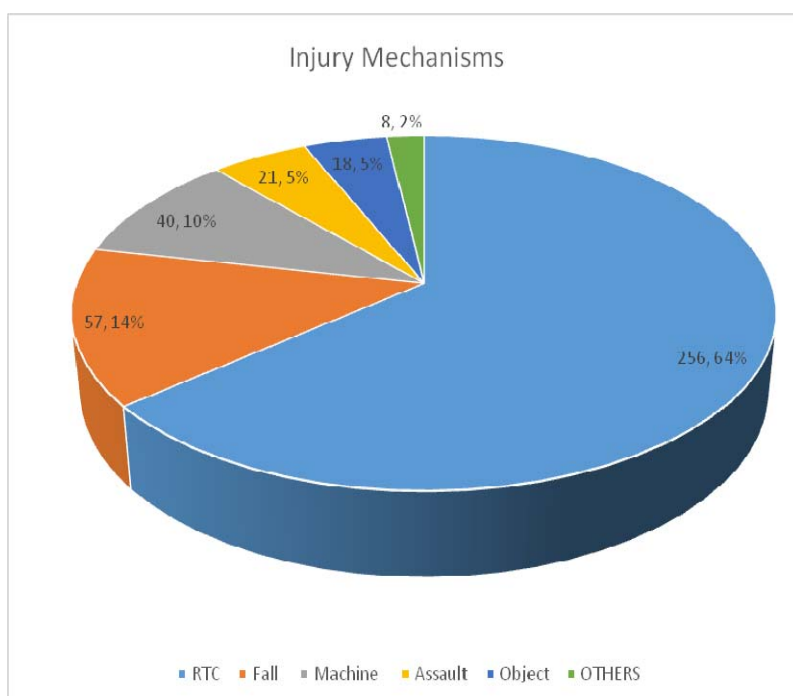


Figure 2: Distribution of causes of injury of applicants of WPD evaluation from MSK injury. Sept 2017 - Sept 2019, Black-lion Hospital (TASH), Ethiopia

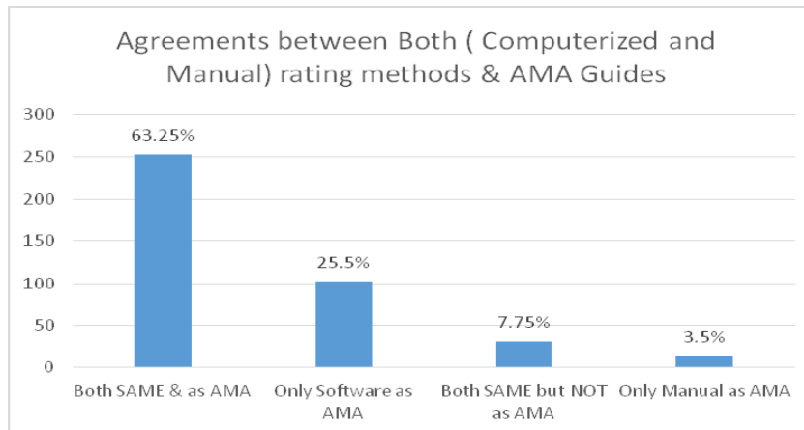


Figure 3: Agreements between WPD Percentages awarded for applicants of MSK injury rated using both manually and with the software developed and compared to American Medical Association (AMA) guides. Sept 2017 - Sept 2019, Black-lion Hospital (TASH), Ethiopia

DISCUSSION

Documented Permanent MSK WPD evaluation and rating in injured Ethiopian civilians started in 1988 (24). Until recently, the orthopaedic Department at AAU, CHS, SOM, in Black-lion Hospital was the only centre to do such impairment ratings in Ethiopia, receiving applications from all over the country.

Most applicants in this study were men (317, 79.25%) and this can be explained by the fact that higher number of males are injured by the main causes of injury in Ethiopia (26). Men may also have a better access to law enforcement and insurances. The age range was 1-82 years, showing us disability affects all age groups. The highly affected was a younger age group 20-29 years. Over 80% the affected applicants were from working age group revealing that the impact of disability on economically active group is enormous. This is similar to other studies where Road Traffic Crush (RTC) is disproportionally higher major cause of physical permanent disability (27, 28).

Applicants came from all regions of Ethiopia, Addis Ababa- the capital contributing for more than half (219, 54.75 %). This finding suggests that WPD evaluation and rating services have to be established in many Hospitals across Ethiopia. After proper training of the staff, such service can be started and could save time and money of the applicants travelling to the Capital from all corners of the country.

Higher body decision has to be made to authorize selected/specific Hospitals who could evaluate disability and award WPD. The developed software makes such practices much easier. It is better if the patient is evaluated for WPD in the Hospital where he/she was treated and all medical documents including imaging are available. Most of the referral documents are incomplete. In line of this, we also found that even though the treatment place for most (260, 65%) applicants was Black-lion Hospital (TASH),

the remaining (140, 35%) WPD evaluation applications were filed for patients we never treated or followed at all. Huge number of referrals! Of these, 102 (25.5%) of applications came from Private Hospitals in the Capital and the remaining requests came from other government & private Hospitals scattered all over Ethiopia. With proper training and authorization, all these Hospitals could be capable of physical disability rating in the injured. Only 8 (2%) requests were personal applications as such applications are discouraged. There has to be a reason and official request by a letter to award WPD. These written requests mainly come from law enforcement, insurance or work place administration.

The predominant (256, 64%) cause of permanent physical MSK disability was Road Traffic Crush (RTC). Like RTC, the other main causes of injury we saw were also preventable: Falls from height, construction or while walking (57, 14.25%); machine injuries (40, 10%), assaults with bullets, stone or stick (21, 5.25%) and injury from falling heavy object (18, 4.5%). This remained the same for many years in our Hospital (24). In Ethiopia, population survey showed that 73.4% of RTC victims spend from a week to half a year off their regular activities. (26)

Most injuries (303, 74.2%) were isolated major bone fractures. This could be explained by the fact that our Hospital is the highest tertiary referral Hospital in Ethiopia mainly receiving difficult injuries. Multiple injuries accounted for 85 (20.8%) of the applications and 20 (5%) applicants had poly-trauma. Eight poly-trauma claimants also had multiple injury. Lower extremity region remains the most injured region in WPD claimants (258, 49.2%) while upper limb was injured in (178, 34%) of applicants. Considering the fact that most applicants were RTC victims, this is consistent with other studies and international data (24, 29).

Pelvis and Acetabulum injury was encountered in 48 (9.2%) of the assessments. This proportion has increased from previous observations. The possible explanations could be due to the fact that heavy trucks in Ethiopia are leading to high-speed deeper bone (Like Pelvis-Acetabulum) fractures or it could be due to the fact that in recent years, in our Department pelvis & Acetabulum surgeries are performed routinely (30). The WPD percentages awarded for pelvic fractures are usually lesser percentages.

The agreement in awarded WPD percentage using both rating methods: computerized and manual. Both methods agreed and awarded same percentage (within + 2% the WPD) in 284 (71%) of the evaluations. This is only a fair agreement with Cohen's Kappa statistical coefficient = 0.34. The Chi-square statistic is 4.79 with P-value .029. This difference between the two rating methods is statistically significant at $p < .05$.

Conclusion

There was statistically significant difference between the computerized and manual WPD rating.

The agreement between the two rating methods was only fair (71%).

The software based computerized rating we developed was quicker, transparent, objective, reliable, reproducible and better in agreement with international guides and standards.

Recommendation

The software developed is highly recommended for use in WPD rating and can be used all over Ethiopia.

ACKNOWLEDGEMENTS

I acknowledge all the Orthopaedic Surgeons working hard every minute trying to avoid or lessen permanent disability following injury. I thank the Orthopaedic department and its board members for running a well-developed WPD rating clinic for over three decades.

I thank our Ministry of Innovation and Technology (M in T, formerly MoST) for funding this research.

Competing interests

There are no any competing interests.

REFERENCES

1. American Medical Association. Guides to the evaluation of permanent impairment. 6th edition 2009.
2. Alliance for inclusive education. Allfie's website accessed on April 5, 2010: <http://www.allfie.org.uk/pages06/about/models.html>
3. Sue A. Ferguson, PhD, and William S. Marras, PhD. Revised Protocol for the Kinematic Assessment of Impairment. The Spine Journal 2004; 4. No (2)163-169.
4. Deen JL, Sharon TV, Huttly RA, Tulloch J. Injuries and non-communicable diseases: emerging health problems of children in developing countries. Bull WHO 1999;7(6):518-24
5. World Health Organization. Injury a leading cause of the global burden of disease, World health Report. Dr E. Krug. Geneva, WHO 1999.
6. Murray, Christopher J. L, Lopez, Alan D, World Health Organization, World Bank & Harvard School of Public Health. The Global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020. 1996;1: 1-16
7. <http://www.who.int/world-healthday/>
8. <http://www.worldortopedicconcern.org>
9. <http://www.hvousa.org>
10. <http://www.icoe.aoassn.org>
11. Nordberg E. Injuries in Africa: a review. East Afr Med J 1994; 71 (6): 339-5.
12. Massey B, Andrew H. The burden of orthopaedic disease in developing countries. J Bone Joint Surg (Am) 2004;86-A: 1819-22.
13. World Health Organization. Investing on Health Research and Development; report of the Ad-Hoc committee on Health Research to Future Intervention options. Geneva, 1996.
14. Zwi A. The public health burden of injury in developing countries. Trop Dis Bull 1993; 90:5-45.
15. Smith GS' Brass p. Unintentional injuries in developing countries. The Epidemiology of a neglected problem. Epidemiol Rev 1991; 13:228-266.
16. Faechem R et al. The health of adults in the developing world. New York, Oxford University Press. 1992.
17. Omran A. R, The Epidemiologic transition: A theory of the Epidemiology of population change, Milbank Q. 1971; 49: 509-538.
18. Brudthland GH, The burden of musculoskeletal condition at the start of new millennium, WHO scientific group in collaboration with Bone and Joint Decade Geneva 2000.

19. Hunerford DS, Book reviews. Outline of Orthopaedics, J Bone Joint Surg. (Br) 1991; 73-B (3): 527-529.
20. Editorial. World Health organization. Bone and Joint Decade at the start of new millennium, prospective of developing countries. JIRA 2000; 8(1): 16-8.
21. Osman M, Yegzaw K, Sissay A. Magnitude and pattern of injuries in North Gondar administrative zone, North East Ethiopia, Ethiop Med J 2003; 41: 213- 20.
22. Ephrem D. et. Al. Analysis of surgical admissions in the Ethio-Swedish children's Hospital in Addis Ababa, Ethiop Med J 1990; 28: 15-22.
23. Habte G. et. Al. Analysis of admissions to Gondar Hospital in North Western Ethiopia, Ethiop Med J 1976; 14: 49-59.
24. Biruk L. Wamisho. Permanent Civilian Musculoskeletal disability following injury-17 Year trends. East and Central African Journal of Surgery 2006; 11(1):41-48
25. Persson A. Road traffic accidents in Ethiopia: Magnitude, causes and possible interventions. Advances in Transportation Studies 2008; 15: 5–16.
26. Abegaz T, Gebremedhin. Magnitude of road traffic accident related injuries and fatalities in Ethiopia. PLoS ONE 2019;14(1): e0202240.
27. Mohan D. Road safety in less motorized environments: Future concerns. Int J Epidemiol 2002; 31: 527–532.
28. Nantulya V, Reich M. The neglected epidemic: Road traffic injuries in developing countries. BMJ 2002; 324: 1139–1141.
29. Agrawal-Harding KJ, Meara JG, Greenberg SL, Hagander LE, Zurakowski D, Dyer GS. Estimating the global incidence of femoral fracture from road traffic collisions: a literature review Bone Joint Surg Am 2015; 97(6): e31
30. Gebresenbet RF, Aliyu AD. Injury severity level and associated factors among road traffic accident victims attending emergency department of Tirunesh Beijing Hospital, Addis Ababa, Ethiopia: A cross sectional hospital-based study. *PLoS One*. 2019;14(9): e0222793

ORIGINAL ARTICLE

PREVALENCE OF DELAYED PRESENTATION OF OPEN LONG BONE FRACTURE PATIENTS AT TWO ETHIOPIAN TERTIARY HOSPITALS

Samuel Hailu, MD^{1*}, Mengistu Gebreyohanes, MD²

ABSTRACT

Background: Clinical experience shows most patients with open long bone fractures present late in Ethiopia and is associated with poor outcome.

