



## Sternal Wound Infection in Patients with Sternal Fixation Using Locking Compression Plates

Mohammed A.K. Salama Ayyad<sup>1</sup>, Mohammed Alaa Nady<sup>2</sup>, Abdel-motaleb<sup>3</sup>, Dalia M. Salah<sup>4</sup> and Kareem Ahmed Hosny<sup>5\*</sup>

<sup>1</sup>Department of Cardiothoracic Surgery, Assiut University Heart Hospital, Assiut, Egypt

<sup>2</sup>Department of Cardiothoracic Surgery, Assiut University Heart Hospital, Assiut, Egypt

<sup>3</sup>Department of General Surgery, Assiut University Hospitals, Assiut, Egypt

<sup>4</sup>Department of Anesthesia and intensive care, Assiut University Hospitals, Assiut, Egypt

<sup>5</sup>Department of Cardiothoracic surgery, Assiut University Heart Hospital, Assiut, Egypt

\*Corresponding author: Kareem Ahmed Hosny, Department of Cardiothoracic surgery, Assiut University Heart Hospital, Assiut, Egypt, E-mail: Kareem\_hosny@aun.edu.eg

**Received date:** 07 April, 2022, Manuscript No. JSCP-22-60197;

**Editor assigned date:** 11 April, 2022, PreQC No. JSCP-22-60197(PQ);

**Reviewed date:** 19 April, 2022, QC No JSCP-22-60197;

**Revised date:** 29 April, 2022, Manuscript No. JSCP-22-60197(R);

**Published date:** 10 May, 2022, DOI: 10.4172/jscp.1000353.

### Abstract

**Background:** Sternal wound infection negatively affects the quality of life of our patients because they need further medical attention. There are many options for sternal fixation [1-4] with no standardization of indications for each line of management. We aim to investigate the rate of Sternal Wound Infection (SWI) when titanium plates are used in patients who needed sternal reconstruction due to traumatic causes and secondly, we want to follow up pain score when titanium plates are used.

**Methods:** This is a pilot case series study which investigates Sternal Wound Infection (SWI) rate and pain score with the use of locking compression plates. We have enrolled 23 patients over a period of 6 months.

**Results:** Our study includes 23 patients whom sternum was fixed using plates and screws technique. At 1 month follow-up, one patient presented with sternal dehiscence and two patients had superficial sternal wound infection. There are no recorded sternal wound infections at Day 60 Post-operative follow-up. It has proven to be associated with immediate relief of pain shown by the differences between pre-operative and post-operative pain scale scores in trauma patients. Median scores are 8 and 2 with range being from 7 to 9 and 1 to 4 respectively.

**Conclusion:** Locking compression plates show potentially promising results with better pain tolerability, less complications and rapid, smooth recovery. Much larger studies can be conducted with high acceptability and feasibility.

**Abbreviations:** SSIs: surgical site infection, DSWI: Deep sternal wound infection.

**Keywords:** Sternal wound infection; Locking plates; Wires; Pain; Dehiscence

### Introduction

Sternal wound infection is one of the most troublesome complications in procedures requiring sternotomy [1]. It negatively affects the quality of life of our patients [2] because they need further medical attention and care. There are many options for sternal fixation [3] which include wire fixation and sternal plating [4].

Many investigate the fixation stability of titanium plates. However, We aim to investigate the rate of Sternal Wound Infection (SWI) when titanium plates are used in patients who needed sternal reconstruction due to traumatic causes and secondly, we want to follow up pain score when titanium plates are used [5-7].

### Material and Methods

This is a pilot cases series study which investigates Sternal Wound Infection (SWI) rates when titanium plates are used in patients whom sternum needs reconstruction. Secondary measurement is pain score. Our study inclusion criteria are patients admitted to our trauma department from March 2021 to September 2021, no other associated neither injuries nor CNS injuries, blunt trauma and agree to join our study and sign our consent for study enrollment. Our exclusion criteria are immunocompromised patients due to immunosuppressing drugs or any other systemic illness that affect their immunity, patients going for a Redo operation, and multiple massive trauma with penetrating chest trauma. Planning is done based on prior assessment of patients' general condition, their preferences and a written consent is signed. Full laboratory investigations are obtained including, complete blood picture, liver function test, kidney function tests, serology and Coagulation profile. Also, Chest X-ray Postero-anterior view is obtained in addition to MSCT chest with 3D rib and sternum reconstruction. Titanium plates were used from BIOMET™ with 2.4\*8 mm self-tapping screw. Morbidity includes wound infection and postoperative pain. Also, delayed healing, sternal dehiscence and postoperative length of hospital stay at short term post-operative period will be considered. All patients were followed for 1 week post-operative and at day 30 postoperative and at Day 60 post-operative.

Primary outcome is to assess the rate of sternal wound infection. Official hospital data recoding papers will be used as the main source of data collection, stored privately with no breach for private data of patients. All investigations and imaging techniques used are performed under standard protocols with highly efficient technical preparations for pre and post-operative results (Table 1).

