Content available at: https://www.ipinnovative.com/open-access-journals

Journal of Oral Medicine, Oral Surgery, Oral Pathology and Oral Radiology

Journal homepage: www.joooo.org

Original Research Article

A comparative study between two point and three point fixation for zygomatic complex fractures

Sumaiya Begum[1], Suresh Menon[2,*], Monica Chillal[2], ME Sham[2], Veerendra[2]

[1]*Dept. of Oral & Maxillofacial Surgery, Almana Group of Hospitals, Al-Khobar Governorate, Saudi Arabia*
[2]*Dept. of Oral & Maxillofacial Surgery, Vydehi Institute of Dental Sciences, Bangalore, Karnataka, India*

ARTICLE INFO

Article history:
Received 16-03-2021
Accepted 19-04-2021
Available online 08-06-2021

Keywords:
Zygomatic complex
Rigid fixation

ABSTRACT

The fractured fragments of a zygomatic complex fracture near the suture lines needs to be restabilized by open reduction by fixation. Depending on the displacement of fracture segments and anticipating the stability of the reduced fracture, one, two or three point fixation is applied. The choice of points of fixation is inclusive and best left to surgeon and depending on the fracture type.

The aim of this study was to compare and evaluate functional and aesthetic outcome of two point fixation at frontozygomatic suture and buttress with three point fixation at FZ, buttress and infraorbital region in patients with zygomatic complex fractures.

This study included 30 patients who underwent treatment of zygomatic complex fractures between 2011 to 2013. Fifteen patients were treated with ORIF using two point fixation and remaining 15 with three point fixation and patients were evaluated and compared preoperatively, first post op day, 7^{th} day, first month and third month post op for anatomic form, function, aesthetics and complications.

There was no statistically significant difference in stability, function and aesthetics achieved with fixation and aesthetics. Two point fixation modality for displaced zygomatic complex fractures is as effective as three point fixation. The surgical treatment varies from surgeon to surgeon and also depends on the type of fracture.

1. Introduction

The word Zygoma is derived from a Greek word 'Zygon' which means "to yoke" or "to fuse". Fractures of zygomatic bone were noted as early as 1670 B.C. in the Edwin Smith papyrus.[1] Due to its lateral prominence in face and because of high velocity injuries, this region is liable to fractures. Hence, they demand restoration of form and function as well.[2]

The zygomatic bone has a body and 4 processes, frontal, maxillary temporal and sphenoid, articulates at frontozygomatic, Zygomatico-maxillary, Zygomaticotemporal, and spheno zygomatic sutures respectively. Thus, when a zygomatic bone fractures, it is more accurate to refer it as "Zygomatic complex fractures".

Historically regarded tripod fracture, it is more accurately termed as tetrapod fractures indicating the fracture involvement at all 4 sutures, resulting in displacement of the zygomatic bone. Prior to the concept of rigid internal fixation, fractures of zygomatic complex were treated with closed reduction which showed residual deformities. With the concept of rigid internal fixation, the form and function was restored to near normal and at the same time the rate of complications were reduced as compared to closed reduction techniques. Depending on the displacement of fracture segments and anticipating the stability of the reduced fracture, one, two or three point fixation have been applied. However, controversies have been ripe regarding the determination of fracture stability with number of points involved and sites chosen for fixation. The difference of opinion among the operating surgeons

* *Corresponding author*.
E-mail address: psurmenon@gmail.com (S. Menon).

https://doi.org/10.18231/j.jooo.2021.023

has always been in treating zygomatic complex fractures. This study was to compare the two point versus three-point fixation to determine the stability and restoration of the form of the zygoma in zygomatic complex fractures. The fractured fragments of a tripod or tetrapod zygomatic complex fracture near these suture lines needs to be restabilized by open reduction followed by fixation.

2. Aim

The aim of this prospective study is to assess the treatment outcome of two point fixation at frontozygomatic and zygomatic buttress with a three point fixation at frontozygomatic, zygomatic buttress and infraorbital region in patients with zygomatic complex fractures.

3. Objectives

To formulate an operative strategy that will achieve stable point of fixation for zygomatic complex fractures. To evaluate comparison of surgical outcome between two point and three point fixation and to evaluate the restoration of anatomic form, function and esthetics with two-point and three-point fixation of zygomatic complex fractures.

