International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 02, 2020
ISSN: 1475-7192

# INCIDENCE OF OPEN REDUCTION VERSUS CLOSED REDUCTION IN TREATING ZYGOMATICOMAXILLARY COMPLEX FRACTURES - AN INSTITUTIONAL BASED RETROSPECTIVE STUDY

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**Abstract**

***Introduction:*** *Zygomaticomaxillary complex fractures (ZMC) are relatively common. They are also known as the tetrapods fractures. They are most commonly followed by the nasal bone fractures because of its prominent location. It complexly involves four bones namely maxillary, temporal, orbital and the greater wing of the sphenoid bone. At the same time, it is difficult to obtain perfect reduction and contour the facial structure postoperatively because of its complex involvement.*

***Aim of the study :*** *The aim of the present study was to analyse the incidence rate of open reduction versus the closed reduction in zygomaticomaxillary complex fractures. Thereby providing better treatment for better outcome including esthetics, restorations of anatomical form, occlusion, functions and neurological defects.*

***Materials and methods :*** *Retrospective analysis of all the operational cases (open reduction and closed reduction) of zygomaticomaxillary complex fractures between June 2019 to March 2020 was retrieved among the overall data of 860000 patients visiting Saveetha Dental College. The data was entered in the Excel spreadsheets. And the collected data was analysed using SPSS software version 19. Chi square test was done to evaluate the results.*

***Results:*** *Among the overall 25 cases reviewed the male population(91.30%) had a higher prevalence of ZMC fractures. And the mean age group was between 20 to 40 years of age (56.52%). Between open and closed reductions in zygomaticomaxillary fracture treatments open reduction(56.52%) had a higher prevalence compared to closed reduction (43.48%). In correlation between age, gender and the treatment (open/closed reduction) in ZMC fractures. (p value> 0.05) which is statistically not significant.*

***Conclusion:*** *From the present small sampled retrospective study, open reduction with internal fixation in managing zygomaticomaxillary complex fractures has been dominating over closed reduction.*

**Keywords:** *Closed reduction, open reduction, zygomaticomaxillary complex fractures.*

## Introduction

Zygomaticomaxillary complex fractures are relatively common in the surgical fields. They are also called tetrapod fractures. The zygomatic complex protects the orbit and the surrounding structures[1].

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The main etiology behind the zygomaticomaxillary complex fractures is road traffic accidents, violent assaults and other sport injuries [2]. It is usually difficult to obtain perfect reduction and contour postoperatively as it complexly involves structures like maxillary, temporal, orbital and the greater wing of sphenoid bone [3]. Patients with zygomaticomaxillary complex fractures often present with tenderness, ecchymosis and edema over the malar region, lateral orbit, upper and lower eyelids and the nasal prominence [4]. Medially displaced zygomatico maxillary fractures may impinge into the coronoid process or the temporalis tendon further resulting in trismus. Involvement of the orbital floor may further result in extraocular muscle dysfunctions or entrapment [5]. Non displaced fractures can be managed expectantly. Management of facial trauma has undergone a revolution in the past decades with introduction of better diagnostic tools and surgical approaches [6]. The fracture complex most frequently occurs at the zygomaticomaxillary suture involving the infraorbital rim and the floor of the orbit [7].

The aim of any treatment methods is to give best results with the least rate of morbidity [8]. Various methods for the repair of zygomatico maxillary complex fractures have been reported including incisions, method of fixation and even reconstruction [8,9]. A literature review showed zygomatico maxillary fractures accounts for about 15% to 23.5% of the maxillofacial fractures [8–10]. The incidence of zygomatico maxillary complex fractures varies with geographical location, social economic trends and incidence of road traffic collisions, amount of alcohol abuse and drug abuse [11]. Number of studies have been reported that zygomatico maxillary complex fractures are second most common after the nasal bone or mandibular fractures [12]. Anatomically, the zygomatic is attached to the frontal bone, the maxilla and the squamous part of the temporal bone. Fractures that involve the zygoma, often occur at the four suture sites leading to a temporal fracture [13]. Furthermore, the zygoma is connected to the lateral orbital margin with the frontal bone. Other fracture patterns included isolated zygomatic arch fractures.

