ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCE

DEPARTMENT OF SURGERY NEUROSURGERY UNIT

CLINICAL AND RADIOGRAPHIC EVALUATION OF POSTERIOR CERVICAL ARTHRODESIS AND STABILIZATION USING LATERAL MASS SCREW AND ROD AT ALERT HOSPITAL,ADDIS ABABA ,ETHIOPIA

Investigator : Surafel Mekonnen,MD

Advisor: Azarias Kassahun, MD, FCS (ECSA), Associate Professor of Neurosurgery,Neurosurgery Unit, Department of Surgery, AAU

Samuel Getahun, MD, Assistant professor of neurosurgery, Neurosurgery Unit, Department of Surgery, AAU

A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCE, DEPARTMENT OF SURGERY, NEUROSURGERY UNIT FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS IN NEUROSURGERY SPECIALITY PROGRAM

NOVEMBER , 2024

ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCE

DEPARTMENT OF SURGERY NEUROSURGERY UNIT

CLINICAL AND RADIOGRAPHIC EVALUATION OF POSTERIOR CERVICAL ARTHRODESIS AND STABILIZATION USING LATERAL MASS SCREW AND ROD AT ALERT HOSPITAL,ADDIS ABABA ,ETHIOPIA

Investigator : Surafel Mekonnen,MD

Advisor: Azarias Kassahun, MD, FCS (ECSA), Associate Professor of Neurosurgery,Neurosurgery Unit, Department of Surgery, AAU

Samuel Getahun, MD, Assistant professor of neurosurgery, Neurosurgery Unit, Department of Surgery, AAU

A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCE, DEPARTMENT OF SURGERY, NEUROSURGERY UNIT FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS IN NEUROSURGERY SPECIALITY PROGRAM

NOVEMBER , 2024

CERTIFICATION

As thesis research advisor, I hereby certify that I have read and evaluated this thesis prepared under my guidance by Surafel Mekonnen (MD), entitled" Clinical and radiographic evaluation of posterior cervical arthrodesis and stabilization using lateral mass screw and rod at alert hospital, addis ababa ,ethiopia," A Retrospective Study.
I recommend this study to be submitted as fulfilling the thesis requirement.

Advisor full name _____

Signature _____

Date ____/_____/_____

Advisor full name _____

Signature _____

Date ____/____/_____

DECLARATION

I Surafel Mekonnen (MD) declare that this paper is a result of my independent research work on the topic entitled "Clinical and radiographic evaluation of posterior cervical arthrodesis and stabilization using lateral mass screw and rod at alert hospital, addis ababa ,Ethiopia",

A Retrospective Study, in partial fulfillment of the requirements for specialty certificate in Neurosurgery at Addis Ababa University, College of Health Sciences, Department of Surgery, Neurosurgery Unit.

This work has not been submitted for a degree to any other university. All the references are also acknowledged.

Dr. Surafel Mekonnen

Signature: _____

Date: ___/_____/_____

Contents

AKNOWLEDGMENT 6
ACRONYMS 7
Abstract 5
1.INTRODUCTION 6
1.1 Background 6
1.2 Statement of the Problem 7
1.3Significance of the study 8
2.Literature Review 9
3 Objective 12
GENERAL OBJECTIVE 12
SPECFIC OBJECTIVE 12
METHODS AND MATERIAL 13
Methodology 13
4.1. Study area and period 13
4.2. Study design 13
4.3. Source and study population 13
4.4. Inclusion and Exclusion criteria 13
4.4.1. Inclusion criteria 13
4.4.2. Exclusion criteria 13
4.5. Sample Size Determination 14
4.6. Variables 14
4.6.1. Dependent Variables 14
4.6.2. Independent variables 14
4.8. Data analysis and processing 15
4.9. Data quality control 15
4.10. Operational Definition 16
4.11. Ethical consideration 16

4.12. Dissemination data 16
5.Result 16
5.1 Sociodemographic status 16
5.2 PREOPERATIVE CLINICAL EVALUATION 18
5.3 Intraoperative evaluation 22
5.4 POSTOPERATIVE EVALUATION 24
6.Discussion 30
7.Conclusion 31
8.Limmitation of the study 31
Reference ..... **Error! Bookmark not defined.**
Annex I 34
ANNEX II 39
mJOA 39
ANEX III 41
ASIA IMPAIRMENT SCALE 41

ACKNOWLEDGMENT

I would like to express my deepest appreciation to my advisors Dr. Azarias Kassahun and Dr Samuel Getahun for their invaluable comments and advice throughout the work of this thesis. I would like to thank Addis Ababa University College of Health Science And ALERT hospital for allowing me to conduct this research.

ACRONYMS

ACDF : Anterior cervical discectomy and fusion

ALERT : All Africa Leprosy, Tuberculosis And Rehabilitation Training Centre

ASIA :American Spinal Injury Association (Asia) Impairment Scale

AAU :Addis Ababa University

CT : Computed Tomography

DM :Diabetes mellitus

HTN : Hypertension

LMSF :Lateral Mass Screw Fixation

MJOA :Modified Japan Orthopedic Association Score For Cervical Myelopathy

SD : standard deviation

Abstract

Background: Lateral mass screw and rod fixation is the most practiced instrumentation for posterior cervical arthrodesis and stabilization for indication of cervical instability, trauma, neoplasm, decompression, and deformity correction**.** There is paucity of data in clinical and radiologic evaluation of Lateral mass screw and rod fixation especially in our setup.

Objective: Clinical and radiographic evaluation of posterior cervical arthrodesis and stabilization using lateral mass screw and rod fixation.

Method: Single center retrospective cross-sectional study of lateral mass screw and rod fixation from September 2019 up to September 2024 was evaluated with clinical and radiographic parameters. Sixty six patients were evaluated using structured questionnaire. Clinical parameters including Demographics and Neurological Status in trauma assessed by ASIA score, Functional Assessment in degenerative conditions by (mJOA), Radiographic Evaluation (computed tomography and dynamic x-ray) of 325 lateral mass screws inserted on 66 patients evaluated. Complications and Adverse Events (Infection, hardware failure, neurologic status, vascular incidents,) were assed from patient chart and radiology archive.

Result : The age of patients ranged from 16 up to 75 with mean age of 40.1yr and 84.9% within age of 20 up to 60. Male account for 84.8% and 15.2% are female**.** Post-traumatic indications accounted for 92.4% of cases, with fracture dislocations observed at C4/C5 (28.8%), C5/C6 (25.8%), C6/C7 (16%), and C4/5 (10.8%).Unilateral locked facet in 4.5% and floating lateral mass in 6%. Total of 325 screws inserted of which 110,79, 75, 57are at C5,C4,C6,C3 respectively in descending order. There was neither postoperative neurologic worsening nor improvement in the immediate postoperative ASIA score. Inadvertent Dural tear 3% articular joint violation in 1.9% and one patient had hardware failure on immediate postop period from loosening of screw nuts with dislodged rod. The postoperative rate of surgical site infection is 6%. Postoperative follow up ASIA score is significantly associated with preoperative ASIA score with Likelihood ratio and fishers exact test P value <0.001. Mean of Postoperative follow up mJOA is 13.3±0.58 SD has an increment compared to preoperative mean mJOA that is 8.67±1.16 SD.

Conclusion: Lateral mass screw and rod fixation is effective treatment modality for cervical stabilization in our set up.

1.INTRODUCTION

1.1 Background

Cervical spine disorders are a significant cause of morbidity and disability worldwide, with varying etiologies ranging from degenerative conditions to traumatic injuries. Among the treatment modalities available for addressing cervical spine pathologies, posterior cervical arthrodesis and stabilization using lateral mass screw and rod constructs have gained prominence due to their efficacy in providing stability and facilitating fusion.

However, the applicability and outcomes of such surgical interventions may vary across different populations and healthcare settings. In Ethiopia, the burden of cervical spine disorders is notable.

Despite the growing need for effective surgical interventions, there is a dearth of local research assessing the clinical and radiographic outcomes of posterior cervical arthrodesis and stabilization procedures using lateral mass screw and rod constructs in Ethiopian patients. Understanding the efficacy, safety, and challenges associated with these procedures in the local context is crucial for optimizing patient care and surgical decision-making.

Therefore, this proposed research aims to conduct a comprehensive evaluation of the clinical and computed tomographic (CT) outcomes of posterior cervical arthrodesis and stabilization utilizing lateral mass screw and rod constructs in patients treated at ALERT hospital in Addis Ababa, Ethiopia.

1.2 Statement of the Problem

Despite prevalence of cervical spine disorders in Ethiopia, there is a lack of locally tailored research assessing the outcomes of surgical interventions, specifically posterior cervical arthrodesis and stabilization using lateral mass screw and rod constructs. This knowledge gap presents several significant issues

1 Limited Local Data: The absence of comprehensive clinical and radiographic data on the outcomes of posterior cervical arthrodesis and stabilization procedures using lateral mass screw and rod constructs hampers evidence-based decision-making tailored to the Ethiopian population.

2 Inadequate Patient Outcomes Monitoring: Without a systematic evaluation of patient outcomes following these surgical procedures, there is a lack of understanding regarding the extent of pain relief, neurological improvement, and functional recovery achieved, hindering the ability to assess the effectiveness of interventions and optimize patient care pathways

Addressing these issues requires a comprehensive evaluation of the clinical and radiographic outcomes of posterior cervical arthrodesis and stabilization procedures using lateral mass screw and rod constructs among patients treated at government hospitals in Addis Ababa, Ethiopia. Such research endeavors are essential for improving the quality of care, optimizing surgical decision-making, and ultimately enhancing patient outcomes in the management of cervical spine disorders in Ethiopia

1.3Significance of the study

Understanding the clinical and radiographic outcomes of this specific surgical technique is crucial for improving patient outcomes. Conducting the study in government hospitals in Addis Ababa ensures that the findings are directly relevant to the local healthcare context. Study results can serve as a guide for clinicians in Ethiopia and potentially in similar resource-limited settings worldwide.