Objective: This study aims to assess the prevalence of delay in hospital presentation among patients with open long bone fractures.

Methods: This is a prospective observational sub-study of the ongoing Open Fracture Irrigation Study (OFIS), a randomized control trial (RCT) in progress at Tikur Anbessa and Hawassa University Hospitals. The data is extracted from the OFIS data registry into Microsoft Excel, then exported to SPSS version 25.

Result: A total of 301 open long bone lower extremity fractures were included. Men accounted for about 85%, with a mean age of 32 years. The most common injury mechanism was road traffic incidents in 171 (57%) patients, followed by a gunshot in 50 (16.6%) patients. The majority (71%) were Gustilo-Anderson grade III. About 85% of open fractures did not present to the hospital within the Lancet Commission on Global Surgery recommended 2 hours time frame. Similarly, once the patient presented to the hospital, more than 65% were not operated on within 24 hours of their presentation.

Conclusion: This study shows a significant delay among open long bone fractures in our set up from trauma to hospital arrival and arrival to operation. We recommend further research to identify factors responsible for open long bone fracture delayed presentation.

Keyword: open fracture, delayed presentation, Tikur Anbessa Specialized Hospital, Hawassa University Comprehensive Specialized Hospital, Addis Ababa University, Ethiopia

INTRODUCTION

According to the World Health Organization (WHO) report, about 5.8 million people die each year due to trauma. Trauma death accounts for 10% of deaths worldwide, which means 32% more than the number of fatalities that result from malaria, tuberculosis, and HIV/ AIDS combined (1). Several others are injured for every person who dies, many of them with permanent sequelae and disability. It is one of the emerging problems throughout the world. However, it has a more significant effect in low- and middle-income countries (LMIC) since approximately 90% of deaths due to injuries occur in countries with limited resources(1–3).

Trauma is one of the most common causes of preventable death in Ethiopia. Though the available data is limited, trauma accounts for 27% of emergency hospital visits. Almost half of the surgical emergency department visits to Tikur Anbessa Specialized Hospital (TASH) and Amhara region were due to trauma, with a prevalence of 55.6%(4). Among all the trauma, musculoskeletal trauma is the leading cause of severe long-term pain and physical disability, affecting millions worldwide.

In resource-limited settings, open long bone fracture is one of the most common conditions encountered during clinical activities. The management remains a significant challenge with devastating disability in the working adult age group. More than 20% of all adult fractures presenting to TASH were open fracture, and a considerable number (35%) of these occurs on the tibia. According to Gustilo- Anderson open fracture classification, 50% of the fracture was Gustilo grade III (33.3- IIIA, 13.9% - IIIB, and 2.7% was IIIC), followed by grade II (27.7%) and grade I (22.3%) respectively (5,6).

An open fracture is one of the emergency conditions faced by an orthopedic surgeon during practice. Timely and appropriate management of the open fracture is crucial for a good outcome. The pillars of open fracture treatment include initiation of high dose intravenous (IV) antibiotics, administration of tetanus prophylaxis, giving cocktails of analgesia which has a different mechanism of action, 'one look physical examination,' appropriate splinting and meticulous early lavage and debridement with skeletal stabilization in the operating theatre. Various studies suggest that giving high dose IV antibiotics according to the institutional protocol within 3 hours of the injury will significantly reduce subsequent infection risk.

¹Orthopedic Trauma and arthroplasty surgeon, Addis Ababa University, Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia.

²Orthopedic Surgeon, Hawassa University Comprehensive Specialized Hospital, Hawassa, Ethiopia

*Corresponding Author E-mail Address: Samuel.hailu@aau.edu.et / samiethio@gmail.com

Scholars advocate doing the 'one look physical examination' concept for all open fractures at the emergency room. One look examination entails opening the wound only once, taking a digital picture after taking verbal consent from the patients or families, and dressing it in saline-soaked gauze to prevent repeated wound exposure by different level of health professionals, including nurses and medical interns, residents (junior to senior) and consultants.

The index health professional needs to open the wound, take an appropriate picture, and share the image with other health care providers that are being consulted. Rather than exposing the wound repeatedly at the emergency department, this technique reduces the rate of contamination and significantly reduces the risk of infection(7–16).

To give the maximum timely care for open fractures, early presentation of patients with long bone fractures to a health care facility is critical. Our clinical practice and few studies done in resource-limited countries show most patients with open fractures present delayed to seek the appropriate care and end up with numerous complications, including prolonged hospital stay due to their delayed presentation (2,3). We used the Lancet Commission for global surgery definition of delay for open fracture in this study. The commission defines delay as presented to the hospital after 2 hours of trauma. (2,17).

Even though few publications exist on the trauma patients' delay to hospital admission in low- and middle-income countries, a significant number presented with a delay. According to Malawi's study, 34% of adult patients present delayed after their trauma (2). A prospective observational study conducted across 18 low- and middle-income countries by the International ORthopaedic MULTicenter Study in Fracture Care

(INORMUS) group showed 71.9% of open fracture patients were not admitted within 2 hours of the trauma (3). To our knowledge, this is the first study done on the prevalence of delayed presentation among patients with an open long bone fracture in our set up, and we hope it will be the benchmark for further study on this big problem in our set up.

PATIENTS AND METHODS

This study is part of the Open Fracture Irrigation Study (OFIS), an ongoing multicentre three-arm Randomized Control Trial (RCT) study aiming to assess silver diluted bleach's impact solution over normal saline in the prevention of infection among patients with open long bone fractures. We used the RCT screening data collected from August 23, 2018, to June 14, 2020, and recruited patients from Tikur Anbessa Specialized Hospital (TASH) and Hawassa University Comprehensive Specialized Hospital (HUCSH). The data is extracted from the OFIS data registry into Microsoft excel, which was then exported to SPSS version 25 for descriptive analysis. This study has ethical approval from both centers' institutional review board.

RESULTS

Socio-demographic characteristics:

A total of 301 open long bone fractures (femur and tibia) patients were presented at the two centers. One hundred eighty patients (60%) were from TASH, and about 85% of the patients were male with a male to female ratio of 5.4:1. The mean age was 32 (SD 14.23; 6 – 80) years. More than 75% of the patients affected were within the age of 18 to 45 years. Most of the patients were presented from Oromia 96 (31.9%), followed by SSNNPR 88 (29.2%) and Addis Ababa accounting 56 (18.6%)

Table 1: Socio-demographic characteristics of patients with an open long bone fracture from 2018 to 2020.

Characteristics		Frequency (n= 301)	Percentage (%)
Hospital where patients were managed	TASH	180	59.8
	HUCSH	121	40.2
Sex of patients	Male	254	84.4
	Female	47	15.6
Age of patients categorized (in Years)	less than 18	27	9
	18 to 25	96	31.9
	26 to 35	96	31.9
	36 to 45	34	11.3
	46 to 55	20	6.6
	56 to 65	22	7.3
	More than 65	6	2
Region where the patients presented	Addis Ababa	56	18.6
	Afar	8	2.7
	Amhara	30	10
	Benishangul Gumiz	2	0.7
	Dire Dawa	5	1.7
	Gambella	3	1
	Harari	8	2.7
	Oromia	96	31.9
	SNNPR	88	29.2
	Somalia	2	0.7
Tigray	3	1	

Mechanism of injury and Gustilo Anderson Classification:

This cohort's most common injury mechanism is road traffic accidents accounting for 57%, with 23% pedestrians, followed by 18% occupants in a car. Gunshot injury was noted in 50 patients (16.6%). Motorcycle injury was 3.5 times higher in HUCSH than TASH.

Based on the Gustilo Anderson (GA) classification, grade III was by far common, accounting for 71.1% (IIIA- 55.1%, IIIB – 10% and 6% IIIC), followed by grade II accounting for 53 patients (17.6%) (Table 2).

Table 2: Mechanism of injury and Gustilo Anderson (GA) Classification of patients with an open long bone fracture from 2018 to 2020

Characteristics		TASH (n=180)		HUCSH (n= 121)		Total cohort (n=301)	
		Freq.	%	Freq.	%	Freq.	%
Mechanism of injury	MVC pedestrian	41	22.8	29	24	70	23.3
	MVC occupant	39	21.7	15	12.4	54	17.9
	Gunshot injury	35	19.4	15	12.4	50	16.6
	Motorcycle	14	7.8	33	27.3	47	15.6
	Fight or assault	12	6.7	19	15.7	31	10.3
	Fall from height	18	10	5	4.1	23	7.6
	Struck by Object	10	5.6	3	2.5	13	4.3
	Fall from ground level	8	4.4	0	0	8	2.7
	Construction site injury	0	0	1	0.8	1	0.8
	Others	3	1.7	1	0.8	4	1.3
GA classification	GA-I	16	8.9	18	14.9	34	11.3
	GA -II	25	13.9	28	23.1	53	17.6
	GA - IIIA	102	56.7	64	52.9	166	55.1
	GA - IIIB	21	11.7	9	7.4	30	10
	GA - IIIC	16	8.9	2	1.7	18	6

Time from injury to hospital presentation and from hospital arrival to operation:

Those patients with an open fracture who presented within 2 hours after sustaining the trauma were only 46 patients (15.3%). One hundred ninety-three patients (64.2%) presented within 24 hours of the trauma, and 18 patients (6%) arrived after one week of the trauma.

Similarly, only 87 patients (32.5%) were operated on within 24 hours after presenting to the hospital, and 40 patients (14.9%) got surgery after 48 hours of arriving at the hospital. (Table 3).

Table 3: Time from injury to hospital presentation and time from hospital arrival to the patients' operation with an open long bone fracture from 2018 to 2020.

Characteristics categories		TASH (n=180)		HUCSH (n= 121)		Total cohort (n=301)	
		Freq.	%	Freq.	%	Freq.	%
Time from injury to hospital presentation (n= 301)	< 2 hours	24	13.3	22	18.2	46	15.3
	2 to 8 hours	18	10	46	38	64	21.3
	9 to 24 hours	50	27.8	33	27.3	83	27.6
	25 to 72 hours	23	12.8	15	12.4	65	21.6
	3 to 7 days	15	8.3	2	1.7	25	8.3
	More than 7 days	15	8.3	3	2.5	18	6
Time from presentation to the first operation in hours (n=268)	Operated within 24 hours of arrival	64	35.6	23	19	87	32.5
	Operated 24 to 48 hours	67	37.2	74	61.1	141	52.6
	Operated after 48 hours	27	15	13	10.7	40	14.9

DISCUSSION

This study shows a significant delay in presentation of patients to hospital after sustaining an open long bone fracture. Approximately 85% of patients present late to get the standard of open fracture care according to the lancet commission global surgery target of hospital admission within 2 hours of the trauma. The finding is higher than the study done by the INORMUS group in which 70% of patients present delayed more than 2 hours, and the research done by Kiran et al. shows 34 % of adult patients presented delayed (17,18). Around 18 patients (6%) with open long bone fractures arrived at the treating hospital after one week of the trauma, which could be due to the poor inter-facility referral process in Ethiopia. This delayed presentation of trauma patients after 72 hours, which is 14.3% in our patients, is significantly associated with poor outcome, prolonged hospital stays, and a significant economic burden on the patients and treating health facilities. It will be essential to close up this gap to address this exaugerated delayed presentation of open fracture.

Delay is also noted in getting surgical intervention once the patients were admitted to the hospitals. Only 32.5% of patients with open long bone fracture get initial surgical intervention within the first 24 hours of admission. Whereas more than two-thirds of patients (71.1%) get operated on after waiting for more than 24 hours after hospital presentation, and 40 patients (13.3%) were operated on after 48 hours in-hospital stay. This delay in primary surgical intervention could be due to various factors. Lack of proper prioritization of open fracture, shortage of operating time and resources, and increased prevalence of polytrauma that should be stabilized before the surgical intervention could be some of the reasons.