4. Materials and Method

This prospective study was conducted in a tertiary care hospital on thirty patients, who were diagnosed and treated for zygomatic complex fractures.

4.1. Inclusion criteria

1. Isolated zygomatic complex fracture without associated midface fracture.
2. Displaced fracture of the zygomatic bone. Patients having associated head injuries were also included following neurosurgery clearance.
3. Fractures less than 2 weeks old.
4. Bilateral displaced fracture of zygoma.

4.2. Exclusion criteria

1. Isolated zygomatic arch fractures.
2. Zygomatic complex fracture with comminuted arch fracture
3. Blow out fractures, where additional procedure is required for reconstruction of the orbital floor.
4. Lefort II and III fractures.

In this study, 30 patients with age ranging from 18-60 years with zygomatic complex fractures were included. Pre-operative radiographs done were paranasal sinus and submentovertex views (Figures 1 and 7).

The 30 patients were divided into two groups. In 15 patients comprising group 1, only 2 point fixation was done (Figures 5 and 6) at the frontozygomatic and zygomatic buttress region. Group 2 comprising of 15 patients had a 3 point fixation done to the zygomatic complex fractures in the frontozygomatic, zygomatic buttress region and infraorbital region (Figures 8 and 9).

Fig. 1:

Fig. 2:

Stainless steel implants manufactured by SK Surgicals India were used in all cases.

Chi squared (X^2) test was used to compare the p-value with the level of significance.

4.3. Surgical technique

Group I: Under general anaesthesia, incision was placed in the lateral brow region approximately 2 cm in length.

Fig. 3:

Fig. 4:

Fig. 5:

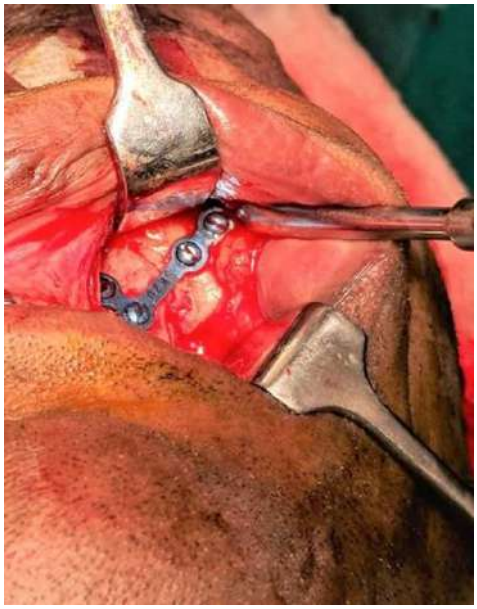

Fig. 6:

Blunt dissection was done to expose the fracture site at the lateral orbital rim /zygomaticofrontal suture line. A ward's periosteal elevator was passed through the incision behind the lateral orbital rim and below the malar eminence to reduce the fracture. The elevator was used to control the position of the zygoma and to reduce it by upward, forward, and outward forces along with palpation of alignment at infraorbital rim and buttress region followed by fixation with a 2mm miniplate at the frontozygomatic region.

A 2cm high vestibular incision was made and zygomaticomaxillary buttress was exposed. A ward's periosteal elevator was introduced beneath the malar eminence, lateral and anterior traction was applied and the inferior orbital rim and the zygomatic-frontal process was palpated. When deemed necessary, the dissection was carried superiorly to examine the infraorbital rim and nerve. After reduction, single 2mm fixation was done at buttress region.

Group II: An additional fixation point in this group of patients was done in the infra orbital rim along with exposure and fixation of frontozygomatic suture and zygomatic buttress region.

Infra orbital rim exposure:

A Subciliary incision of approximately 2 cm was given. Layered dissection was done to expose the fracture site at infra orbital rim. Reduction was done by passing the periosteal elevator through the incision behind the lateral orbital rim and below the malar eminence to reduce the

Fig. 7:

Fig. 8:

fracture. Fixation using single 1.5mm miniplate at the infra orbital region was done.

