MANAGEMENT OF UPPER AND MIDDLE THIRD OF THE FACE FRACTURES THROUGH BICORONAL ACCESS

Dissertation submitted to

THE TAMILNADU DR.M.G.R MEDICAL UNIVERSITY

Towards the partial fulfillment for the degree of

MASTER OF DENTAL SURGERY

BRANCH-III

ORAL AND MAXILLOFACIAL SURGERY

APRIL - 2011

Certificate

This is to certify that ***Dr. ABDUL AZAM KHAN*** *Post Graduate Student (2008-2011) in the Department of Oral and Maxillofacial Surgery, Tamilnadu Government Dental College & Hospital, Chennai has done this dissertation titled* ***"MANAGEMENT OF UPPER AND MIDDLE THIRD OF THE FACE FRACTURES THROUGH BICORONAL ACCESS"*** *under my direct guidance and supervision in partial fulfillment of the regulations laid down by the Tamilnadu Dr. M.G.R. Medical University, Chennai for M.D.S., Branch–III Oral and Maxillofacial Surgery, Degree Examination.*

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ACKNOWLEDGEMENTS

I am greatly indebted to ***Prof. Dr. G.Uma Maheswari M.D.S,*** *Professor and HOD, Department of Oral & Maxillofacial Surgery, Tamilnadu Govt Dental College and Hospital for teaching me the art of surgery during the period of my study. Words cannot express the contribution and relentless encouragement given by this humble and luminous soul, to whom I will be obliged forever.*

I express my sincere thanks to ***Prof. Dr.B.Saravanan M.D.S,*** *Professor, Department of Oral and Maxillofacial Surgery, for his valuable guidance, encouragement, lending me their precious time for the successful completion of this study and throughout my post graduation period.*

I am very much grateful to ***Prof. Dr.C.Durairaj, M.D.S.,*** *Professor, Department of Oral & Maxillofacial Surgery for his unrestricted help and advice throughout the study period.*

I am very much grateful to ***Prof. Dr.S.Gandhiraj, M.D.S*** **.** *Professor, Department of Oral & Maxillofacial Surgery for his help,guidance and advice throughout my study period.*

I offer with profound respect and immense gratitude my heartfelt thanks to ***Prof. Dr. K.S.G.A Nasser M.D.S,*** *Principal, Tamilnadu Govt Dental College and Hospital, for his constant encouragement and support throughout my endeavour during my postgraduation period.*

I express my sincere thanks to, ***Dr. Appadurai M.D.S , Dr.suresh kumar M.D.S and Dr.Vinayagam M.D.S*** *Assistant Professors in the Department of Oral and Maxillofacial Surgery, Tamilnadu Govt Dental College and Hospital for their timely suggestion during course of the study.*

I express my special thanks ***to Dr. Sethurajan M.D.S****, my co-guide for helping me and providing me timely advice during my study period and thereafter.*

I would like to give special thanks to my colleague ***Dr. Davidson*** *for his timely support and warmth during the period of the study and to all my colleagues who supported me for the same.*

Narrow border of language could never express my respect and gratitude to all the patients who co-operated with me for this study.

I dedicate this study to my parents.

Last but not the least I would like to seek the ***blessings of the Almighty*** *without whose grace this endeavour wouldn't have been possible*

DECLARATION

I, **Dr. ABDUL AZAM KHAN** , do hereby declare that the dissertation titled **"MANAGEMENT OF UPPER AND MIDDLE THIRD OF THE FACE FRACTURES THROUGH BICORONAL ACCESS"** was done in the Department of Oral and Maxillo Facial Surgery, Tamil Nadu Government Dental College & Hospital, Chennai 600 003. I have utilized the facilities provided in the Government dental college for the study in partial fulfillment of the requirements for the degree of **Master of Dental Surgery** in the speciality of Oral and Maxillofacial Surgery **(Branch-III)** during the course period **2008-2011** under the conceptualization and guidance of my dissertation guide**, Prof. Dr. B.SARAVANAN, MDS.**

I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Nadu Government Dental College & Hospital.

I also declare that no part of this work will be published either in the print or electronic media except with those who have been actively involved in this dissertation work and I firmly affirm that the right to preserve or publish this work rests solely with the prior permission of the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, but with the vested right that I shall be cited as the author(s).

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INSTITUTIONAL ETHICAL COMMITTEE
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R.C.No. 0431/DE/2010 Date:01.06.2010

Title of the Work : Management of upper and middle third of the face fractures through Bicoronal access.

Principal Investigator: Dr. Abdul Azam Khan, IIIrd Year Post Graduate student

Department : Dept of Oral & Maxillofacial Surgery
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The request for an approval from the Institutional Ethical Committee (IEC) was considered for the following on the IEC meeting held on 22.04.2010 at the Principal's Chambers, Tamil Nadu Government Dental College & Hospital, Chennai-3.

"Advised to Proceed with the study"

The Members of the Committee, the Secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the Principal Investigator.

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7. You should submit the summary of the work to the ethical committee on completion of the work.
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10. Your work should be carried out under the direct supervision of your Guide/Professor.

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SECRETARY

01.6.10
CHAIRMAN

INTRODUCTION

Since the beginning of time, the traumatic injuries of the face and their incidence is increasing at an alarming rate. For many years multiple facial fractures have been treated through a variety of small incisions placed strategically about the face and these small wounds create multiple scars which is aggravated when these peepholes are stretched by retractors and rubbed by mechanical tools.

The bicoronal flap (bifrontal,bitemporal)has been used by the neurosurgeons to gain access to the anterior cranium for nearly a century. It was first described by HARTLEY and KENYON in 1907 and two decades later was advocated by SACHS for bilateral frontal lobe exposure. However, it did not gain widespread acceptance in maxillofacial surgery until the 1970's when TESSIER and later ANDERSON and JACKSON reported excellent access that it provided for lefort II and lefort III osteotomies.[44]

With the evolving concepts of craniomaxillofacial fracture management the basic five principles governing current management are, precise anatomic diagnosis, direct fracture exposure, reduction and rigid internal fixation, primary bone grafting and periosteal and soft tissue

suspension and repair. Early intervention should be done to prevent secondary deformities associated with such injuries.[42]

Bicoronal approach is nowadays used for variety of surgical procedures like gaining access to severe craniofacial dysjunction injuries including lefort type III, frontal sinus and nasoethmoidal fractures and zygomatic complex fractures, simultaneous craniotomy procedures for intracranial injuries ,and treatment of facial fractures, access osteotomies for orgthognathic procedures ,correction of craniofacial deformities and harvesting of calvarial grafts etc[8].

The coronal incision offers advantages like an excellent and extensive approach to the frontal, nasal, superior and lateral orbit and zygomatic complex and zygomatic arch fractures which no other single approach can provide which aids in ensuring exact anatomical reduction of the fracture and also a well hidden scar within the hairline and achieves overall superior functional and aesthetic results.[8,9,14,26,37]

Patient selection and application for the indications of this incision are of paramount importance. This incision should not be overused and should be judiciously used.[41,44]

AIM OF THE STUDY

This study was conducted on patients who reported to the Department of Oral and Maxillofacial Surgery, Tamil nadu Government Dental College and Hospital, Chennai with traumatic injuries of the face involving the upper and middle third of the facial skeleton with or without other fractures.