There are currently no widely accepted treatment protocols and guidelines for the surgical management of zygomaticomaxillary complex fractures [11,14]. Many literature have proven studies regarding the location, number of fixation points, surgical approaches as well as the need for orbital floor exploration. With regards to open reduction, there is variable support regarding the efficacy and the optimum anatomical positions. With the various advances in the treatment of zygomatico maxillary fractures it is also associated with technical terms and in depth understanding the pathophysiology of fractures [11,14,15].

The fracture complex involving the zygomaticomaxillary suture line involves lateral synchondrosis of the orbital cavity and rarely the zygomatic buttress region. Various methods for the repair of zygomatic complex fractures have been advocated by surgeons in the previous literature including, the types of incisions, methods of fixation and at times even reconstruction [16]. The treatment of zygomatico maxillary complex fractures have been caused out by various approaches like extraoral and intraoral approaches. An intact zygoma and its surrounding bony structures are essential for maintaining facial contour and the orbital integrity. Thus, fractures of the zygoma complexes lead to a certain degree of orbital defect. According to various studies, there were approaches in the furcation points, surgical approaches and advances in the orbital floor exploration.

## MATERIALS AND METHODS

The present study is a retrospective study carried out in a hospital setting among a varied population, predominantly South Indian population. It is a single centred study conducted with a small sample size. It was carried out with the Institutional Review Board (IRB) approval. In this study, data of the patients with zygomatico maxillary fractures was collected by complete analysis of data of 86000 patients between June 2019 to March 2020. Data including demographic details like patient name, age, gender and other associated data like the teeth involved and the surgical management were collected. The collected data was cross-verified by another examiner. The collected data of the patients were then tabulated using Excel Spreadsheets and the data was analysed using SPSS software version 19. The statistical test used in the study was the Chi-square test with p value<0.05 with a confidence interval of 95%.

## RESULTS AND DISCUSSION

Zygomaticomaxillary complex fracture, many at times, is challenging diagnostically and results in reconstruction problems [13,17]. The reduction should be performed for any displaced zygomaticomaxillary fractures that result in trismus, contour asymmetry or any kind of orbital floor disruption [13,17,18]. According to the previous studies which involved open reduction and internal fixation in the treatment for zygomatic fractures, the postoperative imaging showed an appropriate reduction of the zygomaticomaxillary region [19] .

Stoll et al., stressed on the importance of the early intervention to achieve better cosmetic and functional results [13,17]. The treatment of zygomaticomaxillary complex fractures varies with the amount of damage but always consists of reduction followed by fixation. The principles of management of zygomatic maxillary fractures are similar to the fracture management elsewhere in the skeletal system [18]. Excessive force and over-slight mobility of the fracture segments may impede the healing process [22]. An assessment of the anatomical reduction can be made intraoperatively and offer fixation at the time of reduction. Etiology and pattern of maxillofacial injuries reflect the trauma patterns [23]. In previous studies, it was considered that Gillie's method of treating zygomatic maxillary fractures was ideal due to the minimal morbidity rates [23–26].

Out of the overall 25 cases taken for the study about 56.52% of the overall population was treated by open reduction technique and the remaining 43.48% were treated by the closed reduction technique. (Table 1) (Figure 1). Ogden GE reported that in his study 92% of the cases did not require open reduction [20].