2.Literature Review

Many techniques for cervical stabilization have been evaluated in the management of cervical disorders. Anterior and posterior approaches are applied commonly. Posterior approach is approach of choice for posterior pathologies, and long segment constructs and stabilization requiring upper cervical spine. (1) (2)

Options of posterior instrumentation of cervical spine include lateral mass screw with rod or plate, pedicle screws, Trans laminar screws. The most commonly practiced approach for posterior stabilization is lateral mass screws using plate or rod system. Screw rod systems are preferred over plate for conditions with associated deformity because the plates have fixed holes which makes the instrumentation suboptimal. In our setup because of economic burden and unavailability of plates screw rod fixation is used. (3)

Posterior cervical fixation with lateral mass screws was first introduced in 1979 and has been used increasingly since that time to treat a variety of cervical spine disorders.Several screw instrumentation techniques have been described since Roy-Camille introduced the procedure. Anatomic insertion of screw the insertion point inferior and medial to center of lateral mass trajectory towards superior lateral tip of the rectangle is the main technique in our setup. They all have similar protocols except for the insertion point and angulation of the screw. Roy-Camille screw lengths varied from a minimum of 8.8 mm to a maximum of 14 to 15 mm. (3) (4)

In a review of techniques of Posterior Sub axial Cervical Spine Screw Fixation Andrei et al described screw insertion techniques by Roy-Camille, Louis, Magerl, Anderson, An, Riew (5).

John G et al performed an anatomic study comparing 3 techniques of lateral mass screws: Magerl, Anderson, and An. For each technique, 1 specimen received 20 screws from C3 to C7 using 20-mm screws to purposefully overpenetrate the lateral masses. The nerve violation obtained was 95% (Magerl technique), 90% (Anderson technique), and 60% (An technique) ($P < .05$). In this study we are planning to identify spesfic technique applied the relative frequency complications. (6)

Radiologic evaluation on lateral mass screw placement for lateral mass screw using Roy-camil and magrel technique by Ebrahim et al each vertebral body is divided vertically into four zones. Zone one is the most posterior. Another equal zone posterior to posterior border of veretebral body is pre zone one. The ideal screw tip location using Roy camil was zone 1 and for magrel technique is prezone one.

Globally lateral mass screw insertion is practiced for Several indications including cervical instability, trauma, neoplasm, decompression, and deformity correction. (7) (8) (9)

Posterior lateral mass screw-rod fixation performed after multilevel cervical spine laminectomy by mohammed et al showed that in 4 month to 8 yr follow up for 430 patients and 2500 screws inserted .Twelve patients had wound infection, of whom 6 had deep infection. Twenty patients had C5 radicular pain that subsided over time; 2 required C5 screw modification; and another 3 required screw repositioning at different levels. Two patients had asymptomatic screw pull-out evident only on radiographs and required no treatment. Iatrogenic dural tear occurred in 12 patients with severe spondylosis, while CSF leakage from the tear was observed in 3 patients. Symptomatic adjacent segment disease was noted in 4 patients within the follow-up period and was treated with surveillance (10)

Lateral mass screws inserted for traumatic cerical spine indication on 88 patients, with cervical injury confirmed radiologically excluding patients less than 12 or greater than 70 years, with traumatic discs, cord compression without subluxation and previously operated on cervical spine showed that The most common level of injury was C5-C6 in 46(52%) patients. And the neurologic status according to Frankel's grade 35 (39.8%) patients were placed in Grade A, 15(17.05%) in Grade B, 22(25%) in Grade C, 12 (13.6%) in Grade D, four (4.5%) in Grade E on admission. Postoperatively, 16 (18.2%) patients were placed in Grade A, 23 (26.1%) in Grade B, eight (9.1%) in Grade C, nine (10.2%) in Grade D and 26(29.6%) patients in Grade E with an overall improvement in neurological function in 51(58%) and power in 37(42%) patients. The major complications encountered were respiratory infections in 10(11.36%) and wound infection in four (4.5%) while eight (9.1%) patients expired (11)

In A prospective study of 200 lateral mass screws which have been placed in 25 (eight women and 17 men) patients aged 20–76 years over a mean followup of 1.5 year No patients experienced iatrogenic neural or vascular injury. Four patients experienced superficial wound infection. Three patients had pain around the shoulder of C5 distribution which subsided over time. No patients developed screw pullouts or symptomatic adjacent segment disease within the period of follow-up. (12)

Assesmnt of Complication and efficacy in maintaining saggital balance by Lateral mass screw fixation for cervical spine trauma showed Instrumentation failure (eg, screw breakage, rod breakage, or decoupling of rod and screw) was judged on plain radiographs. (13)

Loss of fixation was defined as radiographic evidence of screw pullout from the lateral mass or a change greater than 5 degree in sagittal plane alignment on successive radiographs. Fusion was assessed at 6 months and at subsequent visits by radiographic and clinical examination (pain, tenderness, clinical alignment of head and neck, etc.). For 28 of the 29 patients, the mean change in sagittal alignment from the immediate postoperative to the most recent follow-up radiographic examination was 2degree (range, 0to 6). Radiographically, there was one case of instrumentation/fixation failure and loss of sagittal alignment 3 months postoperatively. Other complications included one case of C5 nerve root injury and four wound infections (14)

Clinical indicators by Hugh Deen et al included surgical indication, postoperative neurological status, and wound healing. Radiographic indicators included early postoperative CT scan to check for screw placement and plain radiographs at subsequent visits. Postoperative radiographs were analyzed for evidence of loss of alignment, pseudarthrosis, and adjacent segment degeneration .Of a total of 888 screws implanted in 100 patients acute complications included radiculopathy (4, 0.45% per screw placed), infection , other wound healing problems , and CSF leak . There were no examples of spinal cord injury or vertebral artery injury. (15)

Early complications included loss of alignment and pseudarthrosis and screw breakage 0.22% per screw placed.

On prospective clinical series of 21 patients and 212 lateral mass screws inserted 1.4 % developed transient single level radiculopathy by Deen et al.

Lateral mass screw fixation in 30 children of age 3 to 16 yr done by Hedquest et al for indication of ten instability, 11deformity, seven trauma, five tumor, and three congenital abnormalities There were no revisions due to screw failure or dislodgement. There were no vascular or neurologic complications (16)

In this study we aim to asses preoperative clinical parameters clinical like the indication for surgery,the preopretaive ASIA score for traumatic indications and mJOA score for degenerative cervical spine. Intraoperatively we will asses the specific screw insertion technique applied. But because of different operating physician and different institution we might face challenge.

3 Objective

GENERAL OBJECTIVE

Clinical and radiographic evaluation of posterior cervical arthrodesis and stabilization using laterral mass screw and rod at government hospitals in addis ababa ,Ethiopia

SPECFIC OBJECTIVE

1. To assess the clinical outcomes, including pain relief, neurological improvement, and functional status, following posterior cervical arthrodesis and stabilization procedures using lateral mass screw and rod constructs at government hospitals in Addis Ababa, Ethiopia.

2. To evaluate the radiographic outcomes, focusing on the extent of fusion and presence of complications, as observed on postoperative computed tomography (CT) scans and dynamic radiographs among patients undergoing posterior cervical arthrodesis and stabilization.

3. To investigate patient-related factors, such as age, gender, comorbidities, surgical indications, and preoperative neurological status, influencing the outcomes of posterior cervical arthrodesis and stabilization using lateral mass screw and rod constructs.

4. To identify any intraoperative and postoperative challenges or complications encountered during posterior cervical arthrodesis and stabilization procedures, including but not limited to infection, implant failure, and adjacent segment degeneration, in the context of ALERT hospital in Addis Ababa, Ethiopia.

METHODS AND MATERIAL

Methodology

4.1. Study area and period

The study is conducted at ALL AFRICAN LEPROSY,TUBERCULOSIS, REHABLIATION AND TRAINING CENTER, where majority of the Ethiopias spine procedure is performed.

The study is conducted in patients operated from from September 2019-september 2024

4.2. Study design

Design of the study is Retrospective cross-sectional study

4.3. Source and study population

4.3.1. Source population

All patients for whom lateral mass screw is inserted

4.3.2. Study population

All patients for whom lateral mass screw is inserted

4.4. Inclusion and Exclusion criteria

4.4.1. Inclusion criteria

All patients for whom lateral mass screw was inserted

4.4.2. Exclusion criteria

Patients with lost charts

Patients who have anterior cervical procedure

Patients seen in those clinics outside the study period

Patients absent from follow up

4.5. Sample Size Determination

The size of sample will be determined with taking 50%proportion of prevalence,since there is no study on clinical and radiographic evaluation of posterir cervical arthrodesis and stabilization using laterral mass screw and rod at government hospitals in addis ababa ,Ethiopia, with a margin of error to be 5%, a confidence level of 95% and considering non-response rate of 10%, the representative sample of participants will be determined using a single proportion formula for a cross-sectional survey as follows.

$n=\frac{z(\frac{a}{2})^2}{d^2}pq=\frac{(1.96)^2*0.5*0.5}{(0.05)^2}$=, 384, add 10% non-response rate=422.

But the number of procedures performed is less than the sample size , all patients who meet the inclusion and exclusion criteria will Be selected .

4.6. Variables

4.6.1. Dependent Variables

CLINICAL

Postoperative clinical outcome

ASIA score for trauma

MJOA for degenerative cervical spine

Radiographic

1. **Lateral mass screw and rod assessment**

4.6.2. Independent variables

1. Age
2. Sex
3. Level fused
4. Screw size
5. Screw trajectory
6. Indication for surgery (trauma,degenerative)
7. Comorbidity (diabetes,hypertension,known malignancy)
8. Preoperative neurologic status

4.7. Data collection procedure

Data will be collected with well structured questionnaire written in English language. The questioner will be contained information of sociodemographic variables, clinical presentations, imaging, types of surgical procedure, clinical outcomes. Each patient will have specific questioners to be filled during follow-up visits.