Regarding the mechanism of injury, road traffic accident (RTA) is the leading cause contributing about 56.8 % (17.9 % MVC occupant, 23.3 % MVC pedestrian, and 15.6 Motorcycle injury) followed by bullet injury accounting 16.6 % and fight or assault around 10.3%. In this study, RTA is the leading cause of injury compared with the previous research done at TASH, which shows RTA was contributing for about 39.1%, followed by fall 35.1% (4). This indicates that Ethiopia's prevention modality is not adequate to decrease RTA as a cause of injury. Unlike previous studies, bullet injury is much higher than in our study (4). This can be explained due to the recent political instability experienced in Ethiopia, a seasonal condition. Among all open fractures, more than two-third, 214 (71.1%) were Gustilo grade III (Gustilo-III: 166 (55.1%), Gustilo – IIIB: 30 (10%) and Gustilo- IIIC: 18 (6%)) followed by Gustilo II (17.6 %)

and I (11.3 %) respectively. This study shows that most of the fractures grade is more severe than the previous research done in the same set up where Gustilo grade- III was accounting only 50%, and Gustilo IIIC was only 2.7%(6). The current finding could be explained by the fact that the injury mechanism's severity is getting worse and high energy to cause more severe soft tissue injury. Gustilo Anderson type IIIC fractures are very high in our study compared to the previous research, and it can show how much of our patients could end up with amputation due to trauma.

The most common age group involved in this open long bone injury is 18 to 45 years accounting for more than 75% of the injury. This implies the most productive age group of the nation gets affected, and it will negatively impact the country's economic growth.

Limitation of the study: The study has a limitation as it represents only two canthers in Ethiopia. Our findings could not be generalizable for the whole country.

Recommendation

This study shows the two critical gaps faced in treated open fractures in Ethiopia- delay to initial presentation to hospital and delay in getting initial surgical care. Triaging, prehospital transfer, and interfacility referral system should be revisited to address the delays observed. Identifying the reasons for presentation and surgical delay should be examined in prospective future research, and efforts should be exerted to address these gaps and tackle the bottlenecks to provide early surgical care for open fractures. A prospective and multi-centre study should be conducted in Ethiopia to identify factors affecting patients' hospital presentation and in-hospital treatment delay for open fractures.

ACKNOWLEDGMENT

The authors would like to thank the Orthopedic Trauma Association for funding this project; all residents, nurses, and research data collectors that were instrumental in collecting data at the two centers.

Competing of Interest: The authors declare that they do not have any conflict of interest.

Funding: Aided by a grant from the Orthopaedic Trauma Association. Funds for this grant were provided to the OTA for unrestricted research support by OTA.

REFERENCES

1. World Health Organization, Department for the Management of Noncommunicable Diseases D Violence and Injury Prevention. Injuries and violence: the facts 2014.
2. Agarwal-Harding KJ, Chokocho LC, Mkandawire NC, Martin C, Losina E, Katz JN. Risk Factors for Delayed Presentation Among Patients with Musculoskeletal Injuries in Malawi: *J Bone Jt Surg* 2019 May;101(10):920–31.
3. Pouramin P, Li CS, Busse JW, et al. Delays in hospital admissions in patients with fractures across 18 low-income and middle-income countries (INORMUS): a prospective observational study. *Lancet Glob Health* 2020 May;8(5):e711–20.
4. Ahmed E, Chaka T, Orthopedic and Major Limb Trauma at the Tikur Anbessa University Hospital, Addis Ababa - Ethiopia. *East Cent Afr J Surg* 2005;10(2):43–50.
5. Turyneh C, Seyoum G, Regasa G, Lambisso B. Clinical profile and patterns of extremity fractures in Orthopedics department in Tikur Anbessa Specialized Hospital. *Ethiop Med J* 2020;58(2):159-165.
6. Hailu S, Gebreselassie K, Fikre R, Lambisso B. Pattern of Fracture at Tikur Anbessa University Hospital: Prospective Study. *Ethiopian Soc Orthop Traumatol Year Book* 1. 2011;2(1):51-52
7. Bhandari M, Jeray KJ, Petrisor BA. et al. A Trial of Wound Irrigation in the Initial Management of Open Fracture Wounds. *N Engl J Med* 2015;273(27):1–13.
8. Govaert GAM, Kuehl R, Atkins BL et al. Diagnosing Fracture-Related Infection : Current Concepts and Recommendations. 2020;34(1):8–17.
9. Buteera AM, Byimana J. Principles of Management of Open Fractures. 2009;14(2):2–8.
10. Mundi R, Chaudhry H, Niroopan G, Petrisor B, Bhandari M. Open Tibial Fractures: Updated Guidelines for Management. 2015;3(2):1–7.
11. British Orthopedic Association Standards for Trauma and Orthopaedics (BOASTs): Open Fractures. 2017 [cited 2020 Aug 20]. Available from: <https://www.boa.ac.uk/standards-guidance/boasts.html>
12. Keating J F, Simpson A H R W, Robinson C M. The management of fractures with bone loss: Review article. *J Bone J Surg* 2005;87: 142-150.
13. Cross WW, Swiontkowski MF. Treatment principles in the management of open fractures. *Indian Journal of Orthopedics* 2015;42(4):377–86.
14. Anglen J O. Perspectives on Modern Orthopaedics Wound Irrigation in Musculoskeletal Injury. *J Am Acad Orthop Surg* 2001;9(4):219–26.
15. David G Stewart JR, Robert M Kay, David L Skaggs. Open Fractures in Children: current concepts review. *JBJS* 2005;87(12): 2784–98.
16. Bhandari M, Jeray KJ, Petrisor BA. et al. Fluid Lavage of Open Wounds (FLOW): A Multi Factorial Trial Comparing Alternative Irrigating Solutions and Pressures in Patients with Open Fractures. *BMC Musculoskeletal Disorders* 2010, 11:85-99.
17. Mukhopadhyay S, Ojomo K, Nyberger K, Meara JG. Lancet commission on global surgery. *Iran J Pediatr* 2017;27(4):1-7

ORIGINAL ARTICLE

ASSESSMENT OF NEGATIVE PRESSURE WOUND THERAPY FOLLOWUP AND REPORT INITIATIVE IN TIKUR ANBESSA SPECIALIZED HOSPITAL

Bezawit Teferi, MD¹; Biruk Lambisso, MD¹; Geletaw Tessema, MD¹; Tesfaye Guddisa, MA,BSc², Loch Trimmingham, MD³

ABSTRACT

Introduction-Negative pressure wound therapy is a way of treating wounds using a vacuum-assisted system that is applied over the wound bed and helps expedite wound healing process.

Objective-The objective of this study is to understand the contents of Negative pressure wound therapy reports in Tikur Anbessa Specialized Hospital.

Method-Patients who have been admitted to Orthopedics ward for various musculoskeletal pathologies and treated with wound Vacuum assisted therapy (VAT) have been included in this study Descriptive analysis of these case series was performed with data obtained from nursing follow-up forms and serial pictures.

Result-The report included 28 patients, out of whom 18 were men, and 10 were women.71% of patients were between the age of 15-49, 4 patients between the age of 50-65, 2 pediatric patients under 15 years and 2 patients above the age of 65. More than half of the patients ,52 %, in the report had dressing changes up to 5 times and 48% required between 5-10 times. According to the report the most common cause of injury is road traffic injuries, 16 patients. The second most common cause is bullet injury, followed by falling down accidents in 4 patients. The average percentage of reduction in size was 49%, with a maximum of 94% on one patient, and a minimum of 0 % on 5 patients. Wounds were covered with primary closure in 11, secondary intention in 10, and skin graft was done for 7 patients. The report did not include other parameters.

Conclusion-Reporting of patient progress on negative pressure wound therapy needs to be more detailed, inclusive of more variables, and this requires creating a formal database to be used uniformly among care givers.

Keywords- Negative pressure wound therapy, wound healing, Trauma

INTRODUCTION

Treating patients with a high degree of soft tissue injury is a common practice in a day to day practice in orthopedics. With the increasing number of patients sustaining trauma to the soft tissue together with different degrees of skeletal injuries, creating an effective wound care strategy is very critical. Negative Pressure Wound Therapy (NPWT) has been proved to be an effective tool to wound care as it decreases wound exudates and edema, increases the formation of new blood vessels, potentially minimizes the number of contaminating bacterial colony in the wound, and decreases the wound size significantly which allows for early definitive care (1). It can be used to treat a wide range of both acute traumatic, burn, surgical wounds, and chronic difficult to treat pressure ulcers.

Since the first report of NPWT device use in 1997 by Argenta and Morykwas, there has been a lot of change in the design but the basic structural framework of this device includes a foam dressing that will be applied on the wound which will shrink while absorbing

moisture out of the wound bed with the application of pressure, an electrically driven power source that creates the optimum preset pressure conducive to wound healing, and a connecting tube that is attached to both ends (2). It is possible to apply this device either intermittently or continuously.

Continuous application results in a faster wound healing but causes more pain and discomfort to the patient, the continuous application allows the negative pressure wound therapy to be applied at a set pressure constantly for the set period (2,3). The most crucial part of the use of Negative pressure wound therapy is to make sure that the vacuum seal is intact and the pressure is optimal (2).

It has been shown that using NPWT is practical and important in low-income countries as it decreases the length of hospital stay, and is patient-friendly (2). Studies show that NPWT decreases the time taken for a wound to heal compared to conventional methods but has a higher material cost (4).

¹Department of Orthopedics and Traumatology, School of Medicine, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia. ²Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. ³Foot and Ankle ambulatory sugary center, USA.

*Corresponding Author E-mail: bezawittsegaye1987@gmail.com

In spite of evidences supporting the use of NPWT, many low-income countries including ours is still a long way from implementing NPWT as a primary wound care method due to the expensive price of the device and issues on availability including the need for manpower required to train caregivers, even if there are new initiatives undergoing in some Orthopedic centers in Ethiopia (5).

Following the progress of a wound after various types of wound care strategies involve some important parameters including wound bed clinical appearance (granulating, epithelializing, sloughing, necrotic), wound size measurement, wound edges (color, evidence of contraction), exudates, surrounding skin, presence of infection, and pain (6). One of the most important parameter to use in assessing the progress of wound healing is assessing the change in wound size over time, multiple alternatives have been studied according to inter and intra-observer reliability, ease of usage and, reproducibility including ruler measure, wound surface racing, computerized planimetry, digital image analysis, three-dimensional laser, optical coherence tomography, and light imaging (7). The commonly used parameter to follow wound progress in our setup is a clinical judgment by the physician seeing the degree of new granulation tissue formation, presence or absence of gross infection, amount of exudates from the wound bed, and subjective assessment of the wound size.

Assessing the wound size has been a subject of debate because wound surfaces have different shapes that do not fall into specific geometry and analyzing a three-dimensional wound using two-dimensional parameters underestimates the actual size of the wound (8). Measuring wound size using rulers have been easy to apply, cheap and fast but have been shown to overestimate measurements by 10-44% which increases with an increase in wound size, on the other hand, measurement using manual tracing, where a metric grid is used to measure the wound size by counting the numbers of squares covered under the surface area, has shown some inconsistencies in deciding the actual values of partially filled holes and proper cutting added to the fact that it is time consuming (8). Using photography to measure wound size by tracing wound edges from pictures using a ruler or any other calibrations has shown good inter and intra observer reliabilities despite some shortcomings including underestimation of size by about 10% especially in circumferential wounds or those found in curves areas. It also allows for repeated measurement and uses for any future reference as it can easily be stored and accessed (8).

It has been 9 years since the wound VAT initiative has been started in our department but reporting on the outcomes has not been done until after 8 years following the new collaboration with Peace Health Wound care center, Seattle, USA, and the availability of new designs of NPWT. Five nurses who are trained to work with the NPWT appliance are in charge of applying NPWT, according to the suggestion by the physician in charge of the patient, and follow the progress. Continuous application at a constant pressure of 125mm-Hg is used and wound covers are changed every 48 hours. In this study, we are going to describe the profiles of patients who underwent treatment with NPWT with their wound profiles accessed through serial pictures. A total of 28 Patients are included in the study.

OBJECTIVES

The objective of this study is to understand the contents of negative pressure wound therapy reports in the department of Orthopedics. We also analyze potential drawbacks that are impeding efficacious reporting system.