The aim of study was to evaluate

- The versatility of bicoronal incision for the management of upper and middle third of the facial skeletal fractures
- To evaluate the indications for bicoronal approach
- To evaluate the advantages associated with coronal incision
- To evaluate the complications associated with coronal incision

SURGICAL ANATOMY

The scalp consists of five layers: skin, subcutaneous tissue, occipitofrontalis muscle tissue (including galea between these muscles) subgaleal areolar tissue and the epicranium.

The primary blood supply to the anterior scalp is from the anterior and parietal branches of the superficial temporal arteries as well as from the supraorbital vasculature. Sensory innervation is via the supratrochlear and the supraorbital nerves medially with lateral contributions from the auriculotemporal and the zygomaticofacial nerves. The supraorbital neurovascular pedicle exits the skull via foramen or notch in the superomedial orbital rim and runs on the surface of the orbital rim.

The frontal branch of the facial nerve innervates the frontalis muscle and has elevation of the eyebrow as a primary function. As the frontal nerve exits the parotid gland, it proceeds over the zygomatic arch, along with the frontal branch of superficial temporal artery beneath the temporoparietal fascia or superficial temporal fascia .The latter has been shown to represent the superior extension of SMAS which is also continous with the galea and frontalis muscle superiorly as well as the occipitalis muscle posteriorly. As the frontal branch proceeds anteriorly and superiorly, it remains on the undersurface of the temporoparietal

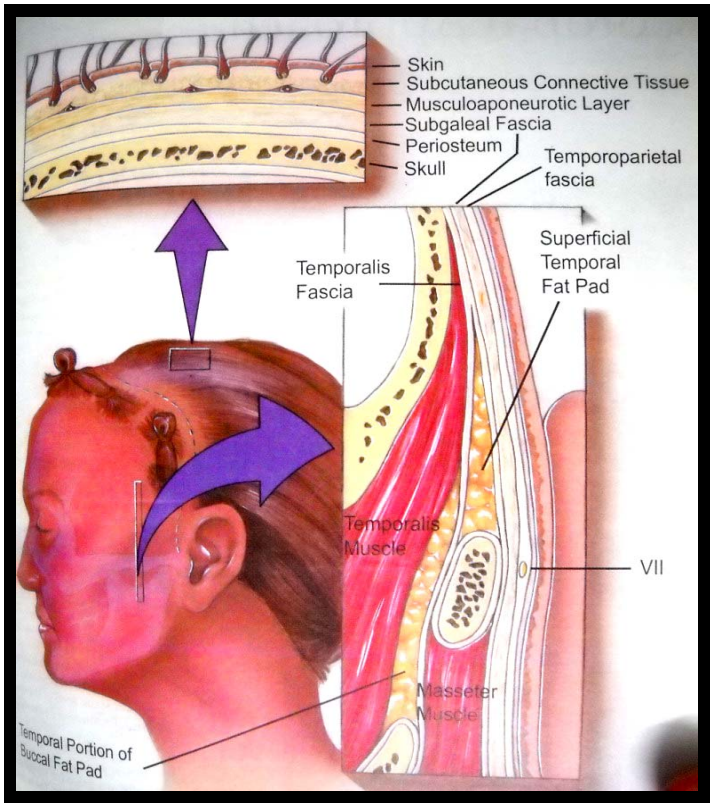
fascia to eventually penetrate the frontalis muscle approximately 1 to 2 cm above the superior orbital rim.

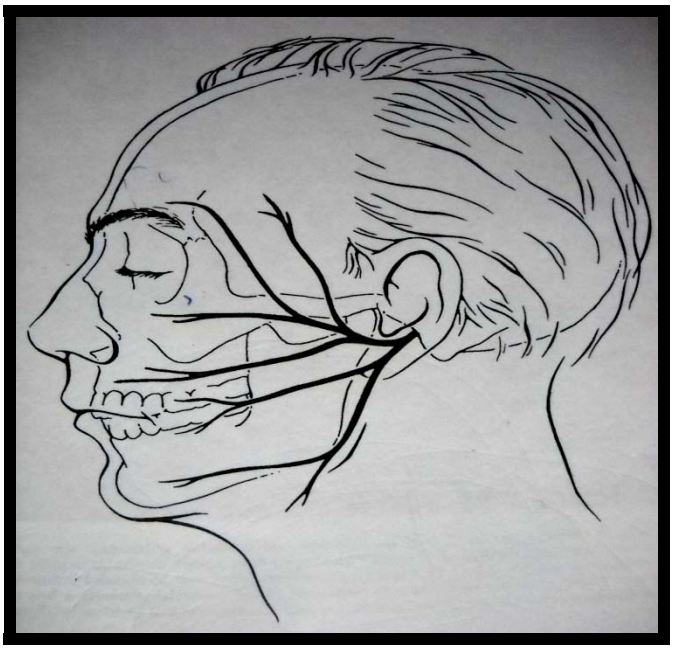
The three fascial layers of importance are the temporoparietal fascia and the superficial and deep layers of deep temporal fascia. The first is important because of the tight adherence of the frontal branch to its undersurface. Deep to this layer and superficial to the deep temporal fascia is the loose areolar plane. Most dissection takes place in this plane only.

The deep temporal fascia is the layer of connective tissue overlying the temporalis muscle. It is continous with pericranium above the temporal line and very thick over approximately the upper half of the muscle. In the region of the superior orbital rim, the deep fascia splits into thinner superficial and deep layers. This diversion is known as temporal line of fusion. The superficial layer of deep temporal fascia continues to become adherent to the lateral surface of zygomatic arch, where it is close relationship to the temporoparietal fascia and the frontal nerve. The deep layer of deep temporal fascia lies on the surface of temporalis muscle and continues to the medial surface of zygomatic arch.

Approximately 2cm above the arch, deep to the deep fascial layers, the temporalis muscle is covered by deep temporal fat pad. Between the 2

layers of temporalis fascia is the layer of fat, the superficial temporal fat pad. It is important to note that the superior surface of zygomatic arch is in contact only with superficial fat pad, with the superficial and deep fascial layers of deep temporal fascia encompassing the medial and lateral surface of the zygomatic arch. Blood supply to these fascial layers is important to note. The superficial temporal artery runs over the temporoparietal fascia supplies this layer. Middle temporal artery runs over the surface of the arch to branch into deep temporal fascia and fat pad. Several small branches penetrate the underlying temporalis muscle.[27]


Skin
Subcutaneous Connective Tissue
Musculoaponeurotic Layer
Subgaleal Fascia
Periosteum
Skull
Temporoparietal fascia
Superficial Temporal Fat Pad
Temporalis Fascia
Temporalis Muscle
VII
Masseter Muscle
Temporal Portion of Buccal Fat Pad



REVIEW OF LITERATURE

Hartley and Kenyon in 1907 [44] – 1st person to describe bicoronal approach

STUDIES ON MODIFICATIONS OF THE TECHNIQUE AND COMBINATIONs

Akita S.Hirano A[3] (1993)

In this article the author describes the modified coronal incision to avoid widened scar. He also analysed the resulting stress distribution using the finite element method (FEM) to determine whether or not the modification he adapted was effective. The analysis showed that the method was effective in terms of mechanical strength. The stimulated surgical craft model was presented and was concluded to be beneficial.

Polley JW, Jarrin P[40] (1995)

A simple hair braiding technique is presented as an adjunct to the intraoperative management of the scalp in patients undergoing craniofacial reconstruction with exposure through a coronal incision. This article describes the method and its practical advantages over the standard approaches.