4.8. Data analysis and processing

All the collected questionnaires will be checked manually for completeness and consistency. The collected data will be coded and entered to SPSS for data processing and analysis. Simple descriptive statistics such as a frequency distribution and percentages will be performed to describe the demographic. Binary logistic regression will be used to measure association of each covariate with outcome variable. In addition, factors that have association with outcome variable will be taken in the multivariable logistic regression analysis to control the potential confounders. The result of the final model will be expressed in terms of adjusted Odd Ratios (AOR) and 95% CI and Statistical significance will be declared if the P-value is less than 0.05.

4.9. Data quality control

To maintain the quality of the data, the data collectors and supervisors will be trained for one day. The data collectors will be residents. The project coordinator will have an ongoing supervision and reviewing of each completed data during the data collection to ensure the quality of data by checking filled formats for their completeness and consistency throughout data collection period.

4.10. Operational Definition

Psudoarthroses for spesfic spinal level

-interspinous distance on dynamic xray >2mm

- absence of trabecular bone formation between facet joints

4.11. Ethical consideration

Ethical Was obtained from Addis Ababa University Institution Review Board. Data collection will be starting after approval and obtained oral informed consent from hospital administrator. All information obtained from patient medical card will be kept confidentially.

4.12. Dissemination data

The research will be submitted and presented to Addis Ababa University. It will be presented on research forum which will organize by Addis Ababa University or other concern bodies. It will be also published on different scientific journal.

5.Result

5.1 Sociodemographic status

Out of 66 patients for whom lateral mass screw and rod fixation was done 56(84.8%) are male and 10(15.2%) are female. Age ranges from16 year upto 75 were operated. The mean age being 40 and 84.9% of patients are from age 20 to 60 yr. 72.7% of the patients are from Amhara,Oromiya and South Nation nationalities and peoples.

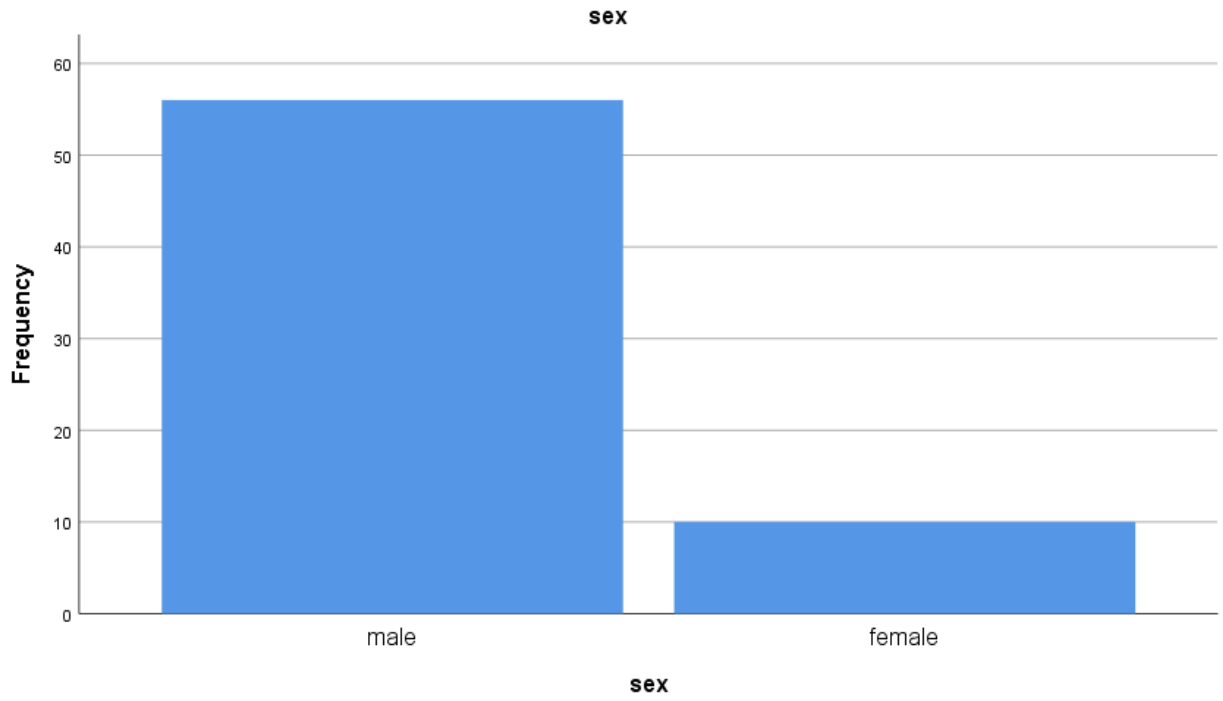


Figure1. Sex of patients for whom LMSF was done

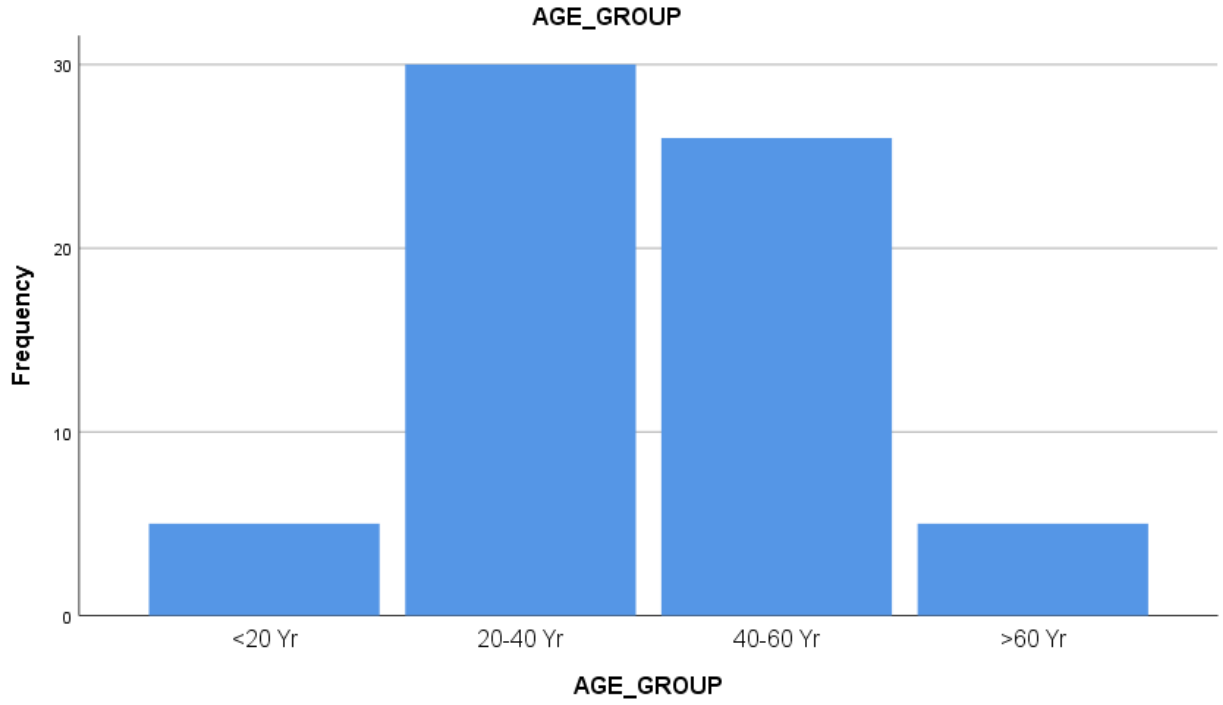


Figure2. Age range of patients for whom LMSF was done

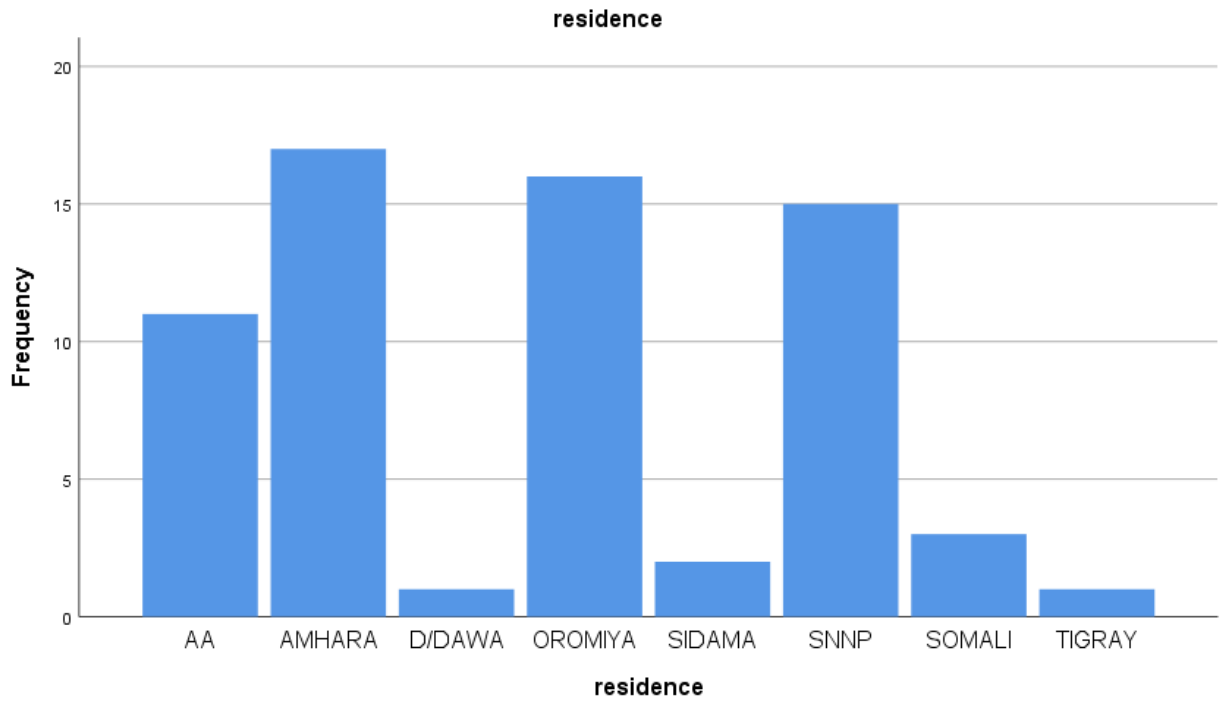


Figure3..State of residence of patients for whom LMSF was done

5.2 PREOPERATIVE CLINICAL EVALUATION

5.2.1 Indication for surgery

Post traumatic indications account for 61(92.4%) of all cases operated followed by post laminectomy for degenerative cervical spine disease which is 5% and one case after resection of intradural extramedullary cervical spine tumor.