PATIENTS AND METHOD

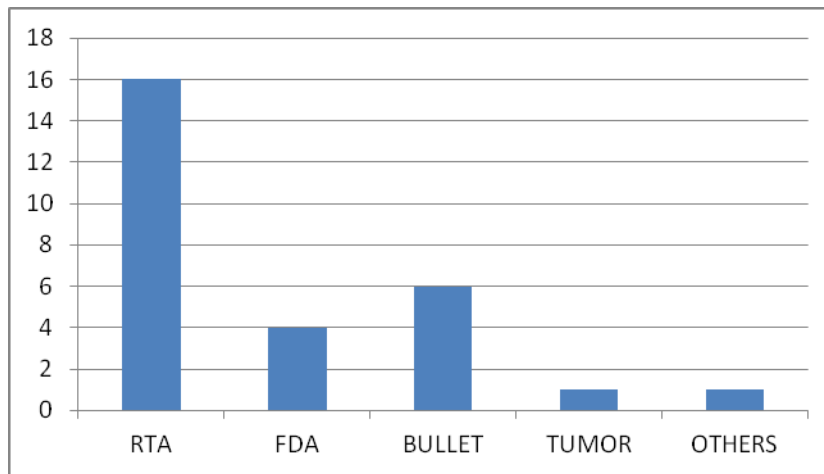
This study was conducted at the Tikur Anbessa Specialized Hospital, Department of Orthopedic and Traumatology. It has 75 beds specifically for orthopedic patients, and an outpatient clinic serving 11,945 Adult, 2812 Pediatric, and 2302 pediatric club foot patients a year. This study is a prospective descriptive study involving a cohort of 28 patients who were admitted in the department for different degrees of musculoskeletal injuries from February 2019 to September 2020, and has a progressive follow up picture of their wounds, taken after every wound care. Every patient with a follow up picture and progress report was included.

Demographic and medical data were collected from patients charts during their initial encounter with the responsible nurse in charge of wound care, consecutive wound pictures were taken with each change of wound VAC dressing were collected and wound size was measured in two of the longest dimensions (length and width) from the pictures. Verbal informed consent was collected from each patient during the time wound pictures were taken and the patients included have fully agreed on the terms of possible use of medical information and pictures for academic purpose and ethical clearance was granted by the department research committee. The data collected was analyzed in SPSS-23.

RESULT

Out of the 28 patients, 18 were men, accounting for 65% and 10 of them, 35%, were women. The age distribution of the patients includes patients aged 15-49 making up for 71%, there were 4 patients between the age of 50-65 years, we had 2 pediatric patients under 5 years and 2 patients above the age of 65. 52% of the patients had wound VAC changed up to 5 times using the intermittent method of application and 48% required between 5-10 times throughout their hospital stay.

The most common cause of injury is road traffic accident, 16 out of the 28 patients, accounting for 57%, the second most common cause is bullet injury-causing wounds in 6 patients, and falling down accidents in 4 patients, one patient had a tumor and another patient stick injury related wounds (Figure-1).



Key
 •RTA-Road Traffic Accident
 •FDA-Fall Down Accident

Figure 1: Summary of the most commonly reported causes of wounds requiring negative pressure therapy among patients in Orthopedics department.

The average percentage of reduction in size, as calculated from initial and final wound sizes, which were estimated from pictures of the wounds was 49%, there was a maximum of 94%, and a minimum of 0% where there was no apparent change in the surface area of the wound on 5 patients, the wound beds were subsequently covered with primary closure in 2 patients, healing with secondary intention in 2 and skin graft was done for one patient. Out of the rest of 22 patients, 8 patients or 33% had up to 50% reduction in wound surface area and the rest 14 patients had more than 50% reduction.

Out of the 15 patients with more than 50% reduction of wound size only 4 of them, and from among patients with under 50% reduction only 3 out of the 13 patients required skin grafting for final closure (Table 1). There has been missing data on the type of emergency stabilization surgeries done for these patients, but 11 patients were reported to have external fixation done during their initial visits.

Table-1: Table summary of the correlation between the average change in size of wounds after negative pressure therapy, in percentage, with the final treatment required for wound closure.

Percent wound size change	Final outcome of the wound			Total
	skin graft	primary closure	skin graft	
0-49%	3	7	3	13
50-100%	4	3	8	15
	7	10	11	28

Ten patients underwent primary wound closure and 11 patients had healed with secondary intention the remaining 7 had surgery for coverage with skin graft after they completed the required numbers of negative pressure therapies. 6 out of the 10 patients whose wounds were treated with primary closure underwent a total of 5-10 VAC therapy and 7 out of the 11 patients healed with secondary intention had up to 5 rounds of VAC treatment. Of the 7 wounds closed with skin graft, 4 patients had 1-5, and the rest 3, 5-10 of VAC therapy changes in total.

DISCUSSION

A prospective descriptive study done on the pattern of injuries in public health facilities in Addis Ababa, Ethiopia which included 40,572 patients showed that road traffic injury is the most common cause of injury among 15-49 years old patients, even though fall down accidents were the commonest cause of injuries in general followed by road traffic (9). A cross-sectional study which was done to analyze the pattern of injury among trauma patients' different age and gender in southern Iraq also revealed 75% of the patients were between 15 to 44 year old, supporting the idea that most patients sustaining injuries are mostly young people (10).

A systematic review done on trauma in Ethiopia stated that the majority of traumas happen on the active group between 15-59 years of age and 2/3 occur in men with only a small percentage occurring in women (11). These studies show confirming more injury among the young age group, and males are supported by many studies. In addition the commonest causes of injury in our study including road traffic injury, and fall down accident are the most commonly encountered causes of injury. Bullet injury, even if it's one of the commonest causes in this study it doesn't reflect on the everyday encounter.

Even though our reports are done using the number of VAC sessions required to achieve target wound size and condition, it is difficult to compare the findings with the results of other facilities with similar experience as majority of the reports included the total days/hours used instead of the number of VAC changes to compare outcomes. Calculating the percentage change in wound size was not standardized and reliable method of calculating the change in wound size was unavailable which is vital in tracking progress and understanding the effectiveness of wound care we provide. Our reporting system lacked other important variables that should be included in the patient data including the time between injury and administration of antibiotics or surgical intervention like Incision and debridement, detailed characterization of

the fracture and soft tissue injury, type of NPWT used, presence or absence of signs of infection, the progress of pain as reported by the patient, the total duration of hospital stay, number of operation room visits, effect it has on quality of life using patient-reported outcome measures, the total cost of inpatient service. In addition there is a need to establish standard method of collecting wound site pictures to be used by everyone following patients to decrease the difference in quality and coverage of pictures taken. It is beyond the scope of this study to focus on the variables with the most effect on patient outcome and progress on wounds but it will be utmost importance to be all inclusive in the reporting mechanism.

Conclusion – Even though Negative pressure wound therapy has been used in dealing with both traumatic and atraumatic wounds in the department there is no standard reporting and follow up system in place. Properly following each individual's progress and keeping a record is vital in understanding the shortcomings and improve. It appears more suitable to report the total number of VAC changes as the days required to have the wound clean and ready for definitive closure which will give a more reproducible way of following wound condition.

Recommendation –We recommend establishing a better wound care report system should include creating wound care only database where patients will be enrolled in since the first day of NPWT application with, important demographic and clinical data vital for follow up and future research activities. Wound pictures should be taken and uploaded and any change in wound parameters should be documented as well, and after the patient finishes NPWT the final outcomes including definitive wound coverage should be documented. This way a database that can uniformly be used in any facility that utilizes NPWT will be available for any future research and helps in understanding what our patients require to get effective wound care that improves their quality of life.

ACKNOWLEDGMENT

We acknowledge Dr.Lock Trimmingham and his wound care team from Peace Health Wound care center for training our nurses, and residents and for providing us with VAC appliances.

Competing of interest-There is no conflict of interest.

REFERENCES

1. Robert N. Negative pressure wound therapy in Orthopaedic surgery. *Orthop traumatol surg res* 2017; 103 (1 suppl): 99-103.
2. Yadav V, Rawal G , Bax M. Vacuum assisted closure technique: a short review. *Pan Afr Med J* 2017; 28: 246-251.
3. Malmström M, Gustafsson L, Lindstedt S, Gesslein B, and Ingemansson R. The Effects of Variable, Intermittent, and Continuous Negative Pressure Wound Therapy, Using Foam or Gauze, on Wound Contraction, Granulation Tissue Formation, and In growth Into the Wound Filler . *Eplasty* 2012;11:42-54
4. Thompson G. An overview of negative pressure wound therapy (NPWT). *Br J Community Nurs* 2008; 13 (6 suppl): 23-30.
5. Sirisena R , Bellot G, and Puhaindran M . The Role of Negative-Pressure Wound Therapy in Lower-Limb Reconstruction, *Indian J Plast Surg* 2019; 52(1): 73–80.
6. Davidson K. Wound assessment and management. https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/Wound_assessment_and_management/. Accessed on Aug. 26, 2020.
7. Bloemen M, Boekema B, Van M, Middelkoop Z. Digital image analysis versus clinical assessment of wound epithelialization: A validation study. *Burns* 2012; 38(4):501-505.
8. Chang A, Dearman B, and Greenwood J .A Comparison of Wound Area Measurement Techniques: Visitrak Versus Photography, *Eplasty* 2011; 11: 158-166.
9. Wolde A, Abdella K, Ahmed E, et al. Pattern of Injuries in Addis Ababa, Ethiopia: A One-year Descriptive Study. *East Cent Afr J Surg* 2008; 13(2): 14-22.
10. Bolandparvaz S, Yadollahi M, Abbasi H, Anvar M. Injury patterns among various age and gender groups of trauma patients in southern Iran: A cross-sectional study. *Medicine (Baltimore)* 2017; 96: 41-48.
11. Azaj A, Seyoum N, Nega B. Trauma in Ethiopia Revisited: A systematic Review, *East Cent Afr J surg* 2013; 18(2): 112-113.
12. Arti H, Khorami M, Nejad V. Comparison of negative pressure wound therapy (NPWT) & conventional wound dressings in the open fracture wounds. *Pak J Med Sci* 2016; 32(1): 65–69.

Natan Wondwossen Elssa, Abera Kumie, Natnael Habtamu Abegaz, Abel Tenaw Tassama, Yodit Abraham Yaynished, Tigest Abebaw Zewdie, Desalew Mekonnen. *Ethiop Med J*, 2020, Vol. 58, Supp. 3

ORIGINAL ARTICLE

MASK UTILIZATION AND PHYSICAL DISTANCING PRACTICES AS A PREVENTIVE RESPONSE TO COVID-19 AT A TERTIARY HOSPITAL, ETHIOPIA

Natan Wondwossen Elssa, MD^{1*}, Abera Kumie, PhD², Natnael Habtamu Abegaz, MD³, Abel Tenaw Tassama, MD¹, Yodit Abraham Yaynished, MD¹, Tigest Abebaw Zewdie, MD¹, Desalew Mekonnen, MD¹

ABSTRACT

Introduction: The impact of COVID-19 has influenced every society in the globe since it was declared as public health emergency of international concern. The recommendation to prevent the transmission includes proper hand hygiene, proper physical distancing and face mask utilization in public places.

Objective: To assess the practice of face mask utilization and proper physical distancing in patients and attendants visiting Tikur Anbessa Specialized Hospital Out-patient waiting areas.

Methods: Institution-based cross-sectional survey was conducted. All patients and attendants visiting the out-patient waiting areas of Tikur Anbessa Specialized Hospital were the source population. Anonymous non-participatory observation data collection using a pretested checklist was used. Excel and SPSS softwares were used for data management and analysis. Descriptive analysis was used to present data.

Result: A total of 3816 individuals were observed in the study. Among them 53.2% were female. Proper face mask utilization was practiced almost universally, 93.4%. Proper physical distancing was practiced in 48.3% of them. The presence of individual enforcement, the daily patient load and the capacity of the waiting areas were influencing the practice of proper physical distancing.

Conclusion: Proper mask utilization among individuals visiting out-patient waiting areas of Tikur Anbessa Specialized Hospital is close to universal relative to physical distancing. Overcrowding and lack of sustainable enforcement of good practices lead to low practice of proper physical distancing.