Munro IR,Fearon JA[37] (1995)

The author discusses that the coronal incision often leaves a noticeable scar causing the hair to part away from it especially when wet. Changing the incision straight line to a zig zag incision, called the stealth incision eliminates this obvious deformity giving better cosmesis

R Grime, C J Kerawala[23] (1996)

A cadaveric study was performed which revealed the pivot point of the flap to lie at the lower end of the flap incision which allowed the modification of incision line in the anteroposterior plane to compensate for sex, age and male pattern baldness. They carried another study of 62 cases to assess the access of the flap for craniofacial trauma.

Mitchell D.A[36] (1997)

The author discusses about the open reduction and internal fixation of condylar fractures via extended bitemporal approach with a masseteric myotomy in a group of patients with a final conclusion of good access for fixation of fractures.

Papay FA,Stein J[38] (1998)

This study investigates the cosmetic effects of advanced electrocautery devices as compared to cold scalpel on scalp incision. 12 children undergoing surgery via bicoronal approach were included. One

side of incision was done by cold scalpel and other side by Colorado microdissection needle. Resultant width of alopecia was measured precisely. They concluded that the peri-incisional alopecia was greater by microdissection needle as compared to cold scalpel.

Yauser Reha, Jackson[53] (1999)

They used a posteriorly placed straight vertical incision with postauricular incision which neither compromise the blood supply of temporal fascia nor the frontal branch of facial nerve and provided maximum exposure for optimum surgical results with minimal morbidity without the disadvantage of anterior preauricular scar.

Jin Sik Burm[26] (1999)

He performed the wedge shaped excision of the scalp and double relaxation sutures of the galea in 15 patients who underwent facial surgery through bicoronal access to reduce the visible linear scar on the temporal scalp. 30 degree bevel incision preserves hair follicles and prevents cicatricial alopecia and camoflouges the scar. Double relaxation sutures prevents scar widening .They found esthetically better results.

Frechet P[19] (1999)

He performed clinical study on 100 cases of scalp surgery. The objective was to change from narrow scars created at present to that of

scars minimally visible to naked eye which was the subject of this article. The technique was based on role of galea responsible for tension and secondary widening of scars in classical techniques. They explained hypodermic incisions to eliminate this wound tension and de-epithelialization. A minimally visible scar was obtained to the naked eye with this technique.

4 Albert J Fox,Sherard A Tatun[4] (2003)

Used a method of camoflouging the incision in the hair to produce a sinusoidal, sawtoothed incision with or without a postauricular extension. They used a tape measure to produce regularly spaced marks which connects in sinusoidal or sawtoothed fashion to make scar inconspicuous.

Leach P.Rutherford S[31] (2005)

The author presents a technique of zig zag bicoronal scalp incision for craniofacial cases in paediatric neurosurgery. Author believes that this technique leads to improved cosmesis especially when the hair is wet.

Damir B Matic[16] (2008)

He studied on group of 27 patients requiring coronal flap elevation for access to anterior and lateral facial skeleton. Each side of head was randomised to suprafacial, subfacial or deep dissection. Temporal hollowing following six months was assessed clinically and by CT volume analysis. They found lowest incidence of temporal hollowing in

suprafascial dissection. He concluded that flap elevation in suprafascial plane and minimisation of weight loss decreases the incidence.

Aojaneponj,chongdee[7] (2009)

He studied on 15 patients who underwent bicoronal incision. Author described the technique to preserve temporoparietal fascia by stopping the coronal incision at subcutaneous plane and then continued subcutaneously under the posterior edge. After cutting the temporal fascia the dissection continued in the subgaleal plane.

Frodel JL.Mabrie D.[20] (2010)

In this review they presented 16 consecutive cases in which a geometric pattern incision was used instead of straight incision in hopes of improving the ultimate appearance of scar in scalp incisions for maxillofacial surgery. They found that incisions made in geometric fashion are less noticeable than traditional elective linear scalp incisions. This was particularly true when there was widening of the scar.

STUDIES ON SURGICAL ANATOMY OF CORONAL APPROACH

Gosain arun k[22](1996)

He performed cadaveric study in 12 facial halves to characterize precisely the number of rami crossing the arch and their interconnection and location and demonstrated that temporal branch consists of multiple

rami which makes localization based on two soft tissue landmarks reference points unreliable. No interconnections were found with other branches but with the same. Rami occupy half the length of arch. Superficial temporal artery and temporal branch of facial nerve lie in same plane.

Agarwal CA,Mendenhall SD[2] (1997

The study was performed on 18 cadaver hemifacies to determine the course of frontal branch of facial nerve in relation to fascial planes above and below the zygomatic arch. Histologic evaluations were performed which concluded that as the frontal branch of facial nerve crosses the zygomatic arch, it is within the innominate fascia , a plane deep to SMAS and superficial temporal fascia.

Salgarelli A,Carminati R[43] (1999)

They discussed anatomy for surgical access by bicoronal approach. Incision is made deeply to subaponeurotic alveolar tissue 4 cm posterior to hairline. Periosteum incised 2cm above supraorbital margins. 7 cm tangential to arch , incise deeply to superficial fold of temporalis fascia. They concluded that this incision is safe and effective way and esthetic results were remarkable with no important complications.

Ali Teoman Tellioglu[48] (2000)

A histologically supported anatomic study was conducted for anatomic relationships and clinical applications on 20 sides on 10 cadavers. He found that outer part of temporoparietal fascia is continous with SMAS in lower border. Frontal branch of nerve runs parallel to artery so subcutaneous rather than subfascial dissection should be done. A thin muscle layer was also noted in outer part of temporalis fascia. He emphasized that anatomy of temporoparietal fascia should be well known as it provides many flap options.

Campiglio GL[55] (2007)

This article provides an accurate account of organisation of temporal fascial layers and their relationship to facial nerve. The arrangement of the temporal fascia on the zygomatic arch is also discussed.

Eman Elazeb Beheiry[18] (2007)

He studied on 44 specimens obtained from stillbirths and cadavers and injected lead oxide solution into external carotid artery to visualise vasculature. He found out that superficial temoporal fascia splits into two and superficial one in lower third splits further into two further layers. Three temporal pad of fat were demonstrated.

Campeero A,Socolovsky M[13] (2008)

The study was conducted to clarify the relationships between the extracranial portions of facial nerve and zygomatic arch on 4 cadavers. The specimens were examined under high magnification. Three points were used to depict a triangle called facial zygomatic triangle which represents the area where dissection can be performed with no risk to facial nerve. This landmark avoids damage when working below the zygomatic arch.

Lettieri S[32] (2008)

This study was conducted to map out the frontal branch of facial nerve as it passes through the dense galeal temporal fascia on 10 fresh cadavers which were dissected by use of standard bicoronal surgical approach. They conclude that the dense tissue within the galeal temporal region needs to be approached with caution, avoiding electrocautery and using sharp dissection. The study demonstrates the close proximity of the nerve in deeper portion of elevated superficial flap.

Andrew P Trussler[5] (2009)

Performed study on 8 fresh cadavers to anatomically define the depth and fascial boundaries of the frontal branch of facial nerve. Full thickness tissue sections were obtained and found that the temporal branch continued under a separate facial plane, the parotidotemporal

fascia which was deep to SMAS as it coursed to the zygomatic arch and remained within the deep fascia over the arch.