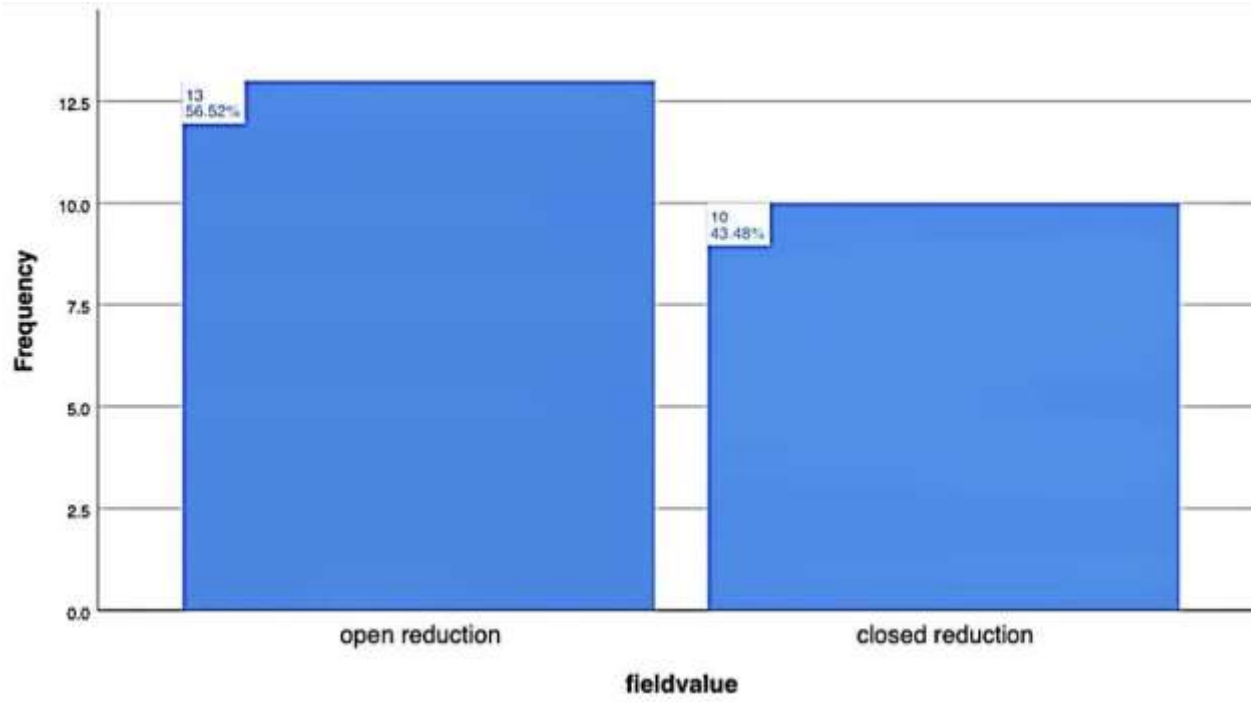


Figure 1: Bar graph depicting the incidence of open reduction and closed reduction among the overall zygomaticomaxillary complex fracture cases reviewed in the study. X axis denotes the treatment of zygomatico maxillary complex fractures (ZMC) (open/closed reduction) . Y axis denotes the incidence of open reduction and closed reduction. Among the study results, open reduction(56.52%) had a higher prevalence over closed reduction (43.48%).