Subject	Patients N=23
Sex	-
Male	13
Female	10

Age average(yrs)	33.16+- 13.5
BMI>= 25	9
Hypertension	4
Smoking	6
COPD	3

**Table 1:** Shows demographics of the patients.

## Results

Our study includes 23 patients whom their sternum has been fixed using locking compression plates. All patients wear their chest belt immediately post-operative and are followed for 1 week post-operative and at day 30 postoperative and at day 60 post-operatives. At 1 month follow-up, one patient presented with sternal dehiscence which was associated with overweight (BMI=34).

We used retention sutures and local antibiotics twice daily according to culture and sensitivity. Two patients had superficial sternal wound infection [Figure 1, Figure 2] and we used local antibiotics with frequent sterile dressing and later on was sutured. We did not find any new recorded sternal wound infection at day 30 Post-operative follow-up except at one patient who had wound seroma resolved by gentle compression only. At day 60 post-operative all patients showed fully healed wounds with no signs of infection or inflammation.

Regarding pain score follow-up, it was associated with immediate relief of pain shown by the differences between pre-operative and post-operative pain scale scores in all patients. Median scores for pre-operative and post-operative, are 8 and 2 with range being from 7 to 9 and 1 to 4 respectively.

In all patients, we used broad spectrum antibiotics such as Amoxicillin / Clavulanic acid twice daily for one week and analgesia in the form of Paracetamol infusion 100 ml (1 gm/100 ml) thrice daily for the first day then we switched to paracetamol tablets 1 gm according to the patient need. Pain score ranges from 1 to 3 at Day 30 post-operative follow-up in all our patients and no pain at all could be felt at Day 60 post-operative.

Our study shows good acceptability with no attrition rate at all which gives a good impression about the feasibility of conducting a much larger study (Figures 1-6).



**Figure 1:** Showing infected sternal wound managed by retention sutures.



**Figure 2:** showing superficial infected sternal wound.



**Figure 3:** MSCT chest with 3D reconstruction of sternum and ribs shows fracture sternum at manubri-sternal junction.



**Figure 4:** Post-operative chest X-ray Lateral view shows sternal fracture fixation by plates and screws.



**Figure 5:** Post-operative CXR poster-anterior view shows sternal fracture fixation by plates and screws.



**Figure 6:** Intra-operative photo of sternal plate *in-situ*.

## Discussion

Sternal wound infection is defined [8,9] by any signs of inflammation such as redness, hotness, swelling and any kind of discharge of wound line breakdown [10]. There are multiple classifications for sternal wound infection. We adopted the classification by J. Anger et al [11,12]. Published at Brazilian journal of cardiovascular surgery (2015) which classifies sternal wound infection into Type I: Skin and subcutaneous, Type II: Exposure of sternum and ribs, Type III: Bone loss of sternum or ribs, Type IV: Exposed mediastinum [13].

Secondary outcome is to measure pain score at the two different groups. We use the numeric pain score at which 0 means no pain and 10 is the maximum pain that is intolerable and needs analgesic administration for relief [14].

Sternal fixation by sternal wires has been the standard method for years now. It carries the advantage of familiarity between surgeons and easy manipulation [15,16]. However, careless closure carries serious risk of sternal dehiscence and sternal wound infection and be extended to visceral injury due to blind stitching [16,17]. This can be extended into mediastinitis which is a life-threatening condition or even immediate loss of the patient if the right ventricle is punctured.

Extension of wire tips and careless burying of them will lead to discomfort and its protrusion under skin with risk of infection. This negatively affects the patient quality of life and carries the risk of re-operation for de-wiring and debridement of the infected area [18].

Sternal reconstruction using titanium plates has shown to be associated with immediate relief of pain [19] shown at many studies. One patient suffered a small hematoma resolved by gentle compressing only. Wound seroma and hematoma is mentioned in many literature with a rate of 24% and there were no relations between its incidence and using plating systems [20]. It can be better in the form explained by hemostasis issues and minors bleed. Bleeding is most probably due to intercostal vessels injury [21] This might have higher incidence with transverse plates and reckless drilling or inappropriate length of screws [22]. However, this should be least likely to occur with longitudinal plates.

Also, one patient presented with sternal dehiscence and it was found to be associated with morbid obesity which might explain the incidence of such complication but to be further examined. We have performed myocutaneous flap of pectoralis major muscle bilaterally for augmentation of anterior chest wall and at Day 60 follow-up he was doing fine with good wound healing.

Also, plating technique has the advantage of providing better and faster sternal healing [22] keeping respiratory functions unaffected with normal chest wall motion avoiding atelectasis and chest infections resulting from severe pain affecting respiration

Our main consideration to give our patients the best available curative options for sternotomy or sternal fractures with better Quality of Adjusted Life Years (QALY). This pilot study shows a promising feasibility for conducting a large scale study for evaluating the outcome of using locking titanium plates for sternal fixation. Locking compression plates show potentially promising results with better pain tolerability, less complications and rapid, smooth recovery. However, it remains to be investigated well with larger number of patients before coming out with statistically significant results. Sternal fixation with sternal wires carries the risk of prominent wire needing meticulous closure with precautions to bury the wire deep in the muscle and subcutaneous tissues and might lead to visceral injury with serious outcomes.

Reviewing Study limitations: Few number of cases and short-term follow-up of patients to day 30 and 60 postoperative may limit our ability of explore more potentialities or complications. However, this is a preliminary study to a larger study that we are planning to conduct.

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