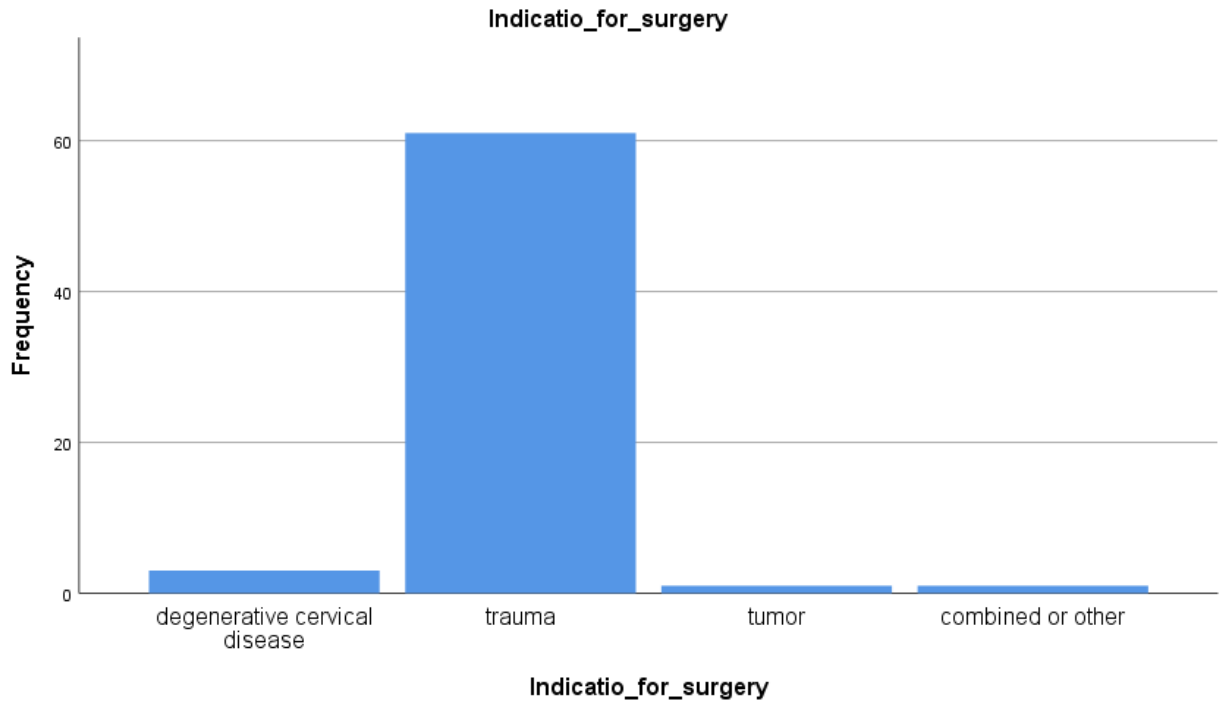
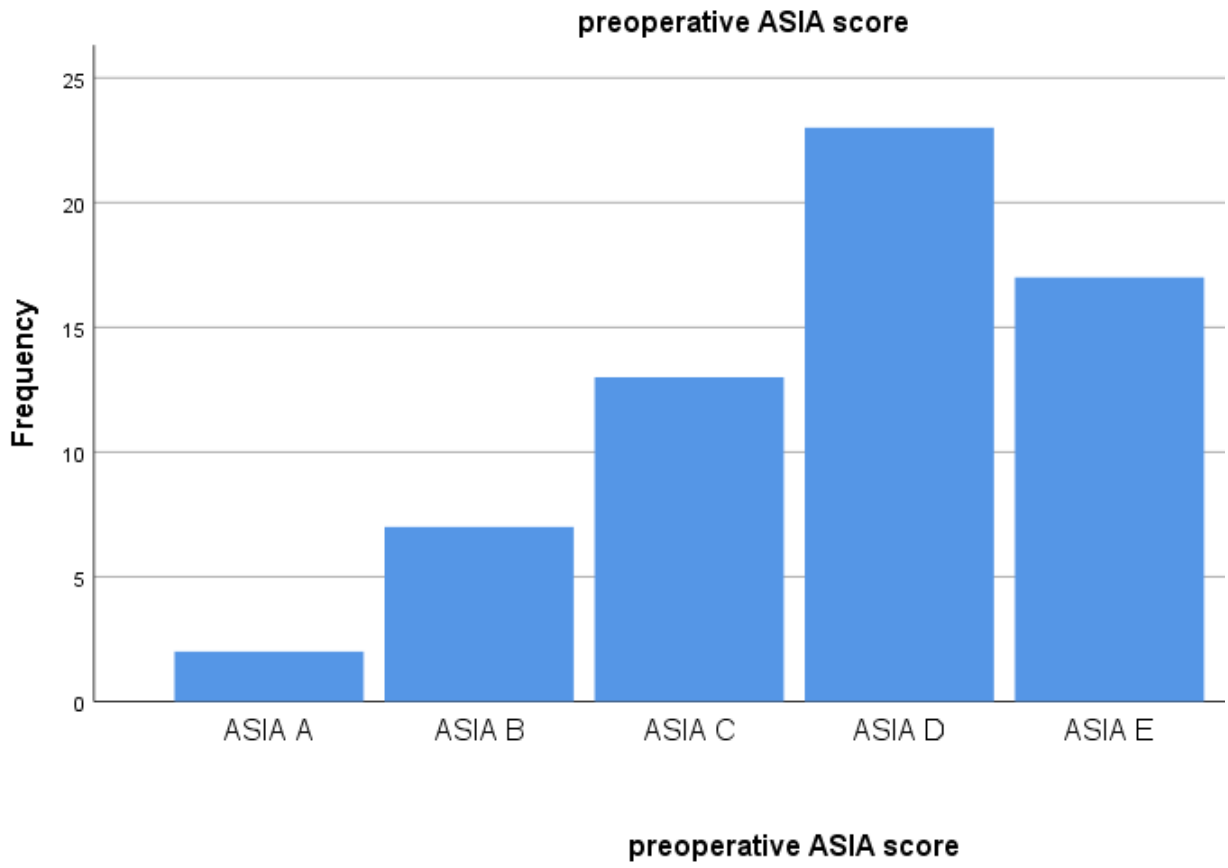


Figure4. Indication for LMSF

5.2.2 Preoperative ASIA score of patients of cervical spine trauma

Incomplete spinal cord injury is the major in 65% of the patients with 34.8% ASIA D , 19.7% ASIA C and 10.6 % ASIA B patients. Twenty five percent are ASIA E and only 3% are ASIA A patients.



`Figure 5. Preoperative ASIA score for traumatic indications of LMSF

5.2.3 Specfic level of trauma

Cervical injury classification score with fracture pathology type was described on the evaluated charts. Fracture dislocation being the most common. C4/ C5 fracture dislocation is 28.8% followed by C5/C6 25.8%. Sixteen percent had C6/C7 fracture dislocation. Unilateral locked facet in 4.5% and floating lateral mass in 6%.

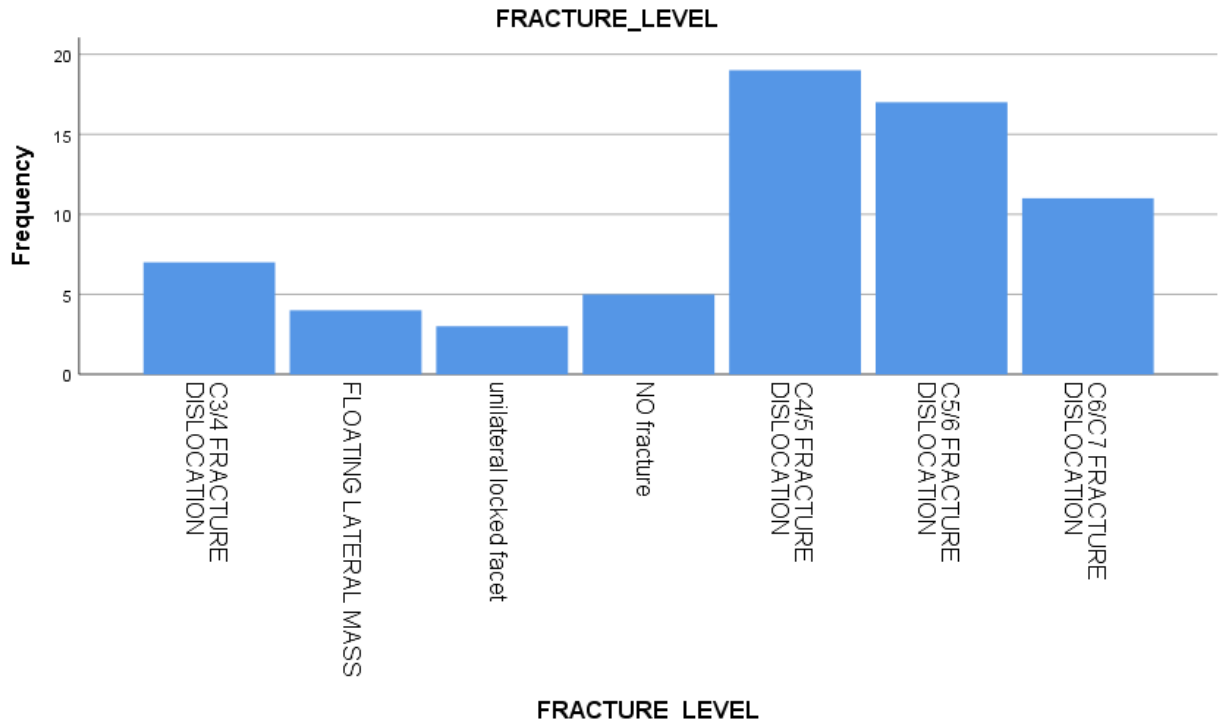


Figure 6.Level of fracture for operated LMSF

5.2.3 Degenerative spine disorder indication

The lateral mass screws with rod fixation was done for 5% of the patients. Except one patient all were after standard laminectomy for multilevel degenerative cervical spondylosis. One patient was operated for post ACDF spnodylolitshesis for posterior stabilization.

