

Management Of Isolated Zygomatic Arch Fractures In Maxillofacial Trauma – A Review Of Literature

Dr.Mathew,Bds¹ ,Dr Abinaya Subramanian, Mds², Dr Vivek Narayanan, Mds³,
Dr Karthik Ramakrishnan,Mds⁴

¹(Department Of Oral And Maxillofacial Surgery, Undergraduate Student, Srm Kattankulathur Dental College And Hospital, Srm Institute Of Science And Technology, Srm Nagar, Kattankulathur, 603203 Chengalput, Chennai, Tamilnadu, India).

²(Department Of Oral And Maxillofacial Surgery, Associate Professor, Srm Kattankulathur Dental College And Hospital, Srm Institute Of Science And Technology, Srm Nagar, Kattankulathur, 603203 Chengalput, Chennai, Tamilnadu, India).

³Department Of Oral And Maxillofacial Surgery, Professor And Hod, Srm Kattankulathur Dental College And Hospital, Srm Institute Of Science And Technology, Srm Nagar, Kattankulathur, 603203 Chengalput , Chennai, Tamilnadu, India).

⁴(Department Of Oral And Maxillofacial Surgery, Professor, Srm Kattankulathur Dental College And Hospital, Srm Institute Of Science And Technology, Srm Nagar, Kattankulathur, 603203 Chengalput, Chennai, Tamilnadu, India)

Date of Submission: 20-01-2024

Date of Acceptance: 30-01-2024

I.INTRODUCTION

Zygoma fracture is of clinical importance regarding facial appearance and function. Displaced malar prominence plays an essential role in the overall facial appearance and results in deformity of the facial contour.

[¹]

The zygomatic arch is important for facial width and projection. Isolated zygomatic arch fractures (IZAFs) are relatively uncommon injury which may result in limitation of Mandibular movement, trismus and a characteristic cosmetic defect if left untreated. [^{2,3}]

For isolated zygomatic arch fractures both closed reduction without fixation and open reduction with fixation through a coronal incision are the accepted methods of treatment. Nondisplaced fractures are treated non operatively, whereas operative techniques for depressed fractures varies among different surgeons [³] In this article, we discuss about an overview of isolated zygomatic arch fractures and various established methods used for their management.

II.DISCUSSION

Isolated zygomatic arch fractures correspond to approximately 5%–10.5% among all facial injuries and 14% of all zygomatic fractures [⁴]. In 2018 Buller et al has conducted a cohort study comprised of 15 women and 79 men, with a median age of 39.4 years. In his study, Isolated ZAF occurred most frequently in men between 25 and 35 years of age. Etiologies of isolated ZAF listed in the study are violence acts in 45%, accidental falls in 35.1%, bike accidents in 10.6% and sports injuries in 9.6% [⁵]

VARIOUS APPROACHES USED FOR CLOSED REDUCTION OF ARCH FRACTURE

Direct technique

Veale et al in 2014 suggests that direct approach to the arch is possible through coronal flap. The disadvantage of this approach includes a huge scar and risk of injury to the facial nerve. Some surgeons describe this approach as an unnecessarily aggressive form of treatment. [³]

Indirect technique

Gillies temporal approach

The temporal approach described by Gillies et al in 1927 remains one of the most popular approaches to treatment of isolated arch fractures. Unstable reduction of an isolated zygomatic arch fracture is a rare

complication. Temporal approach is a simple and effective method of stabilization and can avoid the need to consider alternative approaches such as a coronal flap. Limitations are extra oral scar and instability in the fragments post reduction may result in failure of the reduction and subsequent malunion.^[3]

Upper buccal sulcus approach

The upper buccal sulcus technique was originally described by Keen in 1909. In 1977 Apfelberg et al had done a study in upper buccal sulcus approach, which was used in 30 patients, and he virtually eliminated the necessity for open reduction. Although this technique is not new, having been used with certain modification for many years, it deserves re-emphasis. Two of the 30 patients in their series required a Gillies elevation from above, as well as a buccal sulcus elevation from below to disimpact fracture fragments.^[2]

VARIOUS METHODS USED FOR CLOSED REDUCTION AND STABILIZATION OF ARCH FRACTURE

Internal method

Internal methods involve placement of an obstruction to displacement into the space deep to the arch, overlying temporalis and the coronoid process of the mandible. This can be achieved through a number of routes and using a variety of methods.