STUDIES TO DEMONSTRATE VERSATILITY AND ADVANTAGES OF BICORONAL ACCESS

Michael A M marschall[35] (1988)

He carried study on 8 patients with severe craniofacial injuries. Operative exposure was obtained through a bicoronal incision that was complemented as needed with other incisions like buccal sulcus or a tranasradix incision which enabled full visualization of the cranium, nasoethmoid, periorbital, zygomaticomaxillary and frontal regions. He concluded that conventional approaches remains the choice of treatment of single fracture and craniofacial techniques should be reserved for complex midface and other fractures.

Weber W,Michael C[50] (1989)

This study was performed on 12 patients for central or centrolateral midfacial fractures operated via bicoronal approach. Fractures were treated with titanium miniplates. Esthetic and functional results were very satisfactory due to good access and no visible scars.

Abubaker AO[8] (1991)

Author carried out a retrospective clinical study in 28 craniomaxillofacial injury patients treated with coronal approach. The study showed that this technique provides optimum exposure of fracture sites, allowing for accurate anatomic reduction and fixation of fractured segments and good cosmetic results at the incision site. The surgical technique, indications, management and prevention of potential complications of the coronal approach are discussed.

David A Mitchell[17] (1993)

In this article prospective review of cases in 5 years was given for management of primary facial trauma by bicoronal(bitemporal) flap access. A total of 50 cases were audited. Few transient complications were encountered. The author concludes that bitemporal flap is of enormous value in the exposure of upper mid and lateral face with minor modifications in the technique to produce little complications.

G Atlan P Jammet[10] (1994)

In this study a series of 11 cases were done to illustrate the advantages and possible complication of bicoronal flap access for nasal bone grafting. Nasal bone grafts from iliac or ulnar were harvested. All authors agree that this approach provides excellent access to fronto naso orbital structures. He mentioned advantages like distance from incision

and grafting helps prevent infection and respect of nasal mucosa and skin when compared to intranasal procedures apart from other advantages mentioned elsewhere. In his study, no significant long term neurovascular complications were encountered.

Afshin parischar[1] (2004)

This article discusses the utility of pericranial flap in the obliteration of frontal sinus through bicoronal access. They have found it to be safe and effective and no other incisions are required. So lwest morbidity with minimal complications are seen when bicoronal flap was raised giving exposure as well as flap harvest for obliteration of frontal sinus in trauma cases.

Qing Bing Zhang[41] (2006)

The study was conducted on 69 patients to evaluate the value of coronal incision for treating zygomatic complex fractures. Some patients were treated by other local incisions. He concluded that coronal incisions although provide excellent access for exposure and exact anatomical reduction but also has disadvantages like alopecia, nerve damage, long operative time, infection and widened scar. The incision should be used for multiple, comminuted or delayed bilateral fractures. Incision should not be overused.

Santhosh Kumaran[44] (2009)

He conducted a study on 12 patients to evaluate the value of coronal incisions for treating comminuted fractures of zygomatic complex with or without other associated fractures of the midface and to evaluate the indications, advantages and complications associated with it. He randomly selected cases requiring open reduction and internal fixation. He encountered relatively minor postoperative complications except transient paresthesia of temporal branch of facial nerve. Exposure time on average was 28.7 mins. Hypertrophic scar was found in one case. No case of temporal hollowing was found. He concluded that coronal incision provides excellent access to zygomatic complex fractures and aid in good anatomical reduction and advantage of scar hidden in the hairline. He insisted on judicious use of the incision.

STUDIES ON INDICATIONS OF BICORONAL ACCESS

Hayter JP, Robertson JM[24] (1990)

This article discusses about the bicoronal surgical access for bilateral coronoid hyperplasia by preauricular extension. They mentioned the advantages such as access to both coronoids at one time and excellent exposure of zygomatic arch for osteotomy. Postoperatively, a good aesthetic outcome was achieved with few complications of neurosensory disturbances and infection which was transient.

M.A Pogrell,D.H Perrott[39] (1991)

This paper presents the anatomy and indications for bicoronal approach to provide access to the temporomandibular joints along with the operative technique and complications. He mentioned the indications like TMJ ankylosis, costochondral reconstruction, cases with multiple operations on TMJ and bilateral coronoidectomies. The author concluded that this approach provides excellent access in indicated cases of TMJ and is more rapid than other bilateral approaches but should not be utilized routinely.

Benzill DL, Robotti E[11](1993)

They performed study on 13 patients with GCS of 10-15 treated within 24 hours of trauma. The purpose of study was to determine if early single stage repair of complex craniofacial injuries could be accomplished with accepted morbidity and mortality. Bicoronal skin flaps were used for exposure, frontal sinus obliteration and calvarial bone grafting.

Frodel JL, Marentette JL[27] (1993)

The author describes his experience in terms of indications and benefits of coronal approach in this article. A detailed description of technique emphasizing anatomic planes and neurovascular structures. Careful attention to the latter should allow prevention of potential complications. He operated on variety of cases in which it has proven

indispensible like facial trauma, craniofacial reconstruction and tumor resection.

Cheung LK, Samman N[14] (1998)

Author describes a modified technique of lefort II osteotomy for the correction of nasomaxillary hypoplasia by combination of bicoronal and transoral sulcular incision. He made medial orbital cut through the lacrimal groove. Ant limb of medial canthal ligament was detached but left post and superior limbs intact. No IMF required. This method eliminates the need for facial incision and residual scar.

Yazur ,reha[52] (2004)

Author discussed about the radiographic and clinical diagnosis of frontal sinus fractures and identify various management approaches and indication for each and recognise the most common complications of frontal sinus fractures. He summarised that accurate treatment depends on diagnosis and intraoperative findings. The amount and location of fixation and need for frontonasal duct and sinus obliteration depends on anatomy of the fractures and extent of anterior and posterior table involvement. He insisted on operating early in 1st week of injury and uses bicoronal incision for exposure. He also mentioned endoscopic techniques for the same.

Iman Feiz Erfan[25] (2005)

Performed a study on 8 patients with different anterior cranial base pathology findings. All patients were operated with single stage combined craniofacial and transfacial approach which uses bicoronal incision without other visible facial incision. Sublabial incision was also used. They were able to achieve gross resection and excellent cosmetic outcome with few complications of primary wound infection and anaemia.

Ashok kumar grover,Shaloo bageja[9] (2008)

Carried study on 32 cases for surgical correction of traumatic telecanthus by using bicoronal incision and selected surgical approach based on clinical and x ray evaluation. He used grafting and microplates and wires but MPL tucking was the common one. He insisted on early repair in cases of comminuted fractures or disrupted medial canthal ligament.

STUDIES ON COMPLICATIONS OF CORONAL APPROACH

D.E Shepherd, R.P.Ward Booth[45] (1985)

This paper reviews the morbidity of procedure in 25 patients operated with bicoronal flaps for access to the upper and middle facial skeleton. The author discussed the anatomy and surgical technique employed. He concluded that commonest complication was damage to the supraorbital nerves along with few other transient complications but

access was excellent even to the arch and TMJ. Suggestions for reduction of complication were also given in the article.

J Cliff Bierne[15] (1991)

The author mentioned the various possible problems in bicoronal incisions. In his study no scalp itching was complained and the blood loss was significantly reduced by use of Raney neurosurgical clips.

Schortinghuis J.Boss RR[46] (1999)

Aim of the study done on 44 patients was to evaluate the complications of open reduction and internal fixation of maxillofacial fractures with microplates for the follow up period of 46.8 months. Perioperative and post operative complications were analysed. They concluded that overall complication rate for microsystems was 2%. They proved to be a reliable modality to treat fractures of maxillofacial region and complications can be considered incidental and of neglectable clinical significance.