4.4. Post-operative assessment

Post-operative assessment was done at an interval of 1 week, 4 weeks and 12 weeks following surgery. It included clinical assessment and radiological assessment. Clinical assessment was done to check for stability of fracture by eliciting movements, presence of step deformities, obvious flattening of the malar region, presence of infra orbital

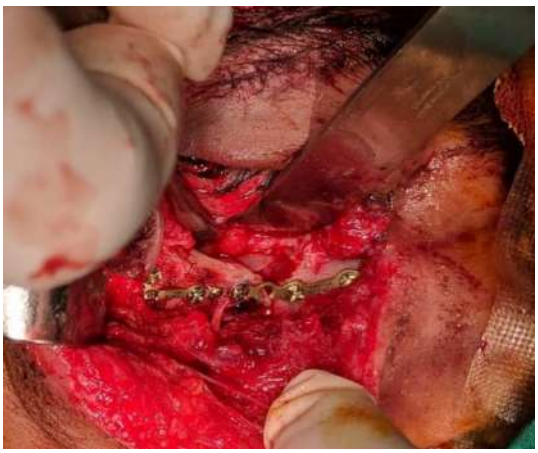

Fig. 9:

neurological deficit using two-point discrimination test and palpability of the implant. Radiological assessment was done with the help of paranasal sinus view and submentovertex view for reduction and alignment of fracture regions.

4.5. Methods of assessment

1. Stability: Stability of fracture is checked by an attempt to mobilize the segment, presence of step deformity in relation to frontozygomatic, infraorbital, buttress region.
2. Flattening of the malar region: Pre operatively, clinical examination of the patients was done from bird's eye view and worm's eye view was done. Palpation of malar eminences from a bird's eye view. Postoperative grading system was carried out according to the classification system proposed by Holmes and Mathew.[3]
3. Two-point discrimination test: The patient's ability to discriminate between two points was measured. The separation of the two points was gradually reduced to the moment where the patient could feel one point only.

5. Results

The mean age of the patients in group I was 30.4+/-9.21yrs and 28.13+/-9.45 years in group II. Although, group II recorded a higher mean age compared to group I, the mean difference was not significant ($p>0.05$). There were 29 males (95.0%) and 1 female (5.0%) patient in the study. In group I, 13 (90.0%) patients were cases of motor vehicle accident and 1 (10.0%) patient had fall due to hit by a vehicle and 1 patient had a car accident. In group II, 13 (40.0%) patients had motor vehicle accident, 1 (60.0%) patients had car accident and 1 was due to self-fall.

epresents malar asymmetry between the study groups preoperatively. In group I malar asymmetry was present

in 10 (67%) patients and in 10 (67%) of group II patients pre-operatively. Symmetry was restored in 9 (60%) patients in group I and 10 (67%) patients in group II during first post-op week. However, it was restored in 25 (83.3%) patients in both the groups during the first month post-operatively. Although the mean difference was significant ($p<0.05$) within each group between pre and post-op period, no significant association was observed in malar asymmetry between group l and group II pre op (Table 1).

To assess the outcome for malar prominence, Homes and Matthews grading scale was utilized. Tables 2 and 3 represents malar prominence at different visits within each group. In both the groups malar prominence was depressed in all patients pre-operatively. Grade I was observed in 12 (80%) patients and grade II in 3 (20%) patient in group I, where as grade I was noted in 13 (86.6%) patients and grade II in 2 (13.3%) patients in group II post operatively. The mean difference was significant ($p<0.05$) within each group between pre and post-op period. However, it was not significant ($P>0.05$) between the groups. Infraorbital paraesthesia was assessed subjectively in all patients at every visit. Although during first post-op week the results were not significant, during third month follow up visit there was a statistical difference within the groups. Table 4 represents the clinically evaluated stability of the bone post operatively clinical stability was present in all the 30 (100%) patients included in the study. All the 30 (100%) patients postoperatively had reduction and alignment of the fractured segments visualized on the radiograph. In both the groups, minor complications like scar, palpability of the implant and infection was present in patients during the third month follow up visit. Four (26%) patient in each group had complications (Table 5).