Foleys catheter/Balloon techniques

The catheter method was originally described by Podoshin and Fradis in 1974 as a method of isolated zygomatic arch fracture reduction. In this technique Foleys catheter was introduced inside the arch through Gillies approach & balloon was inflated with a radio-opaque contrast solution in order to aid radiographic evaluation of reduction.^[3]

Sub zygomatic space packing

Packing of the sub zygomatic space with iodine soaked gauze is another method of reduction of zygomatic arch fracture using a temporal or intra-oral approach.^[3]

External methods

A varieties of external methods of support have been described in literature. All utilize circumferential wiring or suturing around the arch, with the external portion of the wires or sutures fixed over a splint to provide resistance to displacement and reduce the risk of skin necrosis.

Kirschner wire

In 2008 Bezuhly et al did a study using a combination of Gillies elevation and percutaneous Kirschner wire fixation in the treatment of isolated simple zygoma fractures. His technique provided near-equivalent restoration of facial contour to that of open reduction and internal fixation while avoiding the risk of ectropion, temperature intolerance, scleral show, and scar. Veale et al in 2014 described that Kirschner wire can be inserted percutaneously at the malar prominence, passing under the arch and extended back to the infra temporal fossa region just deep to the arch.^[3]

Zimmer splint

Graham 2006 stabilized the unstable arch using an external foam-backed aluminium splint (Orthopaedic “Zimmer” finger splint) along the length of the zygomatic arch to support the fractured segments. He believed that the externally displaced Zimmer splint device offers several advantages and can be contoured to a desired shape under direct vision and also can support multiple bone fragments in comminuted zygomatic arch fracture.^[6]

Problems encountered in External methods

Risk of a small amount of scarring, as well as skin necrosis due to the pressure of the splint, and long-term trismus, presumably due to scarring of temporalis onto the arch where circumferential wires or sutures have inadvertently penetrated the muscle. These problem can be avoided in internal methods, as there is a physical barrier between the muscle and the fracture.

VARIOUS DEVICES USED FOR ZYGOMATIC ARCH CLOSED REDUCTION

Mezitis et al described the use of a curved mosquito for reducing isolated zygomatic arch fractures as a less invasive method. However it requires an experienced and skillful surgeon and has a limitation of using force to reduce the fractures.

Different types of hooks have also been used for the reduction of arch fractures^[5,7]

Krishnan et al in 2008 treated twenty five patients with unilateral isolated zygomatic arch fractures by using a dental forceps through an upper buccal sulcus approach^[8]. They stated that performing this procedure under sedation or local anaesthesia in a clinic set up or an emergency department makes it a highly cost-effective and time-saving tool in the armamentarium of an oral and maxillofacial surgeon^[9]. Researchers proposed the use of a towel clip for reducing depressed zygomatic arch fractures as a quick, simple and effective technique^[10]. However these techniques have a risk of weakness of facial nerve by pressure and may be more complicated compared to the other techniques.

OPEN REDUCTION OF ZYGOMATIC ARCH FRACTURE

Open reduction through a coronal incision can provide a direct view of Zygomatic arch which makes it easy to perform the operation. But the complications post surgery can include surgical alopecia, facial nerve injury, forehead numbness, etc. Hence Open reduction and internal fixation option is generally avoided in isolated zygomatic arch fractures and also in arch fracture associated with other injuries. Though in some cases since zygomatic arch serves as a key of alignment of face, especially when the root of the zygomatic arch is fractured, some authors suggest it to be reduced and then stabilized by rigid fixation using micro screws and or micro plates.^[2,3,6,7] In 2020, Paneerselvam et al described a open reduction and transbuccal fixation method for fixation of zygomatic arch fractures.^[12]