Key words: COVID-19, mask utilization, physical distancing, Tikur Anbessa Specialized Hospital, Ethiopia

INTRODUCTION

Since the director-general of WHO declared the novel corona virus outbreak a public health emergency of international concern (PHEIC), WHO's highest level of alarm, COVID-19 has affected the day to day activity of every society in every country in every continent (1, 2). Globally, as of Aug. 24, 2020, COVID-19 has infected more than 23 million people and killed more than 800 thousand people (3). In Africa, as of Aug. 24, 2020, COVID-19 has infected more than 11 million patients and has killed more than 27 thousand (3). Ethiopia is not also spared from COVID-19. Ethiopian Ministry of health has reported that there are more than 40 thousand infected patients and more than 680 dead (4). Total number of COVID-19 confirmed patients at Tikur Anbessa Specialized Hospital (TASH) has passed 280 (5).

There is no anti-viral curative therapy to date. However, there are preventive measures recommended for the general public that would halt the transmission and spread of the virus. The advices of the World Health Organization (WHO) for the general public were maintaining a 1 meter distance, cleaning hands regularly and thoroughly, following good respiratory hygiene by wearing a fabric mask or medical mask and

covering ones mouth and nose with bent elbow or tissue while coughing or sneezing (6). The centers for disease control and prevention (CDC) also recommends the general population to wash their hands often, to avoid physical proximity less than 6 feet or 2 meters, to wear a mask outdoors, to cover sneezes and coughs and to monitor daily health (7).

On a study conducted in China, use of face mask, covering coughs and sneezes with soft-tissue or if unavailable using flexed elbow to cover, regular hand hygiene with water and soap or alcohol (>60%) based sanitizer, and avoiding contact with infected individuals or maintaining appropriate physical distance were the recommendations (8). The Ethiopian government also declared a state of emergency for the prevention of the wide spread of the transmission. The directive of the proclamation involves actions such as prohibiting all gatherings more than four persons, wearing masks or scarves and the like (9). In a survey conducted online among Chinese general public, almost all individuals wore masks in public places (98.0%) (10). Similarly, a cross-sectional study among Health Care Workers in Pakistan showed that mask using among public gatherings is very high (93.9%) (11).

¹School of Medicine, College of Health Sciences, Addis Ababa University.

²School of Public Health, College of Health Sciences, Addis Ababa University.

³Independent Practice, Addis Ababa, Ethiopia.

*Corresponding Author E-mail: natanwon@gmail.com

Whereas in an institution-based cross-sectional study done in eight teaching hospitals of Ethiopia, the practice of facemask usage was 67.3% and the practice of physical distancing was a staggeringly low (22.4%) among health care workers (12). Likewise, the practice is even worse among health center visitors in Jimma; proper physical distancing (1 meter distance between individuals) was practiced only in about one third of the participants (33.6%) and mask usage was even lower (14.2%) (13).

Tikur Anbessa Specialized Hospital (TASH) has structured an Emergency Operation Center (EOC) for Prevention and control of COVID-19 in the institution (5). Under the EOC, Infection Prevention and Control (IPC) committee works to establish the practices of proper hand hygiene, proper physical distancing and proper respiratory hygiene in the hospital compound. The aim of this study is to evaluate the effectiveness of these actions by assessing the practice of mask utilization and proper physical distancing. We also describe the difference of practices in different waiting areas of the hospital.

PATIENTS AND METHODS

Study Design and Study area: the study involved institution based cross-sectional survey at Adult Out-patient waiting areas of Tikur Anbessa Specialized Hospital (TASH), Addis Ababa, Ethiopia. The hospital is a tertiary care facility and the largest referral public hospital of the country. There are 51 outpatient clinics where specialty, subspecialty and super-specialty services are delivered to half a million population annually. The management of TASH has organized Emergency Operation Center for the purpose of halting the transmission and spread of COVID-19. Different committees have been organized such as Infection Prevention and Control (IPC) committee. Face mask utilization and proper physical distancing enforcements were in practice by the committee.

Study period: the study was conducted from June 22 to August 24, 2020 on a weekly based schedule. Weekly data collection on Monday's was identified on the basis of peak patient flow, as evidenced from the hospital's health management information systems. **Source and study population:** among all patients and attendants, visiting the adult out-patient waiting areas of TASH from June to August, 2020, those visiting on Mondays and who appear to be above 14 were included in the study.

Data collecting instruments: Anonymous non-participatory observation data collection using a pre-tested checklist was used.

Well trained observers who were acquainted with the acceptable definitions of proper mask utilization and proper physical distancing, as proposed by WHO, were employed. The Observers, blending among the patients and attendants, collected the data using the checklist. The checklist includes the date of observation, time of observation, total number of observed individuals in each Out-patient waiting areas (groups), sex in the groups, proper physical distancing in the group, proper mask utilization in the group and the presence of sneezing or coughing in the group.

The observation sites were various out-patient waiting areas: Cardiac and Neurology Clinics, Out - Patient Laboratory, Surgery and Gynecology Clinics, GI and Chest Clinics, Ortho (Pediatrics Clinic), Diabetes (Endocrine Clinic), Oncology, Infectious Disease Clinic, and ANC. The observers studied and recorded their observation on all patients and attendants who are waiting at the out-patient waiting areas. The duration of observation was for about 15 minutes in each waiting area, on each observing day.

Operational definition

Proper physical distancing is a distance between two individuals, which can allow at least two individuals to pass through, which roughly correlates with the set point defined by WHO as 1meter apart. (6) Proper mask utilization is any medical, non-medical, respirator or cloth mask, which covers the nose, mouth and chin of an individual. (6)

Data management and analysis: the check list was pretested for appropriateness. There was also daily review for completeness, accuracy, consistency and clarity of data. The data collectors were well acquainted with the operational definitions and the checklist. The data was entered into SPSS version 20 and analyzed using descriptive data and pictorial presentation.

Ethical consideration: Since it was an observational study, conducted at a public setup, there was no breach of privacy and confidentiality. This was a covert research with no direct involvement with patients and human kind, proper ethical clearance from the college IRB was found not necessary.

RESULTS

Characteristics of study subjects: A total of 3816 individuals were observed in the study. Among them 1786(46.8%) were male and 2030(53.2%) were female (Table 1).

Table 1: Total number of individuals observed in sex and in waiting areas, Tikur Anbessa Specialized Hospital, 2020

Out-patient Waiting Areas	Male (%)	Female (%)
Cardiac and Neurology Clinics	258(44.2)	326(55.8)
Out- Patient Laboratory	152(48.1)	164(51.9)
Surgery and Gynecology Clinics	279(50.5)	273(49.5)
GI and Chest Clinics	168(50.9)	162(49.1)
Ortho (Pediatrics Clinic)	137(39.5)	210(60.5)
Diabetes (Endocrine Clinic)	96(46.2)	112(53.8)
Oncology	375(50.6)	366(49.4)
Infectious Disease Clinic	260(53.6)	225(46.4)
ANC	61(24.1)	192(75.9)
Total	1786(46.8)	2030(53.2)

Proper mask utilization: A total of 3566 (93.4%) individuals had proper mask utilization. There was comparable utilization in various out-patient waiting areas,

with the least being applied at lab waiting area (86.1%) and highest being utilized at ANC waiting area (96.4%) (Figure 1).

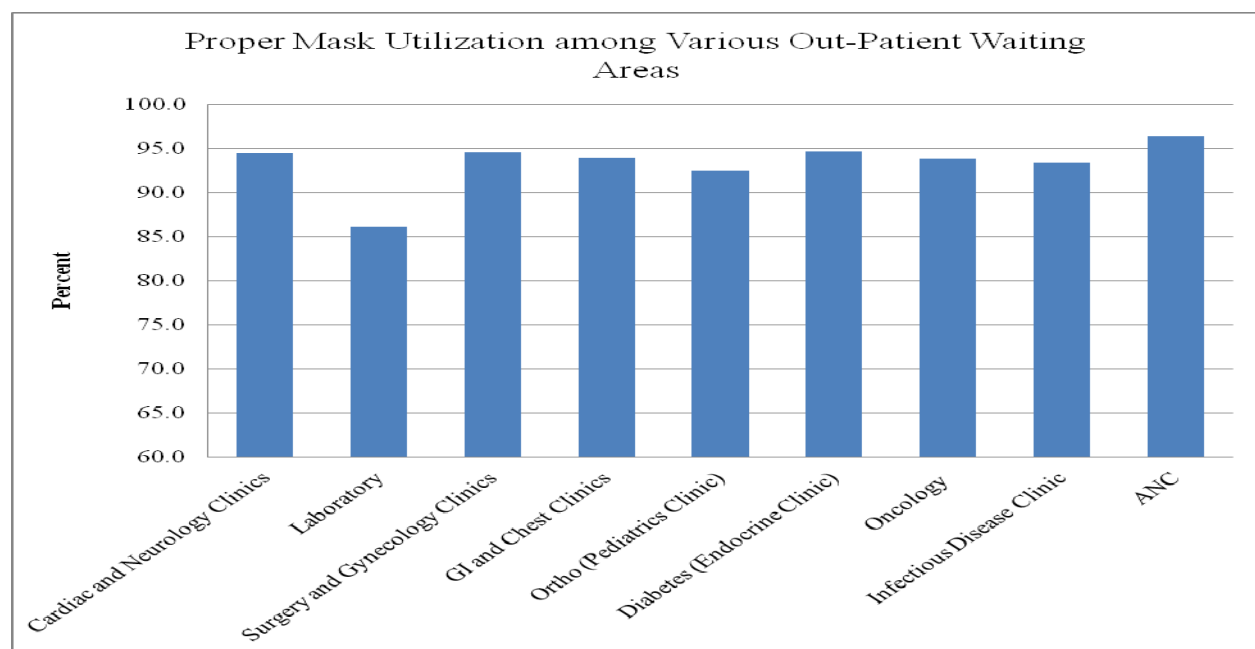


Figure 1: Proper mask Utilization among various out-patient waiting areas, Tikur Anbessa Specialized Hospital, 2020

Proper Physical Distancing in a Group: Out of 3816 individuals, 1842(48.3%) of them had kept proper physical distances. In comparison, the most implementation of proper physical distancing was noted at diabetes waiting area (91.3%).

In the other out-patient waiting areas, there was relatively less proper physical distancing observed, ranging from 23.3% at the ANC OPD to 58.2% at Surgery and Gynecology clinics waiting areas (Figure 2).

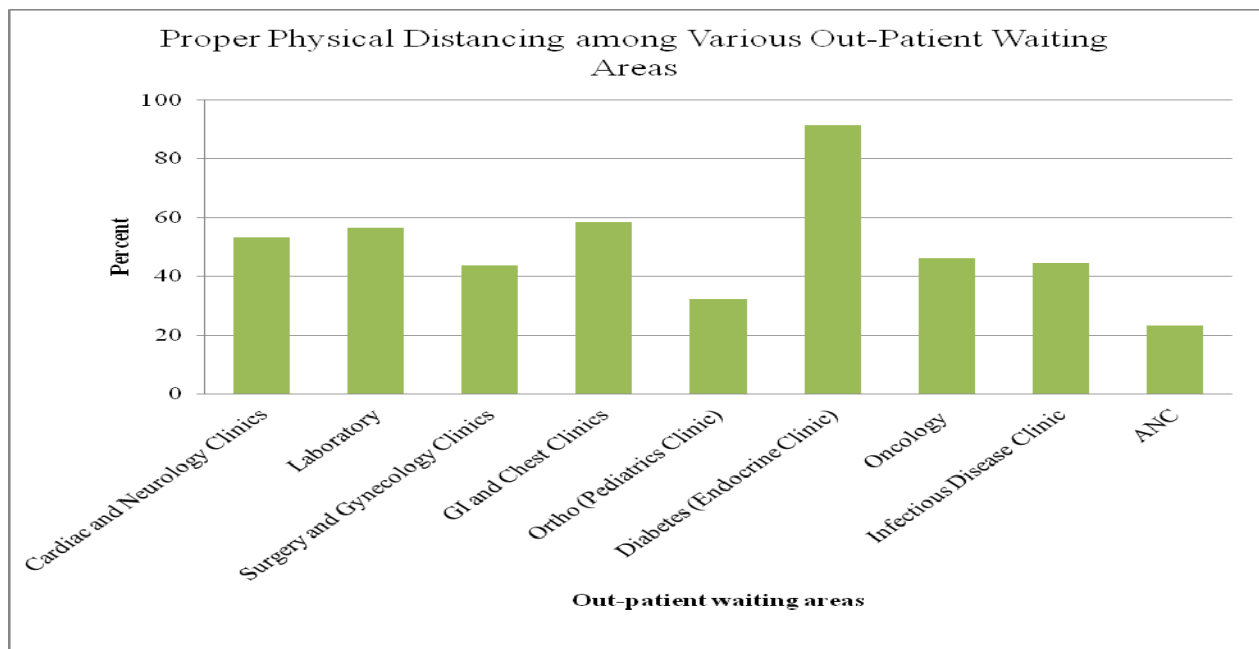


Figure 2: Proper physical distancing among various out-patient waiting areas, Tikur Anbessa Specialized Hospital, 2020.