6. Discussion

Management of zygomatic complex fractures has evolved remarkably over the past few decades, ranging from simple observation to a more proactive open reduction and rigid mini bone plate internal fixation.[4] However open reduction & internal fixation (ORIF) has been used as the standard method for treating zygomatic tripod fractures. Zygomatic complex fractures can cause both functional and cosmetic difficulties. Functionally untreated fractures or inadequately reduced fractures can cause diplopia, infraorbital nerve dysfunction or trismus. The cosmetic sequelae include enophthalmos, hypophthalmos or flattening of the cheek. Earlier treatment modalities like indirect reduction or closed reduction usually ended up with unsatisfactory results.[5] ORIF is the choice of treatment in comminuted fractures or when there is fracture instability.[3] With advent of open reduction and internal fixation, the surgical treatment started to provide greater predictability of results for the reduction of the zygomatic bone fractures, postoperative restoration of more satisfactory form and function with reduced complications.[6]

Three-point fixation technique is the standard fixation technique of zygomatic complex fracture. However, apart from asymptomatic and clinically unnoticeable radiological difference, two-point fixation modality for displaced zygomatic complex fractures is almost as effective as three-point fixation and prevents post-reduction rotation or clinical displacement with significantly lower cost.[7]

The present study was undertaken to compare and evaluate functional and aesthetic treatment outcome of two-point fixation at frontozygomatic suture and zygomatico-maxillary buttress region with three-point fixation, additional infraorbital region in patients with zygomatic complex fractures. A total number of 30 patients with zygomatic complex fracture were selected and randomly categorized into two groups with 15 patients in each group. The follow up period was three months for all patients with exception of two patients (one in each group) who were lost to follow up after one month.

In a retrospective study, patients who were evaluated for postoperative long-term results after osteosynthesis of isolated zygomatic fractures, the two-point fixation at frontozygomatic suture and infra-orbital rim additional exposure of (2-point-fixation), with that of zygomatic buttress and osteosynthesis(3-point-fixation). It concluded that in osteosynthetic reconstruction of isolated zygoma fractures the only 2-point-fixation is usually enough to achieve lateral middle face symmetry.[8] Also, infraorbital exploration for rigid fixation may result in lower eyelid problems e.g. ectropion and a perceptible scar.[9] The frontozygomatic and zygomatic buttress are preferred for rigid internal fixation because of the stability provided against rotation and correct alignment to pre-traumatic state respectively.[10]

Ellis and Kittidumkerng demonstrated that with proper reduction and stabilization of the fracture, there were no differences in the presence of post-reduction displacement related to the number of fixation plates used.[11] Hwang also demonstrated good results with one plate on the superolateral orbital rim through a lateral brow incision in 14 patients.[12] Single-plate fixation is typically limited to noncomminuted zygomatic complex fractures without ocular symptoms. Biomechanical studies have attempted to delineate forces acting on the zygomatic complex and how they could potentially affect fixation techniques. While the masseter is the main muscle causing zygomatic complex displacement, there is debate on the extent that it truly impacts postoperative outcome. In addition, exposure using an intraoral approach elevates masseteric attachments from the zygoma that may also influence muscle function. This malar asymmetry is more likely due to imprecise reduction than fracture instability.[13]

Early in 1995, Mitchell et al. described enhanced fixation method at the frontozygomatic suture in the treatment of

Table 1: Malar asymmetry between the study groups pre-operatively.

Pre op	Two-point fixation		Three-point fixation		X^2	p-value
	n	%	n	%		
Present	10	67%	10	67%		
Absent	5	33%	5	33%	0.000	1.000
Total	15	100%	15	100%		

Table 2: Malar asymmetry post-operative within the group : two point fixation

Post op	Clinical assessments				X^2	p-value
	Grade I		Grade II			
	n	%	n	%		
1 week	12	80%	3	20%		
4 week	12	80%	3	20%	0.240	0.624
12 weeks	12	80%	3	20%		

Table 3: Malar asymmetry post-operative within the group : three point fixation

Post op	Clinical assessments				X^2	p-value
	Grade I		Grade II			
	n	%	n	%		
1 week	13	86.67%	2	13.33%		
4 week	13	86.67%	2	13.33%	0.240	0.624
12 weeks	13	86.67%	2	13.33%		

Table 4: Clinical stability

Clinical stability	Two-point fixation		Three point fixation		X^2	p-value
	n	%	n	%		
Present	15	100%	15	100%		
Absent	0	0%	0	0%	—	——
Total	15	100%	15	100%		

Table 5: Distribution of complications in the group

Complication	Two-point fixation		Three-point fixation	
	n	%	n	%
Infection at FZ	4	50%	1	25%
IO scar	11	0%	1	25%
Scar at FZ	2	50%	1	25%
Scar at FZ and IO	0	0%	1	25%
Total	4	100%	4	100%

displaced zygomatic complex fractures, thus infraorbital fixation was not routinely performed.[14]