INTRA-OPERATIVE METHODS AIDING IN CLOSED REDUCTION OF ZYGOMATIC ARCH FRACTURE

An isolated fracture of the zygomatic arch is recognized as mild injury among various facial fractures. Although the treatment method is relatively simple, mostly closed reduction, confirming the exact location of reduction of fracture is challenging because the swelling of soft tissue could mask the fracture site and there is vulnerability to sole reliance on palpation and visual inspection. Additionally, reduction of the zygomatic arch requires skills and experience of surgeon in order to reduce an uneven and curved bone adequately. Hence the use of intraoperative radiographic aids guided the surgeon in accurate reduction of fracture. Ultrasound were used as guide in reducing arch fractures. If internal devices are used, computed tomography was more reliable than plain radiography or ultrasound. Because it is possible to take images from various levels of the fracture site.^[14,15,19]

C-arm or mobile fluoroscan increased the accuracy of surgical reduction by confirming the fracture site simultaneously during the operation, but the problem of radiation exposure persisted. C-arm requires positioning of the patient in supine decubitus position with the neck hyper extended and removing the mobile C-arm from the operating room which was time consuming.^[16]

The endoscope is a useful adjunct for assisting in the visualization and fixation of the zygomatic arch. It also eliminates the radiation exposure. Application of the endoscope to assist repair of zygomatic fractures provides several advantages over the conventional methods. It avoids the undesirable sequelae of a bicoronal incision. Careful physical examination and ophthalmologic examination carried out preoperatively will exclude the possibility of extra ocular muscular entrapment and enophthalmos or exophthalmos.^[18]

COMPLICATIONS OF UNTREATED ZYGOMATIC ARCH FRACTURE

Complications of an untreated Zygomatic arch fractures are facial contour asymmetry, functional deficits such as trismus & limited mouth opening and psychological consequences. Isolated zygomatic arch fractures healed in a wrong location can lead to posttraumatic ankylosis between the arch and coronoid process.^[20,21]

III.CONCLUSION

Zygomatic arch is important to maintain facial architecture. In this review various approaches, methods and devices used for reduction and stabilization of isolated zygomatic arch fractures were discussed. Various fixation methods used in literature were also mentioned. In recent years, intraoperative radiographic aids and endoscopic repair plays a major role in zygomatic arch fracture reduction. Most of the authors suggested zygomatic arch reduction using closed methods only.

Although, open reduction and fixation methods were suggested by few authors in cases of unstable fracture. Furthermore large-scale randomized, prospective trials of the open fixation methods are required in future with less postoperative complications to substantiate the methods.

REFERENCES

- [1]. Hönig Jf, Merten Ha. Classification System And Treatment Of Zygomatic Arch Fractures In The Clinical Setting. J Craniofac Surg. 2004 Nov;15(6):986-9.
- [2]. Apfelberg Db, Lavey E, Maser Mr, Lash H. Upper Buccal Sulcus Approach To Reduction Of Zygomatic Fractures. J Trauma . 1977 Nov; 17(11):847-9.