Weekly trends of mask utilization and physical distancing: During the duration of the study, there was steadily a high proper mask utilization (i.e. > 90%) seen in all the weeks (Figure 3).

On the contrary, there was an overall non-uniform decline in proper physical distancing with peak being at weeks 2 & 3 (76.2% & 77.5% respectively) and the lowest applications being at week 8 (29.2%) (Figure 4).

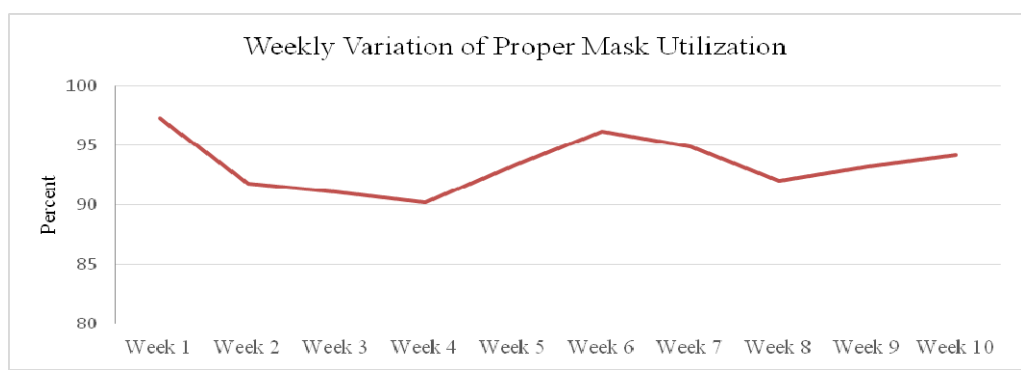


Figure 3: Weekly variation of proper mask utilization, Tikur Anbessa Specialized Hospital, 2020.

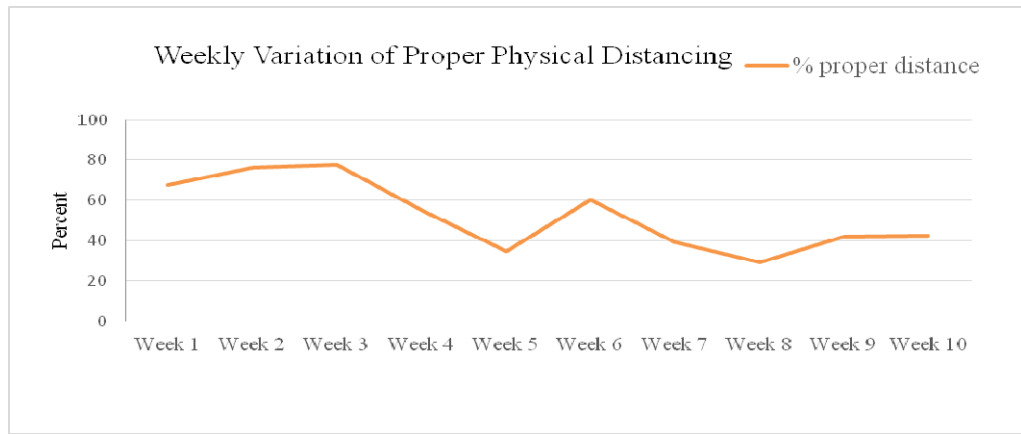


Figure 4: Weekly variation of proper physical distancing, Tikur Anbessa Specialized Hospital, 2020.

Additional Observations: There were no individuals who were sneezing or coughing during the data collection period.

DISCUSSION

Mask usage is almost universal (93.4%), which is comparable with studies conducted in China (98%) and Pakistan (93.9). (11, 12) But it is much better than the results obtained from a study in Jimma (67.3%). (10) This might be because of extensive enforcement of mask usage, the failure to abide leading to a fine and an imprisonment, by government bodies especially in Addis Ababa. (14)

In specific waiting areas, mask usage is not highly variable, most are >90%. The only exception is at Laboratory waiting area. This area is situated outside of the hospital building; this might be the reason for the decrement (86.1%) from other areas.

In the first three weeks of the study, physical distancing was relatively good (more than two third of observed individuals in the groups had proper physical distancing). This might be attributed to the low patient burden at those times (the total individuals observed was less than 300). In contrast in the last four weeks, physical distancing was poor (only about 40%). Almost certainly, this can be ascribed to the high patient flow and crowding (more than 450 individuals were observed in those weeks).

The other explanation, for the waxing and waning of proper physical distancing, might be the immense health education that was given at the first few weeks by mass media and the enforcement of proper physical distancing by guards. Within the fourth week, there was a public unrest, after the assassination of a well-known artist, which might have shifted the focus of the public from fear of COVID-19 to fear of turmoil. This was most likely reflected in the deterioration of proper physical distancing in the next consecutive weeks. The peak at week 6 happened probably because of the intervention of IPC team of the EOC-TASH in educating guards about the proper practice of physical distancing. But the improvement was not sustainable.

The impact of crowding was patent for the variation of proper physical distancing in different out-patient waiting area. The waiting area at diabetes OPD has the best proper physical distancing observed (91.35%). This is partly, if not mostly, because of the capaciousness of the area for the number of visiting individuals. On the contrary, ANC, which has a minute waiting area, has the least proper physical distancing (23.32%).

Limitation of the study: The study was only a snapshot of the practice at a certain point. It might not be able to say a lot about the practice of an individual in different circumstances. The key findings are only reflection of the study period as there could be uncertainties of performance without enforcement.

Conclusion: Proper mask utilization among individuals visiting out-patient waiting areas of TASH is close to universal. But overcrowding and lack of sustainable enforcement of good practices lead to low practice of proper physical distancing.

Recommendations: We recommend solving the overcrowding, for establishing proper physical distancing practice. This can be achieved by decreasing the total patient load of the institution and also by assigning enforcers of proper practices. We also recommend providing health education by placing posters about the methods of preventing COVID-19 transmission, such as proper physical distancing and proper utilization of masks.

We consider the government directives have helped in refining implementation of protective practices. We recommend policy makers to continue implementation of the directive until effective curative or preventive methods are available for Covid-19. We also recommend policy makers to decrease patient flow to tertiary health centers by strengthening the three-tier health care system and by allowing down referral system for patients who do not require tertiary care. This will consequently decrease the overcrowding noticed in tertiary hospitals besides providing optimal care for patients.

ACKNOWLEDGMENT

We would like to thank the management of College of Health Sciences, Addis Ababa University for extending their help in our needs.

Competing of Interest: There is no conflict of interest to declare.

Funding: The funding of this study was covered by the authors.

REFERENCES

1. World Health Organization. Timeline: WHO's COVID-19 response. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline#!> Accessed 23/08/2020.
2. United Nations Development Programme. Socio-economic impact of COVID-19. <https://www.undp.org/content/undp/en/home/coronavirus/socio-economic-impact-of-COVID-19.html> Accessed 23/08/2020.
3. Worldometer. Reported Cases and Deaths by Country, Territory, or Conveyance. <https://www.worldometers.info/coronavirus>. Accessed 24/08/2020.
4. Ethiopian Ministry of Health. Status update on #COVID19Ethiopia. https://twitter.com/lia_tadesse/status/1297579395620769792 Accessed 23/08/2020.
5. Emergency Operation Center (EOC) of Tikur Anbessa Specialized Hospital. COVID-19 Epidemiologic Bulletin. Issue: No 21, Aug. 16, 2020.
6. World Health Organization. Coronavirus disease (COVID-19) advice for the public. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>. Accessed 24/08/2020.
7. Centers for Disease Control and Prevention (CDC). How to protect yourself and others. <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html> Accessed on 24/08/2020.
8. Adhikari S, Meng S, Wu Y, et al. Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: a scoping review. *Infect Dis Poverty* 2020; 9: 29-41.
9. Ethiopian News Agency. Attorney General Issues Directive for Execution of State of Emergency Proclamation. <https://www.ena.et/en/?p=13819>. Accessed 24/08/2020.
10. Zhongl B-L, Luo W, Li H-M, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci* 2020; 16(10): 1745-1752.
11. Kumar J, Katto MS, Siddiqui AA, et al. Knowledge, Attitude, and Practices of Healthcare Workers Regarding the Use of Face Mask to Limit the Spread of the New Coronavirus Disease (COVID-19). *Cureus* 2020; 12(4): 7737-7745.
12. Jemal B, Ferede ZA, Mola S, et al. Knowledge, attitude and practice of healthcare workers towards COVID-19 and its prevention in Ethiopia: a multicenter study. <https://www.researchsquare.com/article/rs-29437/v1> Accessed 26/08/2020.
13. Kebede Y, Yitayih Y, Birhanu Z, Mekonen S, Ambelu A. Knowledge, perceptions and preventive practices towards COVID-19 early in the outbreak among Jimma university medical center visitors, Southwest Ethiopia. *PLoS One* 2020; 15(5): e0233744.
14. Tadesse AG. Ethiopia: Over 1,300 held for going out without masks. <https://www.aa.com.tr/en/africa/ethiopia-over-1-300-held-for-going-out-without-masks/1839883> Accessed 27/08/2020.

EDITORIAL POLICY

Overview

Ethiopia's oldest medical journal, *The Ethiopian Medical Journal (EMJ)* is the official organ of the Ethiopian Medical Association (EMA). The EMJ is devoted to the advancement and dissemination of knowledge pertaining to the broad field of medicine in Ethiopia and other developing countries. The journal first appeared in July 1962 and has been published quarterly (January, April, July, October) without fail since then. It has been published in both online (www.emjema.org) and hard copy (ISSN0014-1755) versions.

The EMJ continues to play an important role in documenting and disseminating the progress of scientific medicine, and in providing evidence base for health policy and clinical practice in Ethiopia and Africa at large.

Our online journal is open access. The hard copies are distributed to members of the Ethiopian Medical Association. Hard copies of the Journal are distributed to institutions and organizations (internal and external) based on subscription.

Reviewing procedure

Peer reviewers

The Ethiopian Medical Journal uses a double-blind review system for all manuscripts. Each manuscript is reviewed by at least two reviewers. The reviewers act independently, and they are not aware of each other's identities. The reviewers are selected solely based on their relevant expertise for evaluating a manuscript. They must not be from the same institution as the author(s) of the manuscript, nor be their co-authors in the recent past. The purpose of peer review is to assist the author in improving papers and the Editorial Board in making decision on whether to accept or reject a manuscript. Reviewers are requested to decline if they have a conflict of interest or if the work does not fall within their expertise.

Peer review process

Manuscripts are sent for review only if they pass the initial evaluation (pre-review by the Editorial Board) regarding their style, methodological accuracy, ethical review documentation and thematic scope. A special care is taken that the initial (pre-review) evaluation is done in 3-5 days.

The Journal policy is to minimize time from submission to publication without reducing peer review quality. Currently the total period from the submission of a manuscript until its publication takes an average of six months. Peer reviewers are requested to respond within four weeks. During the review process, the Editor-in-Chief may require authors to provide additional information (including raw data) if they are necessary for the evaluation of the manuscript. These materials shall be kept confidential and must not be used for any other purposes.

The entire review process takes place under the supervision of the Editor-in-Chief in an online environment, with the assistance of the Journal Secretariat. The online system also allows authors to track the manuscript review progress.

Resolving inconsistencies

In case that the authors have serious and reasonable objections to the reviews, the Editorial Board assesses whether a review is objective and whether it meets academic standards. If there is a doubt about the objectivity or quality of review, the Editor-in-Chief will assign additional reviewer(s).

Additional reviewers may also be assigned when reviewers' decisions (accept or reject) are contrary to each other or otherwise substantially incompatible. The final decision on the acceptance of the manuscript for publication rests solely with the Editor-in-Chief.