Rohner et al. advocated placing a plate on the spheno-zygomatic suture in addition to two other points after their cadaveric biomechanical studies revealed improved structural strength compared with that of four-point fixation.[15] The location and displacement of the fracture sites define the type and number of approaches needed to adequately treat a given zygomatic complex fracture. The osteosynthesis concept also influences the treatment plan. Non-comminuted medially displaced zygomatic complex fractures are typically approached anteriorly applying a one to three-point fixation concept, depending on the degree of displacement, whereas comminuted laterally displaced fractures often require extended craniofacial approaches. The sphenozygomatic suture line is ranked as the most reliable positioning guide in the reduction of isolated zygomatic fractures.[16]

Neutral 2-mm (holes) adaption miniplate applied, usually bridges over an area of bone loss and comminution that could extend up to 1.5 cm. The size of the miniplate needed as well as the degree of bone loss might limit the number of screws applied to one on each side of the fracture line. Therefore, it is important to position the miniplate as laterally as possible on the buttress."

In our study we had a similar experience. In patient a longer L-plate was utilized to bridge the gap of bone loss. In group II patient after reduction, fixation was done.

Complications of zygomatic complex fracture and repair range from limited mandibular range of motion, lack of malar projection, diplopia, enophthalmos to life threatening haemorrhage from branches of maxillary artery and anterior ethmoidal artery. All patients in both the groups had pain and swelling around the operated site postoperatively for around 3-4 days which subsided within a week except for three patient in group II who had subconjunctival haemorrhage almost took two weeks to resolve.

One patient of group I and two patients of group II had persistent paraesthesia after 3 months of follow up. Palpability of the implant was found in 4 patients of group I at the frontozygomatic region, where as in group II palpability of implant was found in 4 cases of which 3 were palpable at the FZ region and I at the infraorbital rim. Visible scar at frontozygomatic region was found in 2 patients of group I and 3 patients of group II of which 2 were found at the frontozygomatic region and 2 at infraorbital region.

In our study, 3 patients reported after 2 months with swelling and pain in the frontozygomatic region of which 2 belonged to group I and 1 case of group II. Of the 2 patients of group 1, one patient was known case of diabetic whose blood sugar levels were fluctuating. The plate and screws at the frontozygomatic region were removed under local anaesthesia in the patients complaining of palpable implant. However, on exploration two screws at the frontozygomatic region was found loose, in the patient presenting with swelling and pain, suggestive of implant rejection. Plates and screws at the frontozygomatic were removed under local anaesthesia in the patient presenting with postoperative pain and swelling. A larger sample size, and long term follow up for assessment of recovery of infra orbital nerve deficit will allow a more complete evaluation of the fixation stability. Nevertheless, it can be concluded that displaced zygomatic bone fractures can be sufficiently treated by two-point fixation at frontozygomatic or buttress region. Additional plates are indicated only in cases where zygomatic bone cannot be stabilized by two-point fixation such as in severely displaced or comminuted fractures. In the current study, there was no difference in stability, function and aesthetics achieved with fixation at frontozygomatic and buttress with that of frontozygomatic, buttress and infraorbital region. Thus, two-point fixation is a better option as an additional site of incision and complications associated with it can be minimized and also an excessive implant placement in the body is avoided with acceptable achievement of form and function. Therefore, one should choose the point of fixation depending on the individual merit of each case.

7. Conclusion

The present study was conducted on 30 patients requiring open reduction and internal fixation for zygomatic complex fracture under general anaesthesia. The stability, function and aesthetics achieved by two-point fixation is equivalent to that of three-point fixation. Fixing at the infra orbital region is helpful in cases when the infra orbital step persists even after reduction of the zygomatic bone at the frontozygomatic and zygomatic buttress region with loss of much of anterior wall of maxilla. It can be concluded that displaced zygomatic bone fractures can be sufficiently treated by two-point fixation at frontozygomatic suture and zygomatic buttress region or frontozygomatic, zygomatic buttress and infra orbital region depending on individual merit of each case.

8. Ethical Approval

The ethical approval was obtained from the ethical committee of Vydehi Institute of Dental Sciences and Research Centre, Bengaluru, India.

9. Source of Funding

None.

10. Conflict of Interest

This is to certify that there is no conflict of interest in the publication of this article.