Xia DL ,Zhang ZY[51](2005)

They performed retrospective study on 149 cases of operation with coronal incision with the aim to analyze the complications of coronal incision and investigate the methods of prevention. They found injury to frontal branch, alopecia, pain, numbness, ptosis of soft tissues and

infection in few cases. They concluded that despite the merits of distinct exposure and hidden scars, its complications cannot be neglected. Precise dissection and neurovascular preservation should be done carefully.

Srinivasan D,White[47] N(2010)

The author discusses about the complication of standard bicoronal approach like temporal branch damage and temporal hollowing. The describes a technique of raising a bicoronal flap in dual plane that avoids these potential complications.

STUDIES ON FIXATION OF FIXATION OF FRACTURES: MATERIALS AND METHODS

Joseph S Gruss[28] (1992)

He worked to devise an algorithm to optimize results in craniofacial fractures. It requires synthesis of neurosurgical techniques and reconstructive techniques for complex injuries. He discussed the pathogenesis and classification of various craniofacial fractures and also discussed repair sequence along with technical problems and pitfalls.

Lyle.S.Leipziger[33] (1992)

This article discusses about the current concepts and management principles in 1992 for the naso-orbitoethmoidal fractures. Successful results depend on knowledge anatomy ability to provide correct early

management. Clinical examination and specific diagnostic techniques are required to determine operative approaches.

Rod J. Rohrich[42] (1992)

The author discussed about the evolving concepts of craniomaxillofacial fracture management. In this article he discussed five principles governing current management at that time that were precise anatomic diagnosis, direct fracture exposure, reduction and rigid internal fixation, primary bone grafting and periosteal and soft tissue suspension and repair. He insisted on early intervention to prevent secondary deformities associated with such injuries.

Ma JJ[34] (2004)

The retrospective study was performed to analyse the causes, 3D CT examination and treatment of ZMC complex fractures. Rigid internal fixation was used in all patients by titanium plates. They concluded that using coronal and vestibular incisions and rigid internal fixation, satisfied outcomes can be achieved in patients with ZMC complex fractures.

Keles B, Ozturk K[29] (2006)

In this study, the approach and type of management along with common complications in maxillofacial trauma were evaluated on 602 patients. Maxillofacial fractures were diagnosed by clinical and

radiographic findings. 43% patients undergone closed reduction and 57% were treated with open reduction and internal fixation. They concluded that ORIF should be the preferred option, since it provides the powerful fixation, is easy to perform and has better esthetic and functional outcome.

STUDIES ON OTHER APPROACHES

Zingg M,Chowdhary k[54] (1991)

The author describes 10 year experience of 813 cases operated for zygoma lateral orbital complex fractures in the article. He performed all operations with transconjunctival approach without a lateral canthotomy. Compared with subciliary access no visible scar reduced incidence of lower eyelid complications. Author emphasized on accurate reduction and stabilization and also discussed about miniplates vs wire ligature. Long term follow up results were presented.

Anthony Cultara,John B Turk[6] (2004)

They performed a study to demonstrate midfacial degloving approach that can provide proper exposure to successfully reduce NOE and midface fractures without the need for external skin incision in 9 patients. He found no significant technical problems in managing NOE, lefort, orbital rim and ZMC complex fractures. Physical examination and imaging studies showed adequate reduction.

MATERIAL AND METHODS

The clinical study on “Management of upper and middle third of the face fractures through bicoronal access” was done in the Department of Oral & Maxillofacial Surgery, Tamil Nadu Government Dental College & Hospital, Chennai.

The criteria for selection of patients include :

1. Patients with no medical contraindication for surgical procedure
2. Patients who does not have family history of male pattern baldness
3. Patients presenting with multiple/comminuted fractures or grossly displaced fractures of upper and middle third of facial skeleton with or without associated fractures of face.
4. Patients with preoperative facial nerve palsy, neurosensory deficit of scalp and previously operated with coronal incision are not included in study.

A group of six patients were selected, all were male with age ranging from 21 to 48 years. All patients suffered fractures of upper and middle third face fractures along with bony injuries of lower third of face in some patients.

Types of fractures include bilateral lefort III ,comminuted zygomatic complex fractures,nasal bone and frontal bone fractures. Most of the patients have multiple and/or comminuted fractures.

Complete case history of the patient was recorded which includes chief complaint, history of present illness, past medical and surgical history, personal history and drug allergies.

Clinical and radiographic examination was performed for final diagnosis of fractures.

Preoperative clinical examination includes inspection of facial asymmetry and injuries like lacerations, abrasion, hematoma, circumorbital edema and echymmosis, subconjunctival hemorrhage, midface depression, traumatic telecanthus, ocular dystopia, nerve paresthesia, mouth opening and occlusion.

Palpation for bony mobility and step deformities at fracture sites were performed.

Preoperative photographs were also taken for post operative comparison.

All the patients underwent radiological examination using occipito mental view and lateral cephalogram and submentovertex if required. CT scans with axial, coronal and 3D reconstruction were also taken for all cases.

All cases were treated by open reduction and internal fixation under general anaesthesia using bicoronal incision. Vestibular and other incisions were also used wherever required for management of other lower face fractures. 2 hole,4 hole,6 hole or sometimes continous holes stainless steel plates were used which were plates with bar, Y-shaped, L-shaped or other shapes for internal fixation of fractures were also used depending on the anatomical site. Transosseous wires were also used wherever required. The dimensions of plates used were 1.5 mm or 2 mm in diameter. The stainless steel screws used for fixation were 1.5x4 mm, 1.5x6mm, 2x4mm, 2x6mm, 2x8mm in dimensions.

Post operative clinical evaluation was performed for assessment of reduction, aesthetics, function and complications.

Post operative evaluation included number, type and duration of complications. Complications were divided into 2 groups:

1. ***Early complications:*** haemorrhage, hematoma, infection, swelling and temporary nerve injury
2. ***Late complications:*** obvious scarring, permanent temporal nerve paralysis, temporal hollowing, alopecia

The follow up period ranges from 3-6 months with review on 15th day, 1 months, 3 months and 6 months postoperatively Pre and post operative photographs, frontal and lateral view were taken for comparison on clinical grounds.

Occipitomental skull radiographs were obtained 1 month post op for assessment of fracture reduction and stability.

Neuorosensory deficits were examined using clinical examination (cold, light touch and two point discrimination). Other complications were observed clinically.

SURGICAL TECHNIQUE

All the cases were operated under general anaesthesia. All the patients underwent full head and facial shave before surgery. Nasoendotracheal or orotracheal intubation was used for all patients depending upon the involvement of bones in the fracture site. It was inserted either by blind nasal or oral route or fibreoptic technique depending on the difficulty during intubation. Once the patient is intubated scrubbing with betadine from the scalp to neck region was done bilaterally and draped to expose only the site of operation.

Step 1 : Locating the incision line – Incisions were located to be placed along a line extending from one preauricular area to the other curving slightly anteriorly at the vertex usually paralleling but remaining 4 to 5cm within the hairline. In cases where exposure of zygomatic arch is not required, the incisions were placed till the helix. Gentian violet ink marker was used to mark the incision line.

Step 2: Hemostatic techniques: vasoconstrictor with saline is injected into the subgaleal plane. In some cases running blocking sutures were used along the incision line. Electrocautery was used after skin and subcutaneous incision to prevent damage to hair follicles.