The preoperative mJOA functional assessment for all patients was severe (<11).

5.2.3 Tumor

For one patient lateral mass fixation was done after long segment laminectomy for cervical intradural extramedulary mass.

5.3 Intraoperative evaluation

5.3.1 Technique and duration

The lateral mass screws are inserted by individualized anatomic technique of insertion starting point inferiomedial to center of lateral mass aiming the lateral superior edge of the rectangle of lateral mass.

Mean duration of surgery is 154.5 minute .Fifty three percent of the patients are operate in 120 to 180 minutes. Three percent of the procedures lasted more than 240 minute and required repeat dose of intraoperative antibiotics.

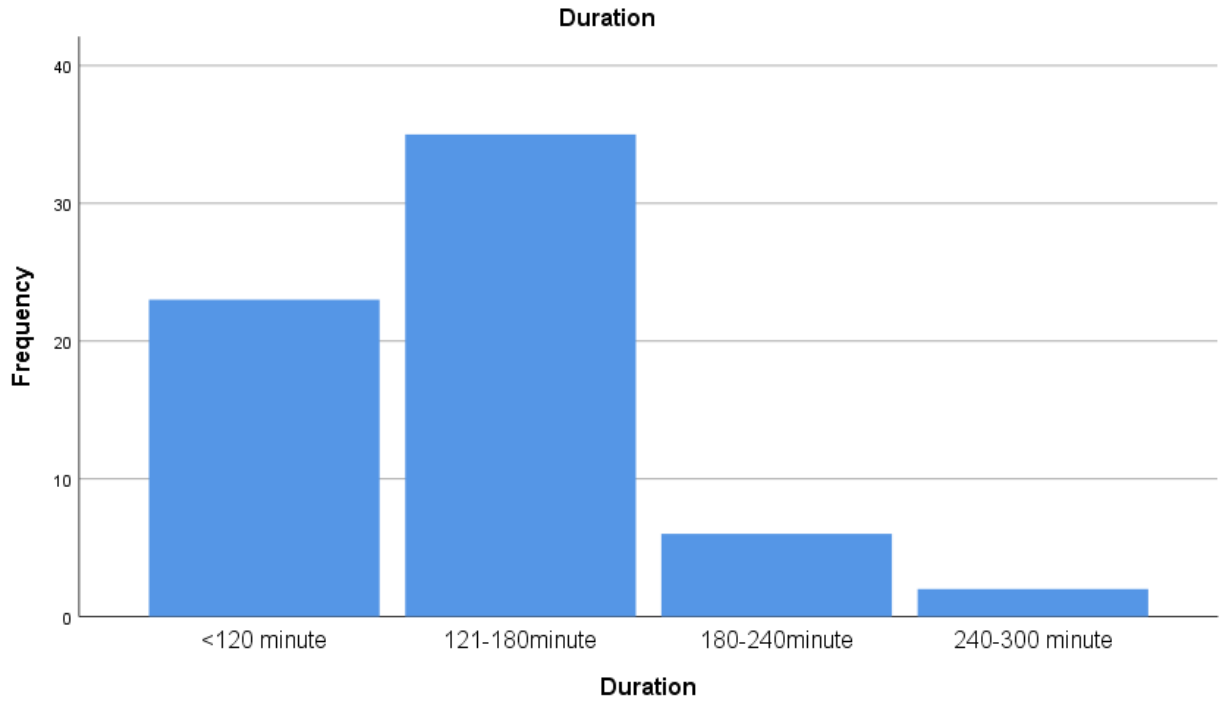


Figure 7. Duration of surgery in minute

5.3.2 Blood loss during surgery

The estimated blood loss is less than 500 ml in 84.8% of the patients and between 500ml to 1000ml in 13.6% of the cases. 1.5% had blood loss between 1000 and 1500ml.

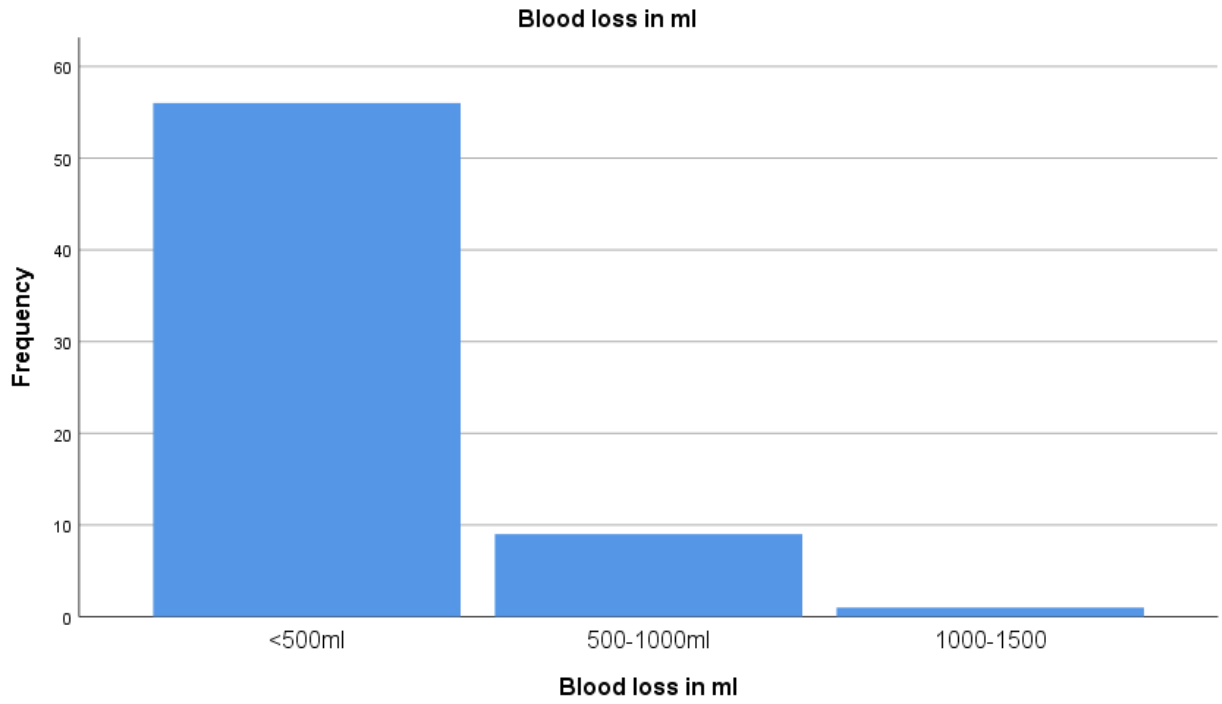


Figure8.Estimated blood loss in ml during LMSF

5.3.3 Level of screw insertion

Total number of screw inserted are 325 from C3 up to C6. The highest number inserted at C5 which is 110 screw followed by C4 79 screw. Screw insertion at C6 and C3 is 75 and 57 respectively.

Statistics

		SUM_OF_LMS_C3_to_C6	C3 LMS	C4 LMS	C5 LMS	C6 LMS
N	Valid	66	66	66	66	66
	Missing	0	0	0	0	0
Sum		325	57	79	110	75

Table 1 number of screw inserted

5.3.4 Intraoperative complications

Documented intaraoperative complication is in 4(6.1%) of the patients. Two of the patients(3%) had inadvertent dural tear and one patient has breach to foramen transversarum and one patient has lateral breakage of lateral mass.

No intraoperative nerve root injury or vascular incident documented.

5.4 POSTOPERATIVE EVALUATION

5.4.1 POSTOPERATIVE CLINICAL EVALUATION

Post operative ASIA score on immediate postoperative period was similar to preoperative period.

Postoperative pain status was not measured by objective parameters but 54% of the patients were described as having mild surgical site pain controlled with analgesics and 3% had persistent pain which continued in the follow-up period.

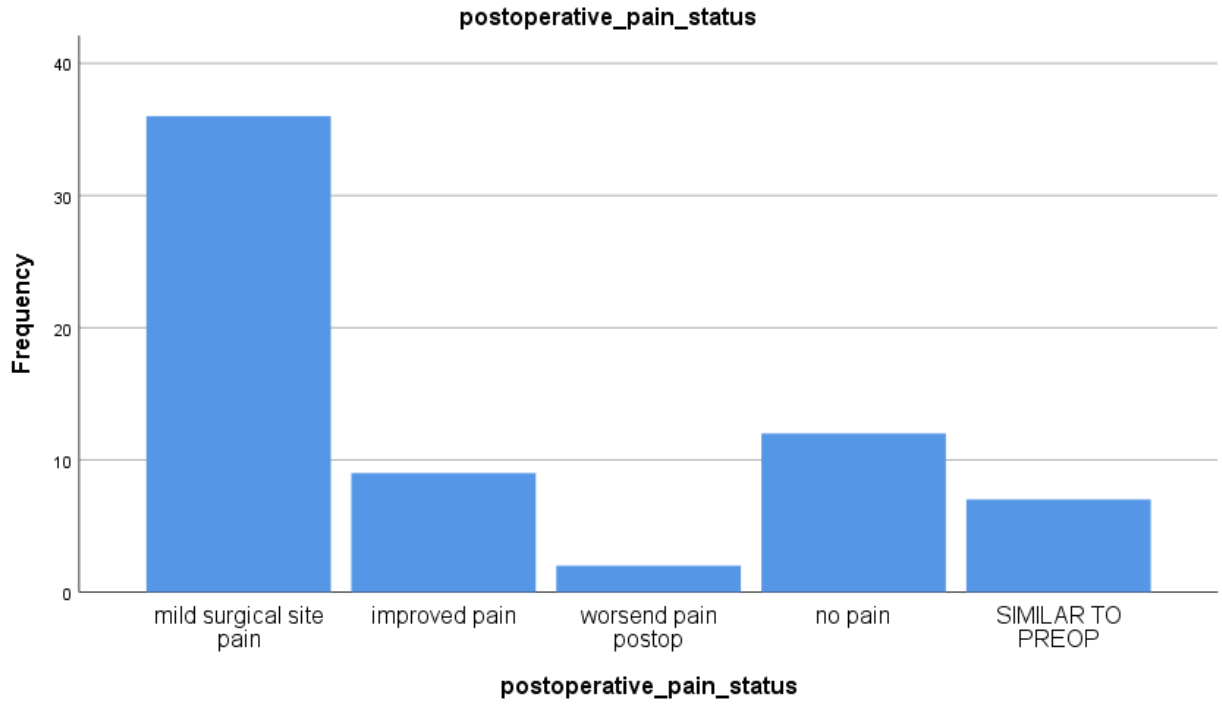


Figure9. Comparison of immediate postoperative period pain

Superficial surgical site infection occurred in 4(6.1%) of the patients. Which was managed non surgically with wound care and antibiotics. Pus culture was not done in any of the cases.