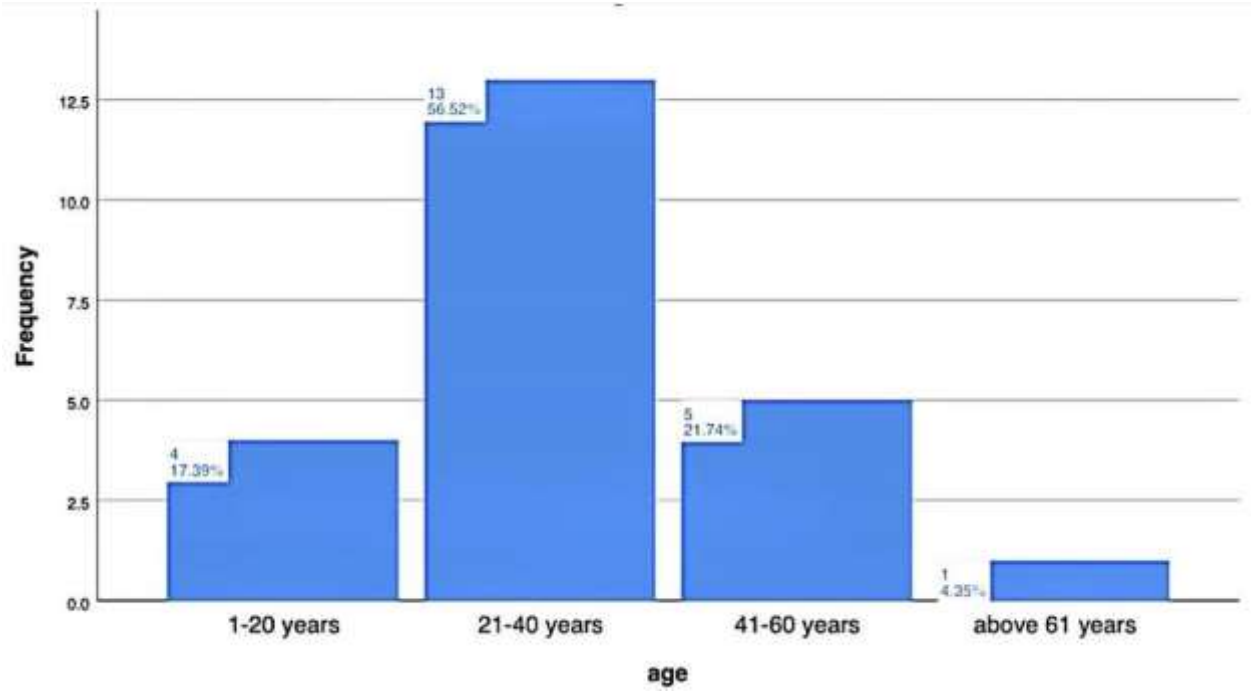


Figure 2: Bar graph depicting the age groups and the incidence of open and closed reduction in each age group. X axis denotes the age groups. Y axis denotes the incidence of open and closed reduction in each age group. ZMC fractures were most commonly seen in the age groups 21 to 40 years (56.52%), followed by 41to 60 years (21.74%), 1 to 20 years (17.39%) and above 60 years (4.35%).