Step 3: Incision: After marking some cross hatches were used. Initial standard bicoronal incision was made with no.10 blade extending from

one superior temporal line to other extending deep till the galea revealing subgaleal plane which is rapidly lifted and elevated. Incision below the temporal line extends till glistening superficial temporalis fascia. Preauricular extension of the incision made till the level of lobule.

Step 4: Elevation of the flap and exposure of fracture sites – Bleeding vessels isolated and cauterized. Flap elevated with finger dissection, dissecting the portion of flap below superior temporal line above the temporalis fascia allows flap to retract anteriorly 3-4 cm superior to supraorbital rims. Periosteum is incised about 3 cm above the supraorbital rims or according to the involvement of frontal bone posteriorly from one superior temporal line to another. Subperiosteal dissection now exposes the fracture sites of frontal bone till the supraorbital rims.

Lateral portion of the flap elevated within 2-4 cm of body of zygoma and inferiorly to the root of zygomatic arch and palpated. Superficial layer of temporalis fascia is incised at the root of arch and incision continued anteriorly and superiorly at 45 degree angle joining the pericranial incision at superior temporal line .Temporal pad of fat was left undisturbed and dissection continues inferiorly in same plane with metzenbaum scissors. Temporal branch of facial nerve was always lateral to temporalis fascia. Periosteal incision can now be given over the superior surface of the arch and continued superiorly along the posterior border of body of zygoma and orbital rim meeting crosshead incision and

subperiosteal elevation done along with the flap to expose zygomatic arch, body of zygoma and lateral orbital rim.

To expose superior orbit / nasal bone the supraorbital neurovascular bundle was released. Dissecting subperiosteally over the superior and medial orbital rims allows retraction down to the level of nasal bones and lateral nasal cartilage. Lateral rim dissection was done when required. Vertical releasing incision over the periosteum of the bridge of the nose was given when required. After this dissection, most of the fracture sites were exposed.

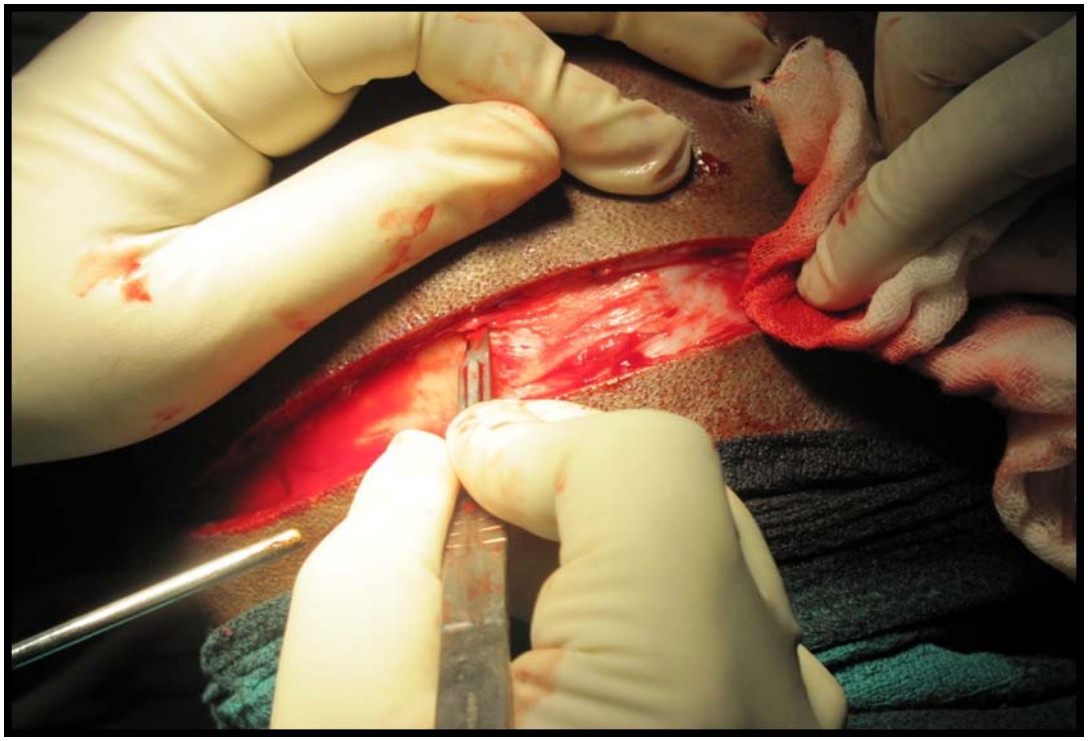
Step 4: Reduction and fixation of fractures: Reduction of fractures was done according to fracture site and near anatomical reduction was achieved even in grossly displaced fractures. Fixation of fractures was done with stainless steel miniplates and screws of varying sizes and shapes as per the requirement. Transosseous wiring was also used wherever required.

Step 5: Closure: Hemostasis was achieved and betadine saline irrigation was done. Temporalis fascia was sutured with resorbable 3-0 vicryl suture material. Suction drain was employed before final closure. Scalp incision is closed in 2 layers using slowly resorbable 2-0 vicryl through the galea/subcutaneous tissues and 3-0 ethilon sutures for skin. Preauricular component was closed as usual. Elastoplast pressure bandage was placed.