- [3]. Bezuhly M, Lalonde J, Alqahtani M, Sparkes G, Lalonde Dh. Gillies Elevation And Percutaneous Kirschner Wire Fixation In The Treatment Of Simple Zygoma Fractures: Long-Term Quantitative Outcomes. *Plastreconstr Surg.* 2008 Mar;121(3):948-55.
- [4]. Buller J, Zirk E, Kreppel M, Grandoch A, Maus V, Zirk M, Zöller Je. Radiomorphometric Analysis Of Isolated Zygomatic Arch Fractures: A Comparison Of Classifications And Reduction Outcomes. *J Craniomaxillofac Surg.* 2018 Aug;46(8):1252-1257.
- [5]. Chu Sg, Lee Js, Lee Jw, Yang Jd, Chung Hy, Cho Bc, Choi Ky. Comparisons Among Four Types Of Absorbable Plates Used For Internal Fixation Of Zygomaticomaxillary Complex Fractures. *J Craniomaxillofac Surg.* 2019 Mar;47(3):383-388. Epub 2019 Jan 17.
- [6]. Graham Rm, El-Rasheed A, Lowry Jc. The Zimmer Splint Revisited. *Br J Oral Maxillofac Surg.* 2007 Jul;45(5):432-3. Epub 2006 Dec 8.
- [7]. Hindin Di, Muetterties Ce, Mehta C, Boukavalas S, Lee Jc, Bradley Jp. Treatment Of Isolated Zygomatic Arch Fracture: Improved Outcomes With External Splinting. *Plastreconstr Surg.* 2017 May; 139(5):1162e-1171e.
- [8]. Ho V. Isolated Bilateral Fractures Of Zygomatic Arches: Report Of A Case. *Br J Oral Maxillofac Surg.* 1994 Dec;32(6):394-5.
- [9]. Johnerjp, Wiedemeier D, Hingsammer L, Gander T, Blumer M, Wagner Meh. Improved Results In Closed Reduction Of Zygomatic Arch Fractures By The Use Of Intraoperative Cone-Beam Computed Tomography Imaging. *J Oral Maxillofac Surg.* 2020 Mar; 78(3):414-422. Epub 2019 Nov 2.
- [10]. Kim Js, Park Yj, Lee Yj, Kim Ng, Lee Ks. Reduction Of Zygomatic Arch Isolated Fracture Using Ultra Sound And Needle Marking. *Arch Craniofac Surg.* 2016 Dec; 17(4):198-201.
- [11]. Krishnan, Balasubramanian Mds, Dnb, Moms Rcps (Glasg); El Sheikh, Mohammad Hossni Bds, Mds, Phd. Dental Forceps Reduction Of Depressed Zygomatic Arch Fractures. *Journal Of Craniofacial Surgery* 19(3):P 782-784, May 2008.
- [12]. Panneerselvam E, Balasubramanian S, Kempuraj J, Babu Vr, Raja Vbkk. Management Of Zygomatic Arch Fractures By Intraoral Open Reduction And Transbuccal Fixation: A Technical Note. *Craniomaxillofac Trauma Reconstr.* 2020 Jun;13(2):130-132.
- [13]. Cohn Je, Othman S, Bosco S, Shokri T, Evarts M, Papajohn P, Zwillenberg S. Management Of Isolated Zygomatic Arch Fractures And A Review Of External Fixation Techniques. *Craniomaxillofac Trauma Reconstr.* 2020 Mar;13(1):38-44.
- [14]. Laine Fj, Conway Wf, Laskin Dm. Radiology Of Maxillofacial Trauma. *Curr Probl Diagn Radiol.* 1993 Jul-Aug;22(4):145-88.
- [15]. Li Z, Yang Rt, Li Zb. Applications Of Computer-Assisted Navigation For The Minimally Invasive Reduction Of Isolated Zygomatic Arch Fractures. *J Oral Maxillofac Surg.* 2015 Sep;73(9):1778-89.
- [16]. Chen Ct, Lai Jp, Chen Yr, Tung Tc, Chen Zc, Rohrich Rj. Application Of Endoscope In Zygomatic Fracture Repair. *Br J Plast Surg.* 2000 Mar;53(2):100-5.
- [17]. Obimakinde Os, Olajuyin Oa, Rabiun Tb, Olanrewaju Oj. Crash Characteristics And Pattern Of Motorcycle Related Facial Bone Fractures In A Sub-Urban Nigerian Teaching Hospital. *Niger J Surg.* 2018 Jul-Dec;24(2):71-75.
- [18]. Pedemonte C, Sáez F, Vargas I, González E, Canales M, Lazo D, Pérez H. C-Arm As Intraoperative Control In Reduction Of Isolated Zygomatic Arch Fractures: A Randomized Clinical Trial. *Oral Maxillofac Surg.* 2016 Mar;20(1):79-83.
- [19]. Sato A, Imai Y, Muraki K, Tachi M. Reliability Of Ultrasound-Guided One-Point Fixation
- [20]. For Zygomaticomaxillary Complex Fractures. *J Craniofac Surg.* 2019 Jan;30(1):218-222.
- [21]. Wu Cm, Chen Ya, Liao Ht, Chen Ch, Pan Ch, Chen Ct. Surgical Treatment Of Isolated Zygomatic Fracture: Outcome Comparison Between Titanium Plate And Bioabsorbable Plate. *Asian J Surg.* 2018 Jul;41(4):370-376. Epub 2017 May 10.
- [22]. Zigterman Bg, Mommaerts My. Slotplates Revisited - A Retrospective Analysis. *J Craniomaxillofac Surg.* 2017 Feb;45(2):171-177.