Responsibilities

Authors' responsibilities

This is provided in the '*Guidelines to Authors*' which appear in each issue of the Journal. Authors must guarantee that their manuscripts are their original work, that they have not been published before, and are not under consideration for publication elsewhere. Parallel submission of the same paper to another journal constitutes misconduct and eliminates the manuscript from further consideration. Work that has already been published elsewhere cannot be reprinted in the Ethiopian Medical Journal

Authors are exclusively responsible for the contents of their submissions and must make sure that the authors listed in the manuscript include all and only those authors who have significantly contributed to the submitted manuscript. If persons other than authors were involved in important aspects of the research project and the preparation of the manuscript, their contribution should be acknowledged in the Acknowledgments section.

It is the responsibility of the authors to specify the title and code label of the research project within which the work was created, as well as the full title of the funding institution. In case a submitted manuscript has been presented at a conference in the form of an oral presentation (under the same or similar title), detailed information about what was published in proceedings of the conference shall be provided to the Editor-in-Chief upon submission.

Authors are required to properly cite sources that have significantly influenced their research and their manuscript. Parts of the manuscript, including text, equations, pictures, tables and graphs that are taken verbatim from other works must be clearly marked, e.g. by quotation marks accompanied by their location in the original document (page number), or, if more extensive, given in a separate paragraph.

Full references of each quotation (in-text citation) must be listed in the separate reference section in a uniform manner, according to the citation style used by the journal. References section should list only quoted/cited, and not all sources used for the preparation of a manuscript.

When authors discover a significant error or inaccuracy in their own published work, it is their obligation to promptly notify the Editor-in-Chief and cooperate with him/her to retract or correct the paper.

Authors should disclose in their manuscript any financial or other substantive conflict of interest that might have influenced the presented results or their interpretation.

By submitting a manuscript, the authors agree to abide by the Editorial Policies of the Ethiopian Medical Journal

.

Editorial responsibilities

The Editor-in-Chief is responsible for deciding which articles submitted to the journal will be published. The decisions are made based exclusively on the manuscript's merit. They must be free from any racial, gender, sexual, religious, ethnic, or political bias. When making decisions the Editor-in-Chief is also guided by the editorial policy and legal provisions relating to defamation, copyright infringement and plagiarism.

Members of the Editorial Board including the Editor-in-Chief must hold no conflict of interest about the articles they consider for publication. Members who feel they might be perceived as being involved in such a conflict do not participate in the decision process for a manuscript.

The information and ideas presented in submitted manuscripts shall be kept confidential.

Editors and the editorial staff shall take all reasonable measures to ensure that the authors/reviewers remain anonymous during and after the evaluation process in accordance with the type of reviewing in use.

The Editorial Board is obliged to assist reviewers with additional information on the manuscript, including the results of checking manuscript for plagiarism.

Reviewers' responsibilities

Reviewers are required to provide the qualified and timely assessment of the scholarly merits of the manuscript. The reviewer takes special care of the real contribution and originality of the manuscript. The review must be fully objective, and the judgment of the reviewers must be clear and substantiated by arguments.

The reviewers assess manuscript for the compliance with the profile of the journal, the relevance of the investigated topic and applied methods, the scientific relevance of information presented in the manuscript, and the pres-

entation style. The review has a standard format. It is submitted through the online journal management system where it is stored permanently.

The reviewer must not be in a conflict of interest with the authors or funders of research. If such a conflict exists, the reviewer is obliged to promptly notify the Editor-in-Chief. The reviewer shall not accept for reviewing papers beyond the field of his/her full competence.

Reviewers should alert the Editor-in-Chief to any well-founded suspicions or the knowledge of possible violations of ethical standards by the authors. Reviewers should recognize relevant published works that have not been considered in the manuscript. They may recommend specific references for citation but shall not require citing papers published in the Ethiopian Medical Journal, or their own papers, unless it is justified.

The reviewers are expected to improve the quality of the manuscript through their suggestions. If they recommend correction of the manuscript prior to publication, they are obliged to specify the way this can be achieved. Any manuscript received for review must be treated as confidential document.

Ethical Considerations

Dealing with unethical behavior

Anyone may inform the Editor-in-Chief at any time of suspected unethical behavior or any type of misconduct by giving the necessary credible information/evidence to start an investigation.

- Editor-in-Chief makes the decision regarding the initiation of an investigation.
- During an investigation, any evidence should be treated as confidential and only made available to those strictly involved in the process.
- The accused will always be given the chance to respond to any charges made against them.

If it is judged at the end of the investigation that misconduct has occurred, then it will be classified as either minor or serious.

Minor misconduct (with no influence on the integrity of the paper and the journal, for example, when it comes to misunderstanding or wrong application of publishing standards) will be dealt with directly with authors and reviewers without involving any other parties. Outcomes include:

- Sending a warning letter to authors and/or reviewers.
- Publishing correction of a paper, e.g. when sources properly quoted in the text are omitted from the reference list.

Publishing an erratum, e.g. if the error was made by editorial staff.

In the case of major misconduct, the Editor-in-Chief may adopt different measures:

- Publication of a formal announcement or editorial describing the misconduct.
- Informing officially the author's/reviewer's affiliating institution.

The formal, announced retraction of publications from the journal in accordance with the Retraction Policy.

- A ban on submissions from an individual for a defined period.

Referring a case to a professional organization or legal authority for further investigation and action.

The above actions may be taken separately or jointly. If necessary, in the process of resolving the case relevant expert organizations, bodies, or individuals may be consulted.

When dealing with unethical behavior, the Editorial Board will rely on the guidelines and recommendations provided by the Committee on Publication Ethics (COPE).

Plagiarism prevention

The Ethiopian Medical Journal does not publish plagiarized papers. The Editorial Board has adopted the stance that plagiarism, where someone assumes another's ideas, words, or other creative expression as one's own, is a clear violation of scientific ethics. Plagiarism may also involve a violation of copyright law, punishable by legal action.

Plagiarism includes the following:

- Self-plagiarism, which is using one's own previous work in another context without citing that it was used previously
- Verbatim (word for word), or almost verbatim copying, or purposely paraphrasing portions of another author's work without clearly indicating the source or marking the copied fragment (for example, using quotation marks) in a way described under Authors' responsibilities;
- Copying equations, figures or tables from someone else's paper without properly citing the source and/or without permission from the original author or the copyright holder.

Any manuscript which shows obvious signs of plagiarism will be automatically rejected. In case plagiarism is discovered in a paper that has already been published by the journal, it will be retracted in accordance with the procedure described under Retraction policy, including blacklisting the author(s).

To prevent plagiarism, the manuscripts are submitted to a plagiarism detection process. The results obtained are verified by the Editorial Board in accordance with the guidelines and recommendations of the Committee on Publication Ethics (COPE).

Retraction policy

Legal limitations of the publisher, copyright holder or author(s), infringements of professional ethical codes, such as multiple submissions, bogus claims of authorship, plagiarism, fraudulent use of data or any major misconduct require retraction of an article.

Occasionally, a retraction can be used to correct numerous serious errors, which cannot be covered by publishing corrections. A retraction may be published by the Editor-in-Chief, the author(s), or both parties consensually.

The retraction takes the form of a separate item listed in the contents and labeled as "Retraction".

The original article is retained unchanged, except for a watermark on the PDF indicating on each page that it is "retracted".

Open access

Open access policy

The Ethiopian Medical Journal is published under an Open Access license. All its content is available free of charge. Users can read, download, copy, distribute, print, search the full text of articles, as well as to establish HTML links to them, without having to seek the consent of the author or publisher.

The right to use content without consent does not release the users from the obligation to give the credit to the journal and its content in a manner described under Licensing.

Article processing charge

The Ethiopian Medical Journal does not charge authors or any third party for publication in its regular quarterly Issues. Both manuscript submission and processing services, and article publishing services are free of charge. There are no hidden costs whatsoever.

Copyright & Licensing**Copyright**

Authors retain copyright of the published papers and grant to the publisher the non-exclusive right to publish the article, to be cited as its original publisher in case of reuse, and to distribute it in all forms and media.

Users are required to provide full bibliographic description of the original publication (authors, article title, journal title, volume, issue, pages), as well as its DOI code. In electronic publishing, users are also required to link the content with both the original article published in the Ethiopian Medical Journal.

Authors can enter into separate, additional contractual arrangements for the non-exclusive distribution of the journal's published version of the work (e.g., post it to an institutional repository or publish it in a book), with an acknowledgement of its initial publication in this journal.

Self-archiving policy

Authors are permitted to deposit publisher's version (PDF) of their work in an institutional repository, subject-based repository, author's personal website (including social networking sites, such departmental websites at any time after publication.

Full bibliographic information (authors, article title, journal title, volume, issue, pages) about the original publication must be provided and links must be made to the article's DOI and the license.

Disclaimer

The views expressed in the published works do not express the views of the Editors and the Editorial Staff of the Ethiopian Medical Journal. The authors take legal and moral responsibility for the ideas expressed in the articles. The Publisher (The Ethiopian Medical Association) shall have no liability in the event of issuance of any claims for damages. The Publisher will not be held legally responsible should there be any claims for compensation.

GUIDELINES FOR AUTHORS

The *Ethiopian Medical Journal (EMJ)* is the official Journal of the Ethiopian Medical Association (EMA) devoted to the advancement and dissemination of knowledge pertaining to the broad field of medicine in Ethiopia and other developing countries. Prospective contributors to the Journal should take note of the instructions of Manuscript preparation and submission to EMJ as outlined below.

Article types acceptable by EMJ

Original Articles (*vide infra*) on experimental and observational studies with clinical relevance
 Brief Communications
 Case Series
 Case Reports
 Editorials, Review or Teaching Articles: by invitation of the Editorial Board.
 Correspondences/Letters to the Editor
 Monographs or set of articles on specific themes appearing in a Special Issues of the Journal
 Book reviews
 Perspectives,
 Viewpoints
 Hypothesis or discussion of an issue important to medical practice
 Letter to the Editor
 Commentaries
 Advertisements
 Obituaries

N.B. Articles are not acceptable if previously published or submitted elsewhere in print or electronic format, except in the form of abstracts in proceedings of conferences.

Content and format of articles:

Title: The title should be on a separate page. It should not have acronyms or abbreviations. The title should be descriptive and should not exceed 20 words or 120 characters including space. The title page should include the name(s) and qualification of the author(s); the department or Institution to which the study/research is attributed and address of the corresponding Author. If the author has multiple affiliations only use the most preferred one.

1. Original Articles

2,500 words, excluding Abstracts, References, Figures and Tables. The manuscript of the Article, should appear under the following headings:

a) **Abstract:** The abstract of the Article is prepared on a separate paper, a maximum of 250 words; it should be structured under the titles: a) Background; b) Methods; c) Results; d) Conclusions. Briefly summarize the essential features of the article under above headings, respectively. Mention the problem being addressed in the study; how the study was conducted; the results and what the author(s) concluded from the results. Statistical method used can appear under Methods paragraph of the Abstract, but do not insert abbreviations or references in the Abstract section.

Keywords: Provide three to six key words, or short phrases at the end of abstract page. Use terms from medical subject heading of Index Medicus to assist in cross indexing the Article.

b) **Introduction :** Should provide a short background and context of the study and provide the rationale for doing the study. It should not be a detailed review of the subject and should not include conclusions from the paper.