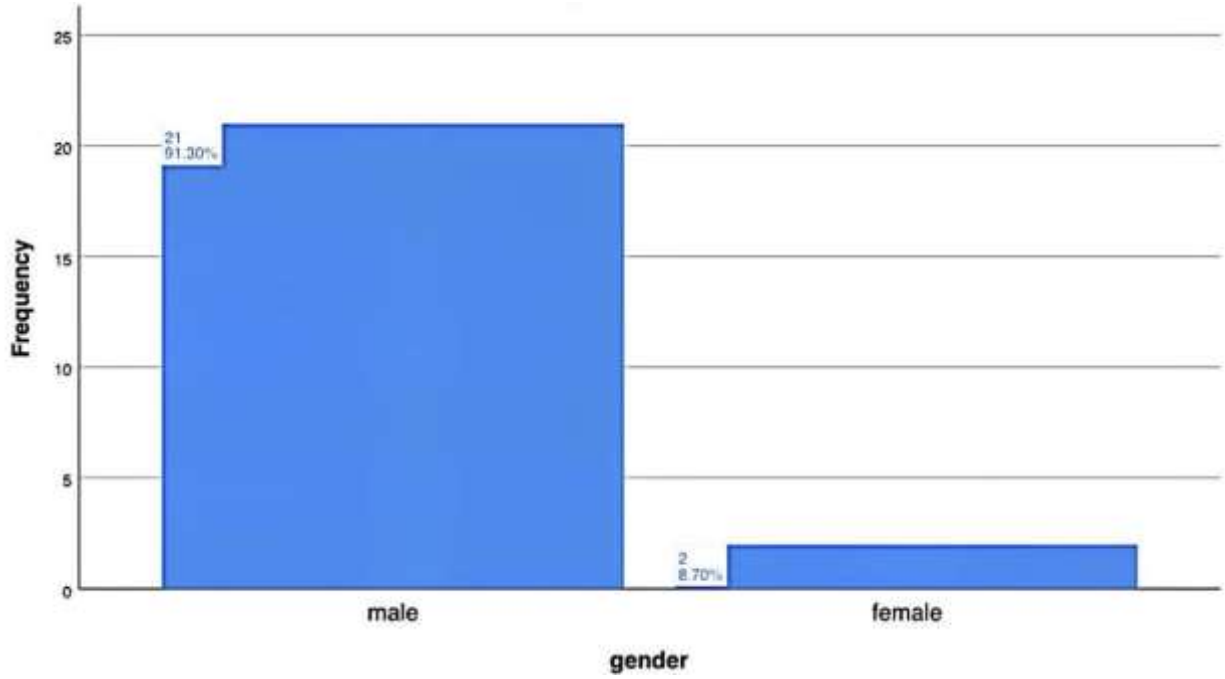


Figure 3: Bar graph depicting the gender and the incidence of ZMC fractures in the male and female population. X axis denotes the gender. Y axis denotes the incidence of open reduction and closed reduction in the male and female population. ZMC fractures were commonly found in the males (91.3%) when compared to the female population (8.70%).

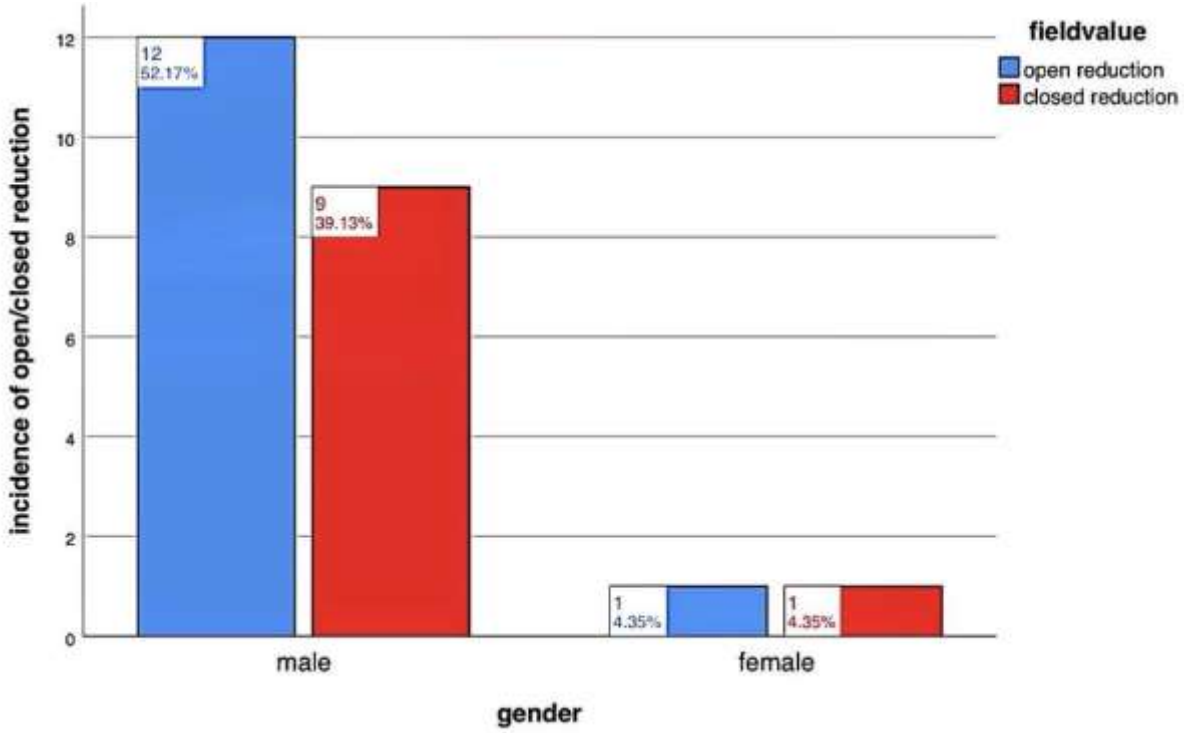


Figure 4: Bar graph depicting the association between the gender and the percentage of open reduction and closed reduction in the male and female population. X axis denotes the gender and Y axis denotes percentage of open reduction and closed reduction. Blue denotes open reduction in males (52.17%) and females about (4.35%) and red denotes closed reduction in males (39.13%) and females about (4.35%). ZMC fractures had a higher prevalence over the male population treated by open reduction(52.17%). Pearson's Chi square test value: 0.38; df: 1; p value= 0.846 (>0.05) which is statistically not significant.