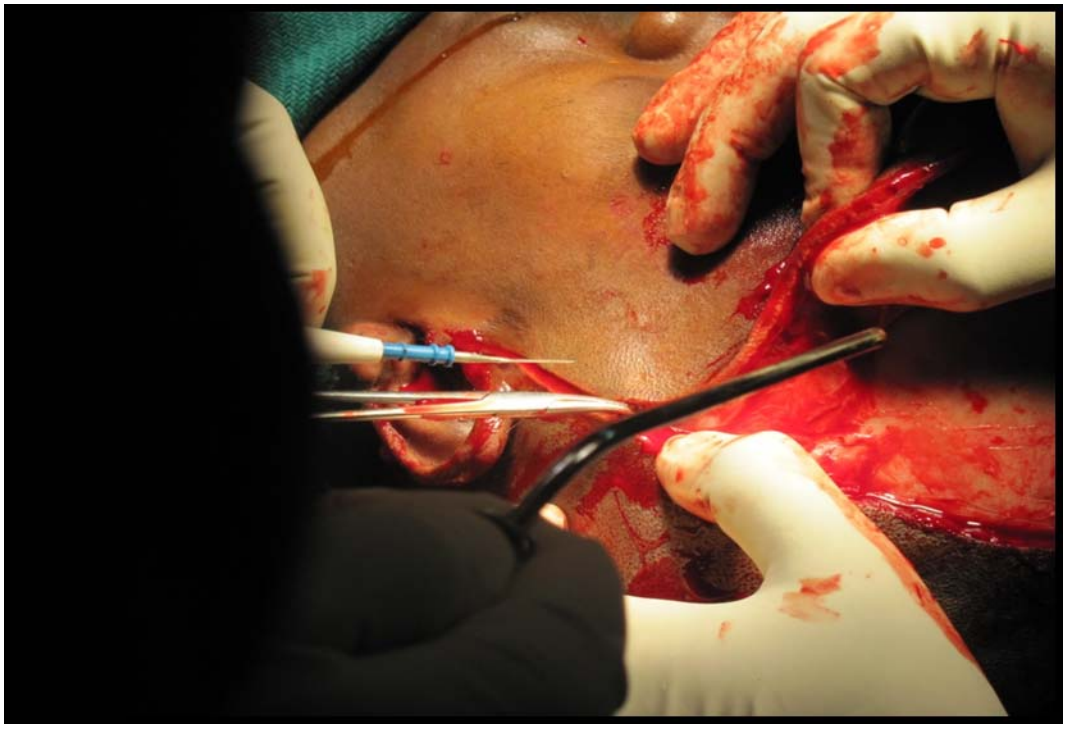
SURGICAL TECHNIQUE

Painting and draping

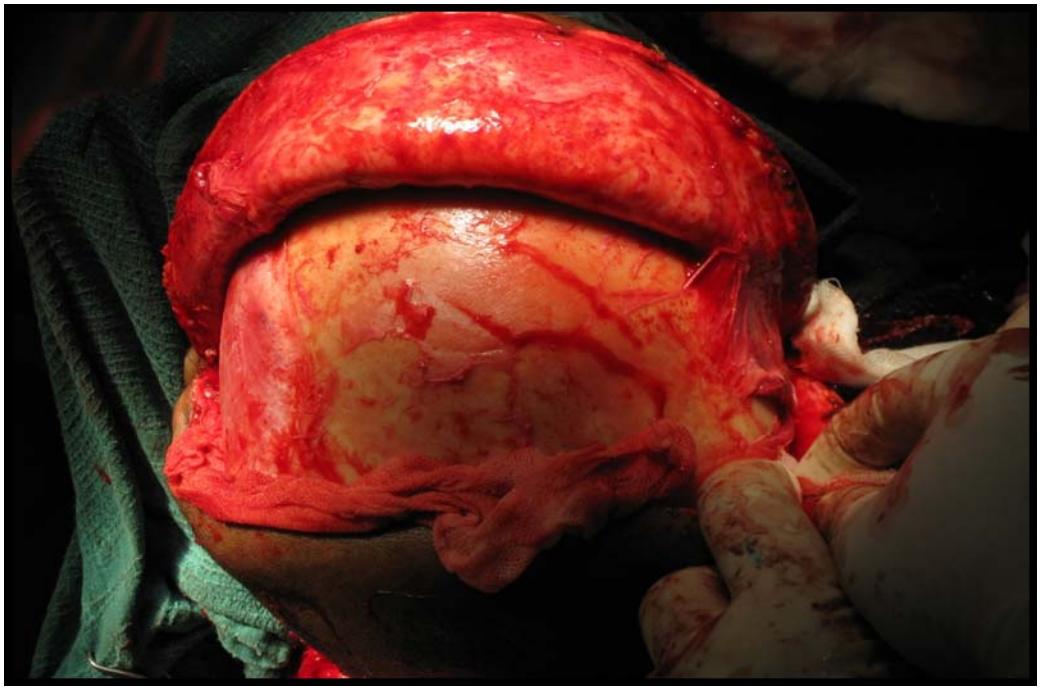
Marking of the bicoronal incision



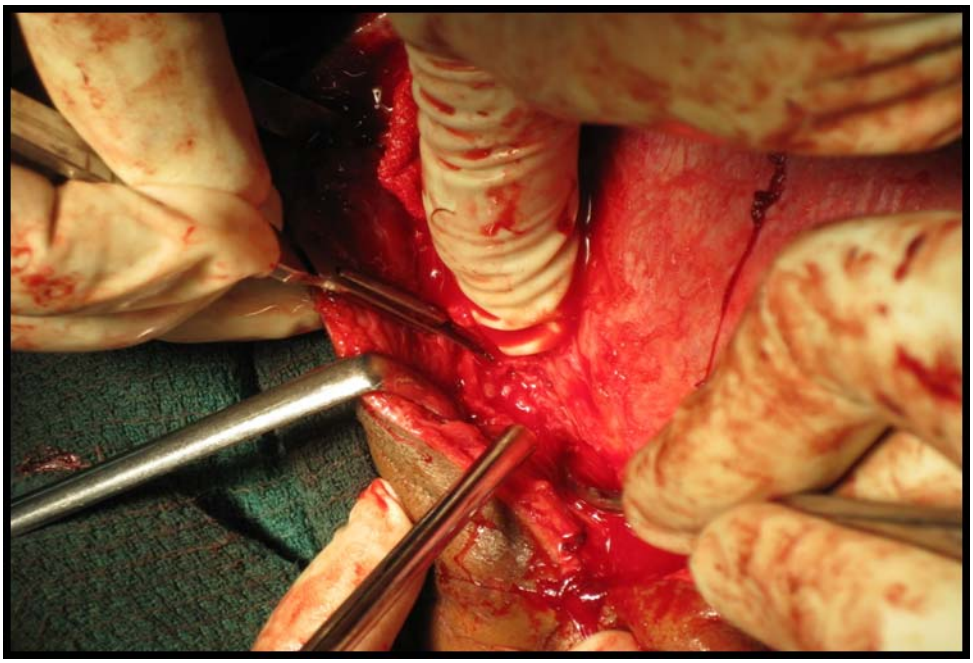
Placement of incision



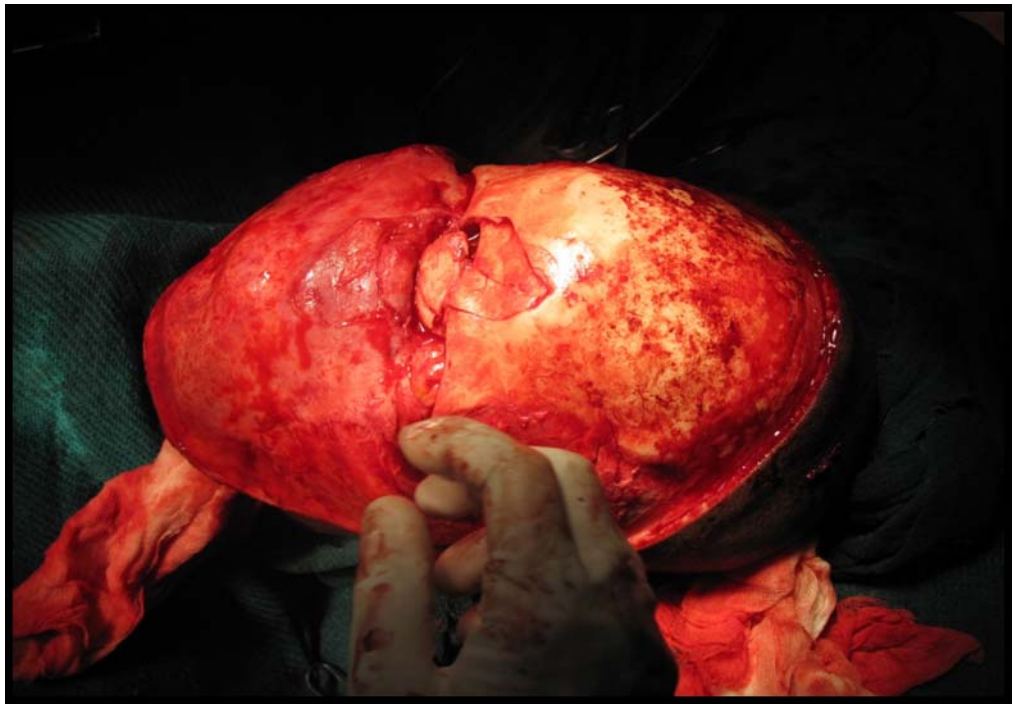
Subgaleal dissection and extension over the preauricular region