No delayed vascular incident happened in any of the cases. No new motor or sensory deficit occurred postoperatively.

5.4.2 POSTOPERATIVE RADIOLOGIC EVALUATION

All of the operated patients have postoperative AP and Lateral cervical radiograph. For the radiographic evaluation of proper placement of screws there was hindrance poor penetration of the X-Ray and 14 of the images were not true lateral cervical spine xray.

There was articular joint violation in six screws (1.9%) out of the 325 screws inserted.

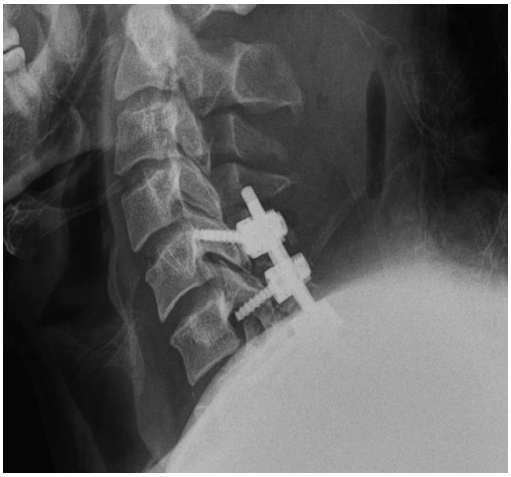
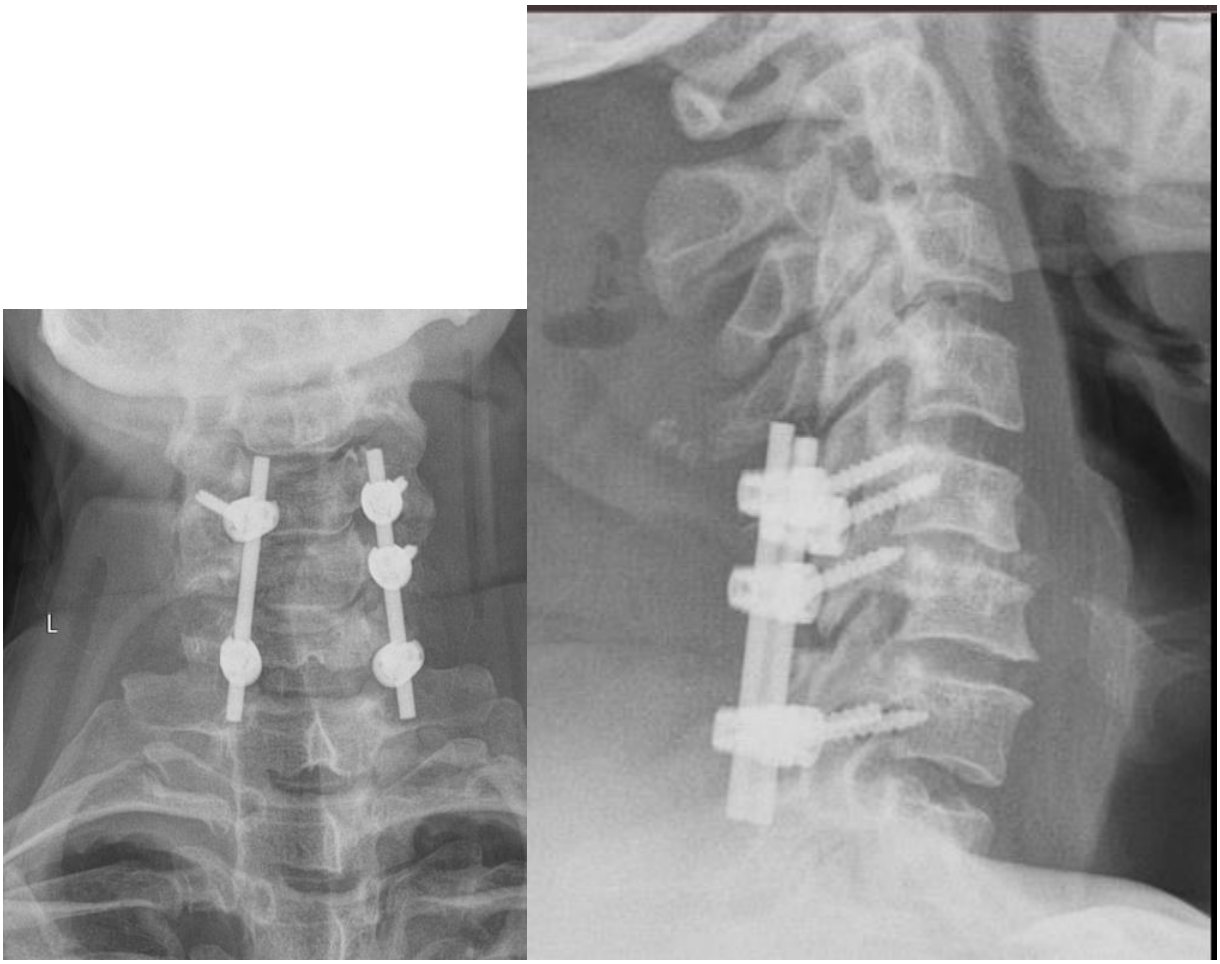


Figure 10 Screw tip that violated articular space

Three screw were only partly in the lateral mass.



A AP view B Lateral view

Figure 11 screws outside lateral mass or pedicle

One patient had hardware failure on immediate postop radiograph with dislodged nut and displaced rod. Which required revision surgery.

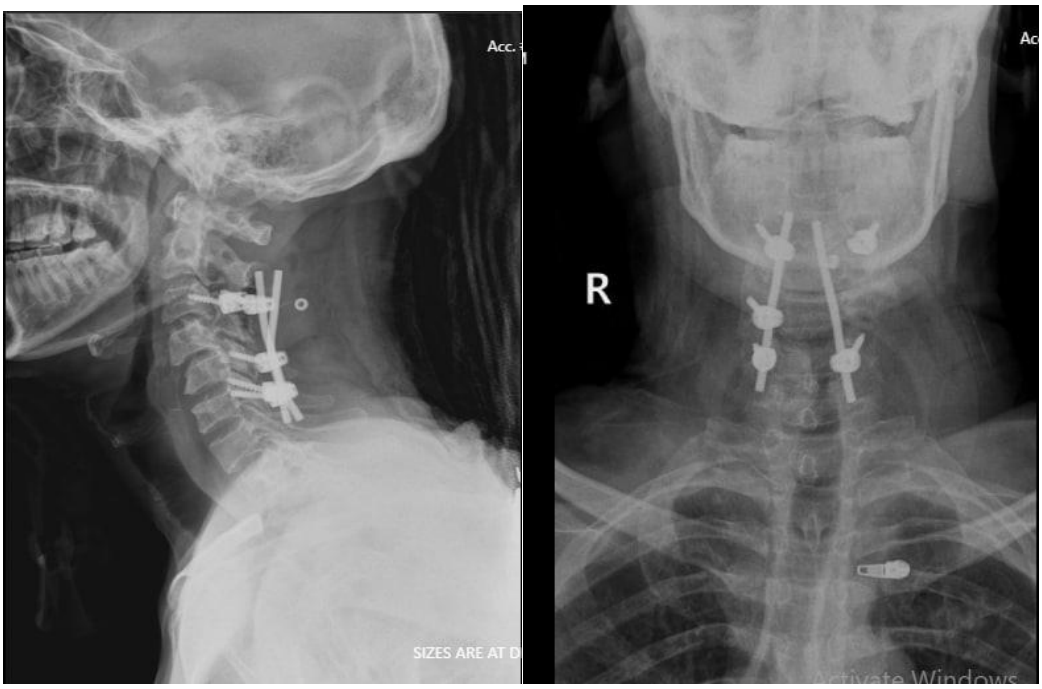


Figure 12 Immediate postop hardware failure

There was violation of foramen transversarum of vertebral artery in two of the patients with no vascular incident as described above.

Figure 13 Breach in to foramen transversarum

Postoperative clinical and radiologic follow-up at 3,6 and 12 month was not assessed due to incomplete data to evaluate the Fusion status and longterm clinical and radiologic outcome.

5.5 POSTOPERATIVE CLINICAL OUTCOME

Final follow-up time ranges from 2 months to 38 months with mean of 15.3±7.6 SD.

5.6 OUTCOME ANALYSIS

Assuming the goal of lateral mass screw fixation was to prevent worsening in neurologic status measured by ASIA score for trauma and mJOA score for degenerative spine, Pearson chi square test was conducted to determine the relation of preoperative and post-operative ASIA scores for patients after lateral mass screw fixation.

Bivariate analysis between postoperative ASIA score and age, sex, level of c-spine fused, duration of surgery, presence of screw malposition, level of fracture was done there was no significant association.

Because 83.3% of the cells have value less than the expected which is 20%, Fishers exact test and Likelihood ratio was analyzed to evaluate the association. The p value is <0.001 which is significant <0.005. Therefore there is significant association between preoperative ASIA score and ASIA SCORE AT FOLLOWUP.