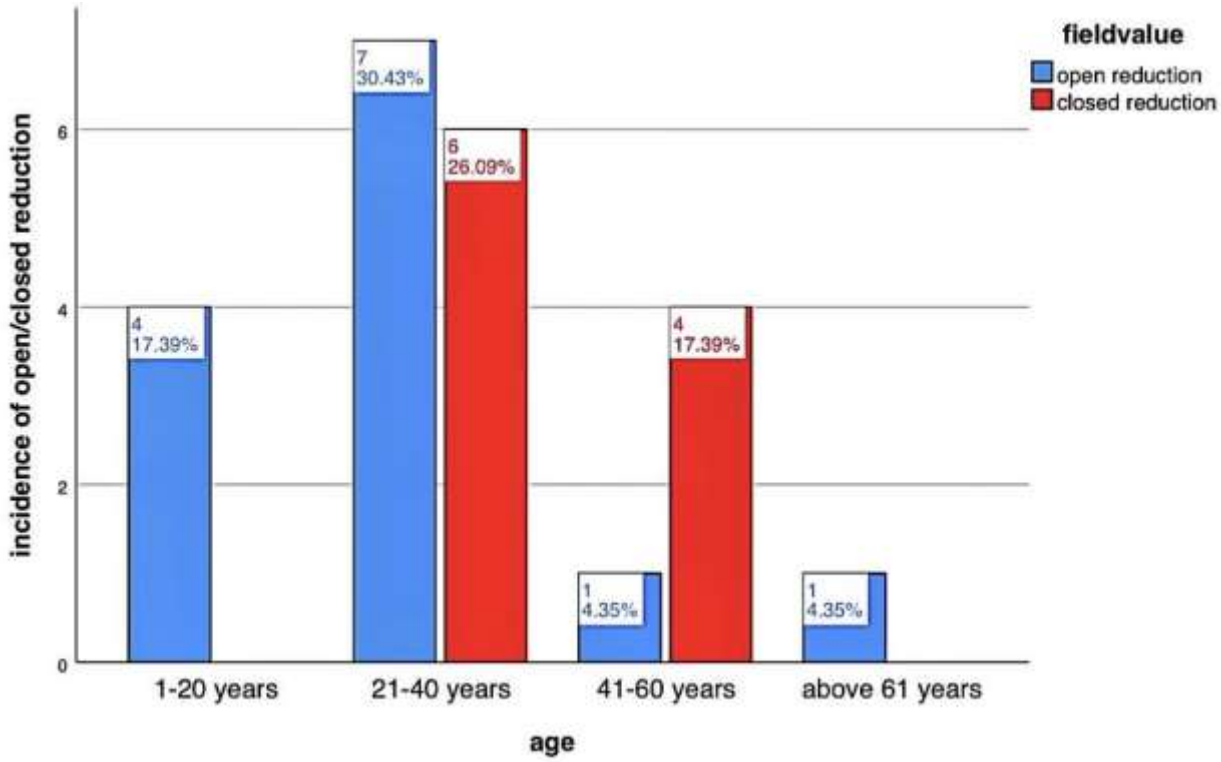


Figure 5: Bar graph depicting association between the age group and treatment (open/closed reduction) in ZMC fractures. X axis denotes the age groups in the study. Y axis denotes the percentage of open reduction or closed reduction in each age group. Blue denotes open reduction in 1 to 20 years about (17.39%), 21 to 40 years (30.43%), 41 to 60 years (4.35%) and above 60 years about (4.35%) and red denotes closed reduction in 21 to 40 years about (26.09%) and in 41to 60 years about (17.39%). ZMC fractures had a higher prevalence among the age group 20 to 40 years and were mostly treated by open reduction (30.43%). Pearson's Chi square test value : 6.598; df: 3; p value = 0.086 (>0.05) which is statistically not significant.