References

1. Fonseca RJ. Oral & Maxillofacial Trauma. 2nd ed. WB Saunders; 2000.
2. Keen WW. Surgery, its principles and practice. Philadelphia: WB Saunders; 1921.
3. Marinho ROM, Freire-Maia B. Management of Fractures of the Zygomaticomaxillary Complex. *Oral Maxillofac Surg Clin N Am*. 2013;25:617–36. doi:10.1016/j.coms.2013.07.011.
4. AChakranarayan, Thapliyal GK, Sinha R, Suresh MP. Efficacy of two point rigid internal fixation in the management of zygomatic complex fracture. *J Maxillofac Oral Surg*. 2009;8(3):265–9. doi:10.1007/s12663-009-0065-0.
5. Ellis E, Perez D. An Algorithm for the Treatment of Isolated Zygomatico-Orbital Fractures. *J Oral Maxillofac Surg*. 2014;72(10):1975–83. doi:10.1016/j.joms.2014.04.015.
6. Kim ST, Go DH, Jung JH, Cha HE, Woo JH, Kang G. Comparison of 1-point fixation with 2-point fixation in treating tripod fractures of the zygoma. *J Oral Maxillofac Surg*. 2011;69(11):2848–52.
7. Nasr WF, ElSheikh E, El-Anwar MW, Sweed AH, Bessar A, Ezzeldin N. Two- versus Three-Point Internal Fixation of Displaced Zygomaticomaxillary Complex Fractures. *Craniomaxillofac Trauma Reconstr*. 2018;11(4):256–64. doi:10.1055/s-0037-1604199.
8. Nitsch A, Bruns A, Gruber RM. Evaluation of the post-operative clinical results of repositioning isolated zygomatic fractures. *Schweiz Monatsschr Zahnmed*. 2006;116(1):43–53.
9. Yonehara Y, Hirabayashi S, Tachi M, Ishii H. Treatment of Zygomatic Fractures Without Inferior Orbital Rim Fixation. *J Craniofac Surg*. 2005;16(3):481–5. doi:10.1097/01.scs.0000157308.39420.74.
10. Courtney DJ. Upper buccal sulcus approach to management of fractures of the zygomatic complex; a retrospective study of 50 cases. *Br J Oral Maxillofac Surg*. 1999;37:464–6.
11. Ellis E, Kittidumkerng W. Analysis of treatment for isolated zygomaticomaxillary complex fractures. *J Oral Maxillofac Surg*. 1996;54(4):386–400. doi:10.1016/s0278-2391(96)90107-x.
12. Hwang K. One-point fixation of tripod fractures of zygoma through a lateral brow incision. *J Craniofac Surg*. 2010;21(4):1042–4.

13. Farber SJ, Nguyen DC, Skolnick GB, Woo AS, Patel KB. Current Management of Zygomaticomaxillary Complex Fractures: A Multidisciplinary Survey and Literature Review. *Craniomaxillofac Trauma Reconstr*. 2016;9(4):313–22. doi:10.1055/s-0036-1592093.
14. Mitchell DA, MacLeod SPR, Bainton R. Multipoint fixation at the frontozygomatic suture with microplates: a technical note. *Int J Oral Maxillofac Surg*. 1995;24(2):151–2. doi:10.1016/s0901-5027(06)80090-1.
15. Becelli R, Quarato D, Matarazzo G, Renzi G, Dominici C. Esthetic Positioning of Rigid Internal Fixation in Tripod Zygomatic Fractures. *J Craniofac Surg*. 2009;20(3):724–5. doi:10.1097/scs.0b013e3181a2efc2.
16. Rohner D, Tay A, Meng C, Hutmacher D, Hammer B. The Sphenozygomatic Suture as a Key Site for Osteosynthesis of the Orbitozygomatic Complex in Panfacial Fractures: A Biomechanical Study in Human Cadavers Based on Clinical Practice. *Plast Reconstr Surg*. 2002;110(6):1463–71.

Author biography

Sumaiya Begum, Registrar

Suresh Menon, Professor & Head https://orcid.org/0000-0002-3384-0810

Monica Chillal, PG Resident

ME Sham, Professor

Veerendra, Reader

Cite this article: Begum S, Menon S, Chillal M, Sham ME, Veerendra. A comparative study between two point and three point fixation for zygomatic complex fractures. *J Oral Med, Oral Surg, Oral Pathol, Oral Radiol* 2021;7(2):119-126.