Significant number of transfer is found from ASIA C to ASIA D which is 9(69%) . ASIA A patients were not found on the postoperative followup. Zero % of Preoperative ASIA E patients are grouped to ASIA Din postoperative Followup.

Mean of Postoperative mJOA is 13.3±0.58 SD has an increment when compared to preoperative mean mJOA that is 8.67±1.16 SD.

			POSTOP_ASIA_SCORE				
			ASIA B	ASIA C	ASIA D	ASIA E	Total
preoperative ASIA score		Count	4	0	0	0	0	4
		Expected Count	.6	.1	.3	1.8	1.2	4.0
		% within preoperative ASIA score	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	ASIA A	Count	2	0	0	0	0	2
		Expected Count	.3	.1	.2	.9	.6	2.0
		% within preoperative ASIA score	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	ASIA B	Count	3	2	2	0	0	7
		Expected Count	1.1	.2	.5	3.1	2.1	7.0
		% within preoperative ASIA score	42.9%	28.6%	28.6%	0.0%	0.0%	100.0%
	ASIA C	Count	1	0	3	9	0	13
		Expected Count	2.0	.4	1.0	5.7	3.9	13.0
		% within preoperative ASIA score	7.7%	0.0%	23.1%	69.2%	0.0%	100.0%
	ASIA D	Count	0	0	0	20	3	23
		Expected Count	3.5	.7	1.7	10.1	7.0	23.0
		% within preoperative ASIA score	0.0%	0.0%	0.0%	87.0%	13.0%	100.0%
	ASIA E	Count	0	0	0	0	17	17
		Expected Count	2.6	.5	1.3	7.5	5.2	17.0
		% within preoperative ASIA score	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
Total		Count	10	2	5	29	20	66
		Expected Count	10.0	2.0	5.0	29.0	20.0	66.0
		% within preoperative ASIA score	15.2%	3.0%	7.6%	43.9%	30.3%	100.0%

Table 2 preoperative ASIA score * Postopertive ASIA score on followup. Crosstabulation

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	129.284[a]	20	.000	.[b]
Likelihood Ratio	119.519	20	.000	.000
Fisher's Exact Test	96.805			.000
N of Valid Cases	66			

a. 25 cells (83.3%) have expected count less than 5. The minimum expected count is .06.

b. Cannot be computed because there is insufficient memory.

Table 3 Chi square test of preop ASIA and postop ASIA score

6.Discussion

Lateral mass screw and rod fixation is the gold standard technique for posterior cervical stabilization and fusion globally and in Ethiopia. However there was no study in Ethiopia which evaluated the operated cases clinically and radiographically, we evaluated those patients operated at ALERT hospital which is dominant spine center in the country.

Sex difference with male predominance in operated patient was seen by Mohammed M. Al Barbarawi is 65% male and 35%female(13). Ahmed S.A. Elfattah also showed that 68% of operated patents are male and 32% female. IN our study **84.8%** are male and **15.2%** are female with wide age gap as compared to other studies.

Age range of our patients is mainly from 20 to 60yr which account for 84.9% of the cases. Mean age is 40.1 with youngest being 16 year old and oldest 75 year old. This result is comparable with what was seen by Sang Hyun kim et al, age ranged from19upto 83 in the 65 patients evaluated.

Unlike global references the commonest indication for LMSF in our study is trauma which accounts for 92.4 % of the cases. Mohammed M. Al Barbarawi's evaluation of 2500 screws only 17.2% are for traumatic indication and 74% was for degenerative cervical spine disorder(13). H.Gordon deen et also showed 66% of was for indication of degenerative cervical spine disorder.This comparison is also true for other studies and shows that traumatic indications are significant on our study. Of these fracture dislocation at C/5 and C5/6 account for 54.6% of the operated cases. Open reduction and fixation by lateral mass screw for unilateral locked facet in 6%of the cases.

Though there are different techniques of screw insertion, our study group are operated by individualized anatomic technique of insertion starting point inferiomedial to center of lateral mass aiming the lateral superior edge of the rectangle of lateral mass. This technique is suitable to have indivisualized intraoperative decision.

The procedures took less than 120 minute in 34.8% of the cases and 53% between 120 to 180 minutes. Oer all less than 87.8% of cases are operated in less than 180 minutes. With the mean duration of surgery being 154 minute. Those wich lasted more than 180 minute are for the spine tumor and few of the degenerative spine indication. There is no identified global study to asses duration of surgery on anatomic technique of insertion. So our study gives an insight for further evaluation.

Level of screw insertion span in our study was majorly 3 levels. C5 having 33.8% of the screws inserted. In most of other studies screw insertion spanned from C3-C6, which can be ascribed to the indications in those studies being degenerative cervical spine disorder. (5),(8),(10),(13)

Blood loss is less than 1000ml in 98.4% of the cases with no requirement of transfusion. Which reduces transfusion related complication.

As compared to 0-1.4% of postop radiculopathy even requiring revision surgery, there was no identified single level radiculopathy. No C5 radiculopathy identified.

The incidence of inadvertent durotmy and CSF leak was3% slightly higher compared to range from 0-2.1%.(1),(5)(8). Trauma being major indication. can have effect on this. So this needs further study.

There incidence of postoperative surgical sight infection is 6.1% which is comparable with multiple studies. All of the cases had superficial surgical site infection as compared to other studies which had infected seromas requiring surgical management.(7),(8),(10),(13 .No intraoperative vascular incident identified.

On the postoperative radiographic evaluation of the screws Majority of the screws have optimum position but there was articular joint violation in 1.9% and one patient had hardware failure on immediate postop period from loosening of screw nuts with dislodged rod. Which was revised. Two patients had screw breach to foramen transversarum but no vascular complication identified. As compared to global studies the rate of complication is comparable but needs further follow up to asses the long term outcome. Clinical outcome assessed by follow-up ASIA score is significantly associated with preoperative ASIA score with P value<0.001

7.Conclusion

Lateral mass screw and Rod fixation is the major technical armamentarium in our practice of care for cervical spine disorders mainly traumatic cervical spine conditions in our set up. The rate of complications evaluated clinically and radio graphically is Acceptable. The result of this study will help us to have further study on long term outcome and have further prospective stu

8.Limmitation of the study

- The study was done on review of documented case cards and records, so inadequate card recording and keeping system made records incomplete, missed and illegible.
- Missing of radiologic follow up for assessment of fusion and clinical outcome due to inadequate data

REFERENCE

1. *Cervical lateral mass screw-rod fixation: Surgical experience with 2500 screws.* Allouh, Mohammed M. Al Barbarawi & Mohammed Z. 2015, British Journal of Neurosurgery, October 2015; 29(5): 699–704, pp. 699-704.

2. *Lateral Mass Screw Fixation in the Cervical Spine.* Jeffrey D. Coe, MD, Alexander R. Vaccaro, MD, PhD, Andrew T. Dailey, MD, Richard L. Skolasky Jr., ScD,. 2013, J Bone Joint Surg Am. , pp. 2136-43.

3. *Early management of spinal injuries.* Roy-Camille R, Gaillant G, Bertreaux D.. 1979, McKibben B, ed. Recent Advances Orthopedics, pp. 57–87.

4. *Anatomic considerations for standard and modified techniques of cervical lateral mass screw fixation .* Andrew A. Merola, MDa, B. Andrew Castro, MD,Paul R. Alongi, MD,Sameer Mathur, MD. 2002, Spine, pp. 430-435.

5. *Posterior subaxial cervical spine screw.* Andrei Fernandes Joaquim, Marcelo Luis Mudo,. 2018, Global Spine journal , pp. 1-10.

6. *Anatomic comparision of Lateral mass screw Techniques.* John G Heller, Greg D Carlson. 1991, Spine, p. 553.

7. *Safety Evaluation of Freehand Lateral Mass Screw Fixation in the Subaxial Cervical Spine.* ., Hak-Sun Kim et al . 2007, SPINE, pp. pp 2 – 5.

8. *Decompressive cervical laminectomy and lateral mass scre rod arthrodesis.* Moh'd M Al Barbarawi1, Ziad A Audat,Moutasem M Obeidat,Waleed F Dabbas1. 2011, Scoliosis, p. 6:10.

9. *Lateral mass screw fixation of complex spine cases.* M. O. KELLEHER, L. MCEVOY, J. P. YANG, M. H. KAMEL & C. BOLGER. 2008, British Journal of Neurosurgery, pp. 663–668.

10. *Cervical lateral mass screw-rod fixation: Surgical experience wit 2500 consecutive screws, an analytical review, and long-term outcomes.* Mohammed M. Al Barbarawi & Mohammed Z. Allouh, , •. April 2015, British Journal of Neurosurgery, pp. 699-704.

11. *Lateral mass screw fixation in cervical spine .* Lal Rehman, Iram Bukhar. 2017, Pak J Med Sci , p. 1355.

12. *Evaluation of lateral mass fixation of the cervical spine.* Ahmed S.A. Elfattah, . 2019, The Egyptian Orthopaedic Journa, pp. 249–256.

13. *Reconstruction of the Subaxial Cervical Using lateral mass and facet screw instrumentation.* Mehmet Aydogan, MD , Meric Enercan, MD , Azmi Hamzaoglu, MD , and Ahmet Alanay , MD. 2012, SPINE , pp. 335–E341.

14. *Lateral mass screw fixation for cervical spine trauma.* Dhruv B. Pateder, MD, John J. Carbone, MD. 2006, The Spine Journal , pp. 40–43.

15. *Lateral mass screw–rod fixation of the cervical spine.* H. Gordon Deen, MD, Barry D. Birch, MD. 2003, The Spine Journal , pp. 489–495.

16. *Lateral mass screw fixation in children.* Hresko, Daniel Hedequist • Mark Proctor • Timothy. 2010, J Child Orthop , pp. 197–201.

18. *Radiological consideration of posterior cervical lateral mass fixation using plate and screw:,.* ., Seung-Hwan et al. yonsei medical journal , p. vol45. No 3.