- c) **Patients or (Materials) and Methods:** should contain details to enable reproducibility of the study by others. This section must include a clear statement specifying that a free and informed consent of the subjects or their legal guardians was obtained. Corresponding author should submit a copy of institution review Board (IRB) clearance or letter of permission from the hospital or department (if IRB exempt) with the manuscript. For manuscripts on clinical trials, a copy of ethical approval letter from the concerned body should be submitted with the Manuscript. If confidential data is being used for publication (such as student grades, medical board data, or federal ethics board data), then appropriate support/agreement letter should be included. Photos of patients should disguise the identity or must have obtained their written consent. Reference number for ethical approval given by ethics committee should be stated. In general, the section should include only information that was available at the time the plan or protocol for the study was being written; all information obtained during the study belongs in the Results section.
- d) **Results:** This section should present the experimental or observational data in text, tables or figures. The data in Tables and Figures should not be described extensively in the text.
- e) **Discussion:** The first paragraph should provide a summary of key finding that will then be discussed one by one in the paragraphs to follow. The discussion should focus on the interpretation and significance of the results of the study with comments that compare and describe their relation to the work of others (with references) to the topic. Do not repeat information of Results in this section. Make sure the limitations of the study are clearly stated.
- f) **Tables and Figures:** These should not be more than six. Tables should be typed in triplicate on separate sheets and given serial Arabic numbers. Titles should be clearly place underneath Tables and above Figures. Unnecessary and lengthy tables and figures are discouraged. Same results should not be presented in more than one form (choose either figure or table). Units should appear in parentheses in captions but not in the body of the table. Statistical procedures, if not in common use, should be detailed in the METHODS section or supported by references. Legends for figures should be typed on separate sheets, not stapled to the figures. Three dimensional histograms are discouraged. Recognizable photographs of patients should be disguised. Authors should submit editable soft versions of the tables and figures.
- g) **Acknowledgement:** Appropriate recognition of contributors to the research, not included under Authors should be mentioned here; also add a note about source of the financial support or research funding, when applicable.
- h) **References:**
- The titles of journals should be abbreviated according to the style used for MEDLINE (www.ncbi.nlm.nih.gov/nlmcatalog/journals).
 - References should be numbered consecutively in the order in which they are first mentioned in the text and identify references in text, tables, and legends by Arabic numerals in parentheses.
 - Type the References on a separate sheet, double spaced and keyed to the text.
 - Personal communications should be placed NOT in the list of references but in the text in parentheses, giving name, date and place where the information was gathered or the work carried out (e.g. personal communication, Alasebu Berhanu, MD, 1984, Gondar College of Medical Sciences). Unpublished data should also be referred to in the text.
 - References with six or less authors should all be listed. If more than six names, list the first three, followed by et al.
 - Listing of a reference to a journal should be according to the guidelines of the International Committee of Medical Journal Editors ("Vancouver Style") and should include authors' name(s) and initial(s) separated by commas, full title of the article, correctly abbreviated name of the journal, year, volume number and first and last page numbers.
 - Reference to a book should contain author's or authors' name(s) and initials, title of chapter, names of editors, title or book, city and name of publisher, year, first and last page numbers.

The following examples demonstrate the acceptable reference styles.

Articles:

- Gilbert C, Foster A. Childhood blindness in the context of Vision 2020: the right to sight. *Bull World Health Org* 2001;79:227-32
- Teklu B. Disease patterns amongst civil servants in Addis Ababa: an analysis of outpatient visits to a Bank employee's clinic. *Ethiop Med J* 1980;18:1-6
- Tsega E, Mengesha B, Nordenfelt E, Hansen B-G; Lindberg J. Serological survey of human immunodeficiency virus infection in Ethiopia. *Ethiop Med J* 1988; 26(4): 179-84
- Laird M, Deen M, Brooks S, et al. Telemedicine diagnosis of diabetic retinopathy and glaucoma by direct ophthalmoscopy (Abstract). *Invest Ophthalmol Vis Sci* 1996; 37:104-5

Books and chapters from books:

- Henderson JW. Orbital Tumors, 3rd ed. Raven Press New York, 1994. Pp 125-136.
- Clipard JP. Dry Eye disorders. In Albert DM, Jakobiec FA (Eds). Principles and Practice of Ophthalmology. W.B Saunders: Philadelphia, PA 1994 pp257-76.

Website:

- David K Lynch; laser History: Masers and lasers.
<http://home.achilles.net/jtalbot/history/massers.htm> Accessed 19/04/2001

2. Brief Communication

Short versions of Research and Applications articles, often describing focused approaches to solve a health problem, or preliminary evaluation of a novel system or methodology

- Word count: up to 2000 words
- Abstract up to 200 words; excluding: Abstract, Title, Tables/Figures and References
- Tables and Figures up to 5
- References (vide supra – Original Article)

3. Case Series

Minimum of three and maximum of 20 cases

- Up to 1,000 words; excluding: Abstract, Title, Tables/Figures and References
- Abstract of up to 200 words; structured; (vide supra)
- Statistical statements here are expressed as 5/8 (62.5%)
- Tables and Figures: no more than three
- References: maximum of 20

4. Case Report

Report on a rare case or uncommon manifestation of a disease of academic or practical significance

- Up to 750 words; excluding: Abstract, Title, Tables/Figures and References
- Abstract of up to 100 words; unstructured;
- Tables and Figures: no more than three
- References: maximum of 10

5. Systematic review

Review of the literature on topics of broad scientific interest and relevant to EMJ readers

- Abstract structured with headings as for an Original Article (vide supra)
- Text should follow the same format as what is required of an Original Article
- Word count: up to 8,000 words, excluding abstract, tables/Figures and references
- Structured abstract up to 250 words
- Tables and Figures up to 8

6. Teaching Article

A comprehensive treatise of a specific topic/subject, considered as relevant to clinical medicine and public health targeting EMJ readers

- By invitation of the Editorial Board; but an outline of proposal can be submitted
- Word limit of 8,000; excluding abstract, tables/Figures and references
- Unstructured Abstract up to 250 words

7. Editorial

- By invitation of the Editorial Board, but an editorial topic can be proposed and submitted
- Word limit of 1,000 words: excluding references and title; no Abstract
- References up to 15.

8. Perspectives

- By invitation of the Editorial board, but a topic can be proposed and submitted
- Word limit of 1,500
- References up to six

9. Obituaries

- By invitation of the Editorial board, but readers are welcome to suggest individuals (members of the EMA) to be featured.

Preparation of manuscripts

- Manuscripts must be prepared in English, the official language of the Journal.
- On a single separate sheet, there must be the title of the paper, with key words for indexing if required, and each author's full name and professional degrees, department where work was done, present address of any author if different from that where work was done, the name and full mailing address of the corresponding author, including email, and word count of the manuscript (excluding title page, abstract, references, figures and tables). Each table/figures/boxes or other illustrations, complete with title and footnotes, should be on a separate page.
- All pages should be numbered consecutively in the following order: Title page; Abstract and key-words page; main manuscript text pages; References pages; acknowledgment page; Figure-legends and Tables
- The Metric system of weights and measures must be used; temperature is indicated in degrees Centigrade.
- Generic names should be used for drugs, followed by propriety brand name; the manufacturer name in parenthesis, e.g. diazepam (Valium, Roche UK)
- Statistical estimates e.g. mean, median proportions and percentages should be given to one decimal place; standard deviations, odds ratios or relative risks and confidence intervals to two decimal places.
- Acronyms/Abbreviations should be used sparingly and must be given in full, at first mention in the text and at the head of Tables/foot of Figure, if used in tables/figures.eg. Blood Urea Nitrogen (BUN). Interstitial lung disease (ILD).
- Use the binomial nomenclature, reference to a bacterium must be given in full and underlined - underlining in typescript becomes italics in print (e.g. *Hemophilus influenzae*), and later reference may show a capitalised initial for the genus (e.g. *H. influenzae*)
- In the text of an article, the first reference to any medical phrase must be given in full, with the initials following in parentheses, e.g., blood urea nitrogen (BUN); in later references, the initials may be used.
- Manuscripts for submission should be prepared in Microsoft Word document file format

Submission of manuscripts

- As part of the submission process, authors are required to check off their submission's compliance with journals requirements

- All manuscripts must be submitted to the Editor-in-Chief of the Journal with a statement signed by each author that the paper has not been published elsewhere in whole or in part and is not submitted elsewhere while offered to the *Ethiopian Medical Journal*. This does not refer to abstracts of oral communications at conferences/symposia or other proceedings.
- It is the author's responsibility to proof-read the typescript or off-print before submitting or re-submitting it to the Journal, and to ensure that the spelling and numerals in the text and tables are accurate.
- Authors should submit their work through the Ethiopian Medical Journal website; ema.emj@telecom.net.et.

Conflict of interest

Authors should disclose at the time of submission of manuscripts any conflict of interest, which refers to situations in which financial or other personal considerations may compromise, or have the appearance of compromising their professional judgment in conducting or reporting the research results They should declare that there is no conflict of interest to declare if there is none,

Manuscripts review procedures

The procedures for manuscripts review include:

- Within one week of receipt of a manuscript, the Editorial Board will review it in reference to (i) conformity with the Journal's "guidelines to authors (revised version available in all issues starting January 2020)", (ii) relevance of the article to the objectives of the *EMJ*, (iii) clarity of presentation, and (iv) plagiarism by using appropriate software
- The Editorial Board has three options: accept manuscripts for external review, return it to author for revision, or reject it. A manuscript not accepted by a board member is blindly reviewed by another board member. If not accepted by both, the manuscript is rejected by the Editorial Board. Decision will be made by the suggestion of a third Editorial Board member if the decisions of first two do not concur.
- Once accepted for external review, the Editorial Board identifies one (for brief communication, case reports, and teaching articles) or two (for original articles) reviewers with appropriate expertise. The reviewers will be asked to review and return manuscripts with their comments online within two weeks of their receipt. Reviewers have four options; accept, accept with major revision, accept with minor revision, or reject.
- A Manuscript accepted subject revision as suggested by reviewers will be returned to the corresponding author. Author(s) will be given four weeks to respond to reviewers' comments, make necessary changes, and return the manuscript to the Editorial Board. A Manuscript not returned within the specified time will be considered withdrawn by the author(s).
- Manuscripts with minor revisions will be cleared by the Editorial Board and accepted for publication. Those with major revisions will be returned to external reviewers and follow the procedures as outlined for the initial review.

General information

The Editorial Board reserves the right for final acceptance, rejection or editorial correction of papers submitted. However, authors are encouraged to write an appeal to the Editor-in-Chief for reconsideration of rejected manuscripts or any other complaints they might have.

Accepted papers are subject to Editorial revision as required and become the copy-right of the EMA Twenty-five reprints of published articles are supplied free to the first/corresponding author.

The Editorial Board welcomes comments on the guidelines from Journal readers.

Privacy statement

The names and email addresses entered in this journal site will be used exclusively for the stated purposes of this journal and will not be made available for any other purpose or to any other party.

Acknowledgment

We gratefully acknowledge the financial support of the U.S. Centers for Disease Control and Prevention (CDC) obtained through the CDC-EMA Cooperative Agreement No. 5U2GPS000834. We also warmly thank those who generously give donations to meet the Journal's cost.

THE ETHIOPIAN MEDICAL JOURNAL

The *Ethiopian Medical Journal*, founded in 1962, appears four times a year and is available from the Secretary, EMA House, Addis Ababa, or by mail P. O. Box 3472, Addis Ababa, Ethiopia. Request for previous issues is welcomed. For this and any other information, please contact us through:

e-mail: emjeditor2018@gmail.com **Tel.** 251-1-158174 or 251-1-533742; **Fax:** 251-1-533742

The Journal contains original articles and research of special relevance to the broad issue of medicine in Ethiopia and in other developing countries. It is listed in the *Index Medicus* and *Current Contents*. Its ISSN number is ISSN 0014-1755.

If you wish to subscribe to the Journal, please complete the section below and return it to the Secretary. The Subscription rates are:

Ethiopia: Eth. Birr 372 annually, postage included; World-wide: US\$ 120, airmail postage included

.....

Request to: The Secretary, *Ethiopian Medical Journal*, P. O. Box 3472, Addis Ababa, Ethiopia. I wish to subscribe to the *Ethiopian Medical Journal* for the Year(s) to

Name

Address

I enclose my subscription fee of

Signed

Cheques should be made payable to the *Ethiopian Medical Journal*. If payment is made by Bank Transfer (A/C No. 0172018004100, Commercial Bank of Ethiopia, Addis Ababa Branch), please ensure that the Secretary of the Ethiopian Medical Journal is notified of the transfer.

NOTICE TO MEMBERS OF THE ETHIOPIAN MEDICAL ASSOCIATION

If you are a paid-up member of EMA, and have not received your copy of EMJ, please notify the secretary, with the support of your ID card or letter from your hospital. Also, if you are transferred to a different hospital or institution, please return the following change of address form **PROMPTLY**.

NAME (in block)

FORMER ADDRESS:

P. O. BOX CITY/TOWN

NEW ADDRESS

INSTITUTION

P. O. BOX CITY/TOWN