In few studies, open reduction and fixation by transosseous wiring was done in relation to the frontozygomatic suture via Dingmans Lateral eyebrow approach [27]. Kalam Cassini et al., disputed that wire osteogenesis production Ed one dimensional apposition, rotation and it was not functionally stable lacking the three-dimensional stability [28]. The recent application of rigid fixation technique has outdated the older technique of fixation [23–25]. In a displaced zygomatic maxillary fracture, masseter muscle with its attachment along the inferior surface has often been a primary cause for post-reduction displacements. Exerting sufficient inferiorly directed force in the fractured zygoma causes movement, even after surgical insertion of fixation devices. In the present study, The ZMC fracture was commonly seen in the age groups between 20 to 40 years (56.52%), followed by 41to 60 years (21.74%), 1 to 20 years (17.39%) and above 60 years (4.35%) among the overall study population which consisted of individuals from 10 to 70 years of age. (Figure 2).The ZMC fractures had a higher predilection over the male population (91.30%) compared to the female (8.70%) population. The male: female ratio in the overall study was (23.3%) (Figure 3). The demographic details obtained in the previous studies showed that the commonest age group was about 27 years of age with zygomaticomaxillary complex fractures and significantly higher incidence (89%) in men compared to women (11%), which were in concomitant with the current study [23–26,29,30].

According to the previous studies, most of the study population were treated by closed reduction using Gillies lift of Keen's approach [12] . In few studies it was reported that 84% of the population with zygomatic maxillary fractures were treated with open reduction and the remaining patients of about 16% of the overall study population were treated by closed reduction [19,31]. Those above-mentioned studies are in consensus with the present study, there was a significantly higher prevalence of open reduction (54.2%) compared to that of closed reduction which found to be about (41.7%) [29]. The existing literature quoted that the etiology of zygomatic maxillary fractures were mostly related to violence (53%), falls and assaults, sports-related injuries and other mechanical trauma [29,30,32]. Anatomically, zygomaticomaxillary complex fractures may result in orbital floor defects to a certain degree. Manson et al., his study supports one point fraction as the most popular (54%) followed by two-point (26%) and three-point fixation (20%) [23,24]. Intraoral approaches have the advantages of avoiding external facial scarring. Some literature suggested that the incision for infraorbital or the orbital floor carried out most complications [23–26,33]. The transconjunctival approach resulted in favourable esthetics in the patients [34]. This study supports the management of zygomaticomaxillary complex fractures surgically [35]. It is generally accepted that sufficient stability is obtained using the open reduction technique.

Henceforth it has been observed from this retrospective study that the incidence of zygomaticomaxillary complex fractures has been found higher in the male population (91.30%) compared to the female (8.70%) population. Open reduction in males was about (52.17%) and females about (4.35%) and closed reduction in males (39.13%) and females about (4.35%) (Figure 4) p value= 0.846 (>0.05) which is statistically not significant. Open reduction among 1 to 20 years was about (17.39%), 21 to 40 years (30.43%), 41 to 60 years (4.35%) and above 60 years was about (4.35%) and closed reduction in 21 to 40 years about (26.09%) and in 41to 60 years about (17.39%). ZMC fractures were common between second to the fourth decade of life (20 to 40 years of age) (56.52%) p value = 0.086 (>0.05) which is statistically not significant.

(Figure 5). There was significantly higher prevalence of open reduction (56.52%) compared to that of closed reduction which found to be about (43.48%) among the overall study population. Further work in constructing a management protocol for zygomaticomaxillary complex fractures, alongside prospective research would minimise the lack of consensus and optimise the case for zygomatic maxillary complex patients.

## CONCLUSION

It can be concluded from the present small sampled retrospective study, open reduction with internal fixation in managing zygomaticomaxillary complex fractures has been dominating over closed reduction treatment modality furthermore a large sampled study is necessary to implicate the outcome of this study into the maxillofacial surgical field.

## ACKNOWLEDGEMENT

The authors sincerely acknowledge the faculty Medical record department and Information technology department of SIMATS for their tireless help in sorting out datas pertinent to this study.

**AUTHORS CONTRIBUTION**

Rithanya.P: Literature search, data collection, data analysis, manuscript writing.

Dr.M.Sivakumar: Study design, data verification, manuscript drafting.

Dr.Subhashree.R: Study design, manuscript development.

**CONFLICT OF INTEREST**

The authors declare that there were no conflicts of interest in the present study.

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