Annex I

Questionnaires

CLINICAL EVALUATION

1. **PATIENT DEMOGRAPHICS**

   1.1. AGE

   1.2. SEX A,MALE B FEMALE

   1.3. MARRITAL STATUS A SINGLE B,MARRIED C ,DIVORCED D, WIDOWED

   1.4. RESIDENCE A,URBAN B , RURAL

   1.5. PHONE NUBER _____

   1.6. DATE OF OPERATION _____

   1.7. DATE OF DISCHARGE _____

2. **PRE-OPERATIVE SYMPTOMS**

   2.1. PAIN INTENSITY

   2.2. LOCATION OF PAIN (NECK, ARM, SHOULDER)

   2.3. FUNCTIONAL LIMITATIONS (Mjoa for Degenerative spine , ASIA score for trauma)

   2.4. RADICULOPATHY

2.5. MYELOPATHY

2.6. MOTOR WEAKNESS

2.7. SENSORY LOSS

2.8. OTHER : _____

3. **INDICATIONS FOR SURGERY**

3.1. DEGENERATIVE CERVICAL DISEASE

3.2. TRAUMA

3.3. TUMOR

3.4. INFLAMMATORY CONDITION

3.5. OTHER : _____

3.6. SPECIFIC LEVELS OF INVOLVEMENT (C3-C7):

C2 C3 C4 C5 C6 C7

4. **INTRA-OPERATIVE PARAMETERS**

4.1. LEVELS OF LATERAL MASS SCREW FIXATION:

4.2. SCREW LENGTH AND DIAMETER:

4.3. SURGICAL TIME:

4.4. INTRAOPERATIVE COMPLICATIONS

4.5. SCREW MALPOSITION

4.6. NERVE ROOT INJURY

4.7. DURAL TEAR

4.8. VASCULAR INJURY

4.9. OTHER : _____

5. **POST-OPERATIVE CLINICAL EVALUATION**

5.1. PAIN REDUCTION

5.2. NEUROLOGICAL IMPROVEMENT:

5.3. FUNCTIONAL OUTCOME

5.4. DURATION OF HOSPITAL STAY

5.5. ANY IMMEDIATE POST-OP COMPLICATIONS

5.6. WOUND INFECTION

5.7. HARDWARE FAILURE

5.8. VASCULAR INJURY

5.9. NEUROLOGICAL DEFICIT

5.10. OTHER: _____

5.11. REOPERATION REQUIRED (Indication) _____

6. **FOLLOW-UP (3 MONTHS, 6 MONTHS, 12 MONTHS)**

6.1. PERSISTENT OR RECURRENT SYMPTOMS:

6.2. RANGE OF MOTION (ROM) ASSESSMENT:

6.3. LATE COMPLICATIONS

6.4. HARDWARE FAILURE,

6.5. INFECTION

6.6. ADJACENT SEGMENT DISEASE

6.7. PERSISTENT PAIN

6.8. HARDWARE FAILURE

6.9. NONUNION

6.10. OTHER

RADIOGRAPHIC EVALUATION

7. **PRE-OPERATIVE IMAGING**

7.1. IMAGING MODALITY USED (CT, MRI, X-RAY):

7.2. EXTENT OF PATHOLOGY

7.3. SPINAL CORD COMPRESSION

7.4. LATERAL MASS INVOLVEMENT

7.5. PRESENCE OF CONGENITAL OR ACQUIRED SPINAL DEFORMITIES:

8. **POST-OPERATIVE IMMEDIATE IMAGING**

8.1. CORRECT PLACEMENT OF LATERAL MASS SCREWS

8.2. LEVEL OF CONSTRUCT

8.3. SCREW TRAJECTORY AND ENGAGEMENT:

8.4. UNICOTRTICAL OR BICORTICAL PRCHASE

8.5. ARTICULAR JOINT VIOLATION

8.6. EVALUATION OF SPINAL ALIGNMENT

8.7. PRESENCE OF HARDWARE-RELATED COMPLICATIONS

8.8. SCREW MALPOSITION

8.9. VERTEBRAL ARTERY INVOLVEMENT

9. **SERIAL RADIOGRAPHIC FOLLOW-UP**

9.1. STABILITY OF THE CONSTRUCT (ASSESSED AT 3 MONTHS, 6 MONTHS, 12 MONTHS VIA DYNAMIC X-RAYS OR CT):

9.2. FUSION ASSESSMENT (Dynamic xray movt >2mm)

9.3. ADJACENT LEVEL CHANGES OR DEGENERATION

9.4. HARDWARE INTEGRITY (LOOSENING, FRACTURE, MIGRATION):

10. **COMPLICATIONS ON IMAGING**

10.1. SIGNS OF PSEUDOARTHROSIS:

10.2. ADJACENT SEGMENT DISEASE (ON FOLLOW-UP IMAGING):

10.3. RADIOLOGICAL EVIDENCE OF INFECTION OR SCREW-RELATED COMPLICATIONS:

10.4. LOOSENING

10.5. BREAKAGE

10.6. MIGRATION

10.7. LUCENCY AROUND SCREW

10.8. NONE

ANNEX II

mJOA

Name:_____ Surgery Date: _____ Today's Date:_____

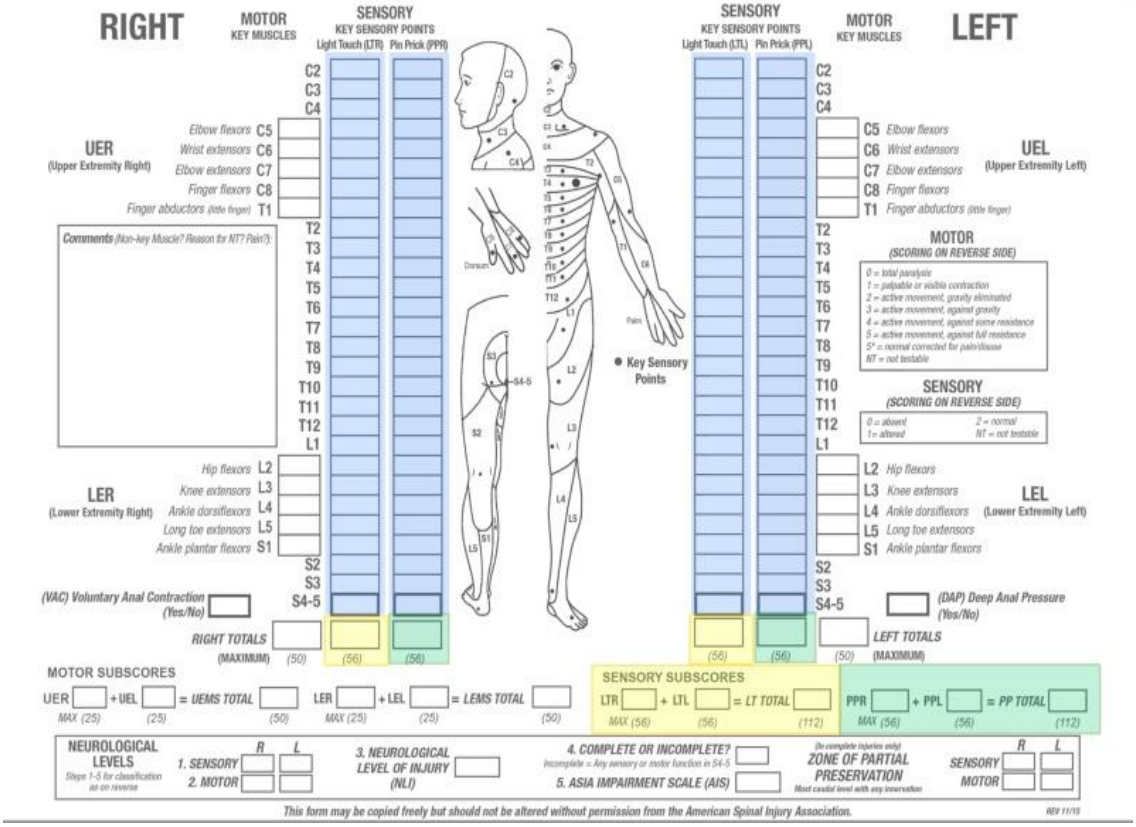
I. Motor dysfunction score of the upper extremities	Circle one
Inability to move hands	0
Inability to eat with a spoon but able to move hands	1
Inability to button shirt but able to eat with a spoon	2
Able to button shirt with great difficulty	3
Able to button shirt with slight difficulty	4
No dysfunction	5
II. Motor dysfunction score of the lower extremities	Circle one
Complete loss of motor and sensory function	0
Sensory preservation without ability to move legs	1
Able to move legs but unable to walk	2
Able to walk on flat floor with a walking aid (i.e., cane or crutch)	3

Able to walk up and/or down stairs with hand rail	4
Moderate to significant lack of stability but able to walk up and/or down stairs without hand rail	5
Mild lack of stability but walk unaided with smooth reciprocation	6
No dysfunction	7
III. Sensation	Circle one
Complete loss of hand sensation	0
Severe sensory loss or pain	1
Mild sensory loss	2
No sensory loss	3
IV. Sphincter dysfunction	Circle one
Inability to urinate voluntarily	0
Marked difficulty with micturition	1
Mild to moderate difficulty with micturition	2
Normal micturition	3

mild myelopathy	mJOA from 15 to 18
moderate myelopathy	mJOA from 12 to 14
severe myelopathy	mJOA from 0 to 11.

ANEX III

ASIA IMPAIRMENT SCALE



Grade	Type of Injury	Description of Injury
A	Complete	No sensory or motor function is preserved in sacral segments S4-S5, no sacral sparin
B	Sensory Incomplete	Sensory but not motor function is preserved below the neurological level and includ AND No motor function is preserved more than three levels below the motor level on eith
C	Motor Incomplete	Motor function is preserved below the neurological level AND

		More than half of the key muscle functions below the neurological level of injury hav 2)
D	Motor Incomplete	Motor function is preserved below the neurological level AND At least half (half or more) of the key muscle functions below the neurological level o
E	Normal	If sensation and motor function are graded as normal in all segments AND the patient had prior SCI-related deficits *Individuals without a spinal cord injury do not receive an AIS Grade.