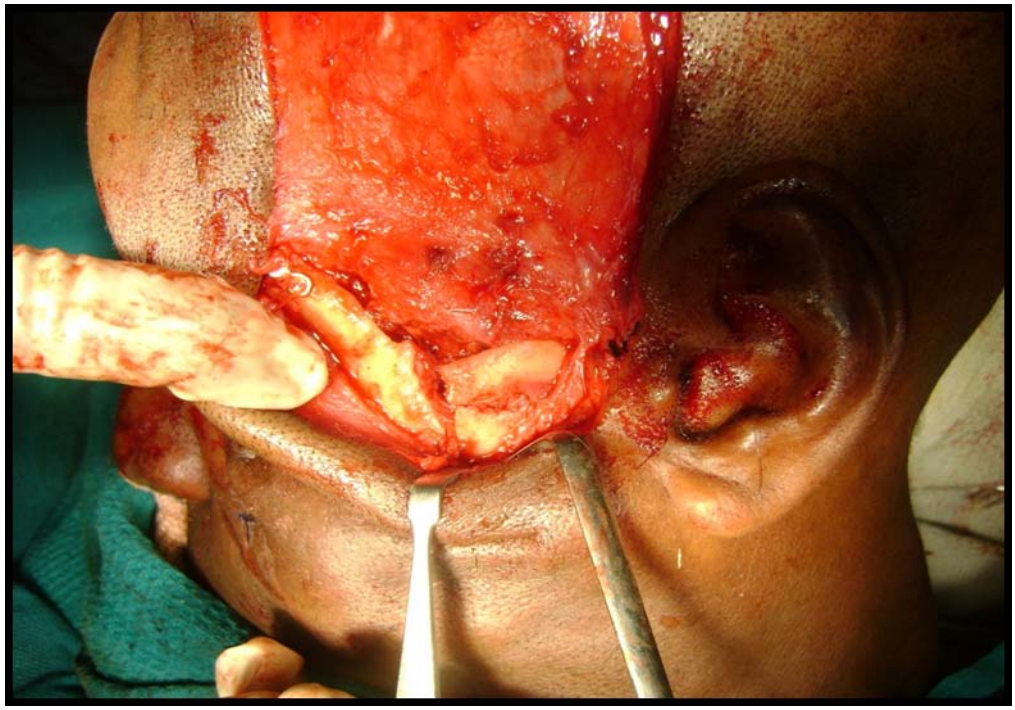
Elevation of bicoronal flap



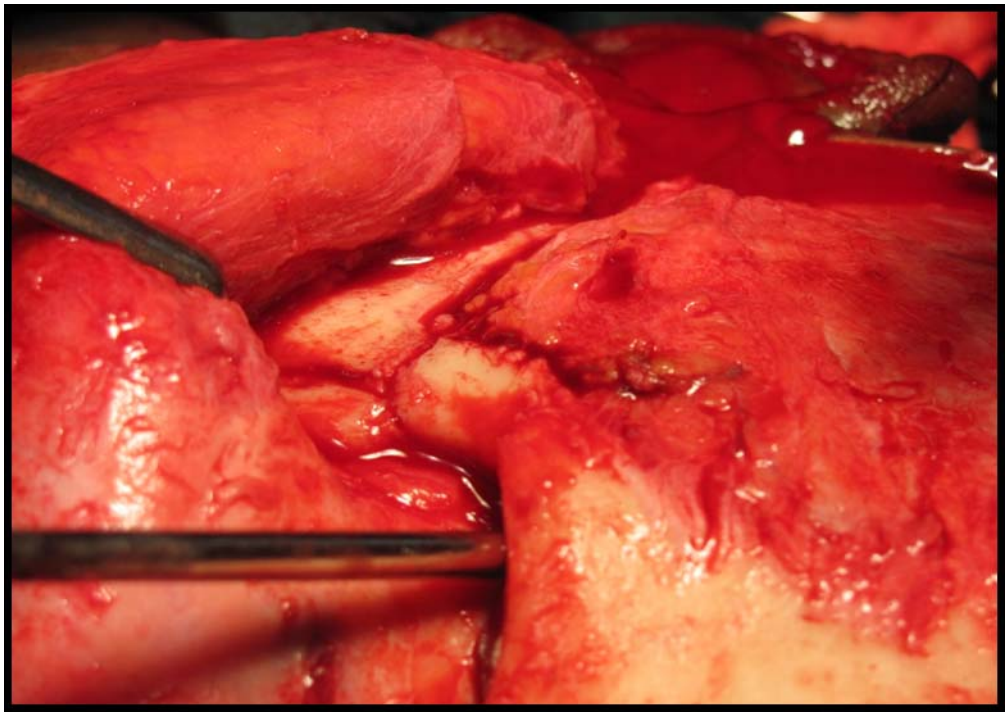
Incising the temporalis fascia at 45 degrees



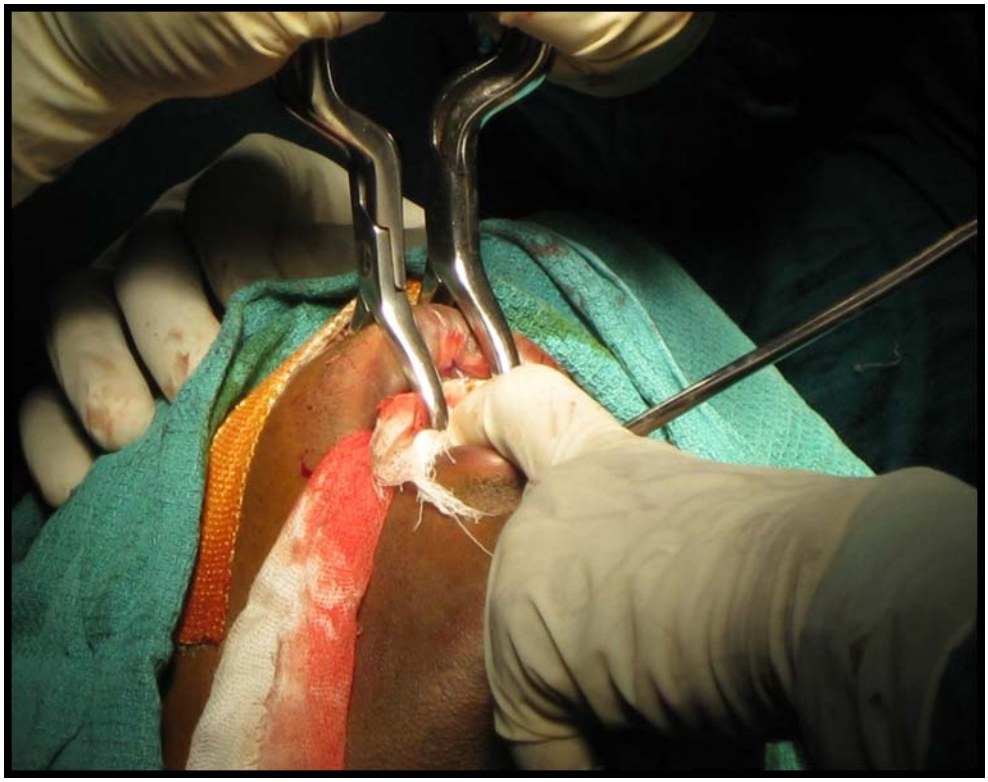
Complete reflection of bicoronal flap



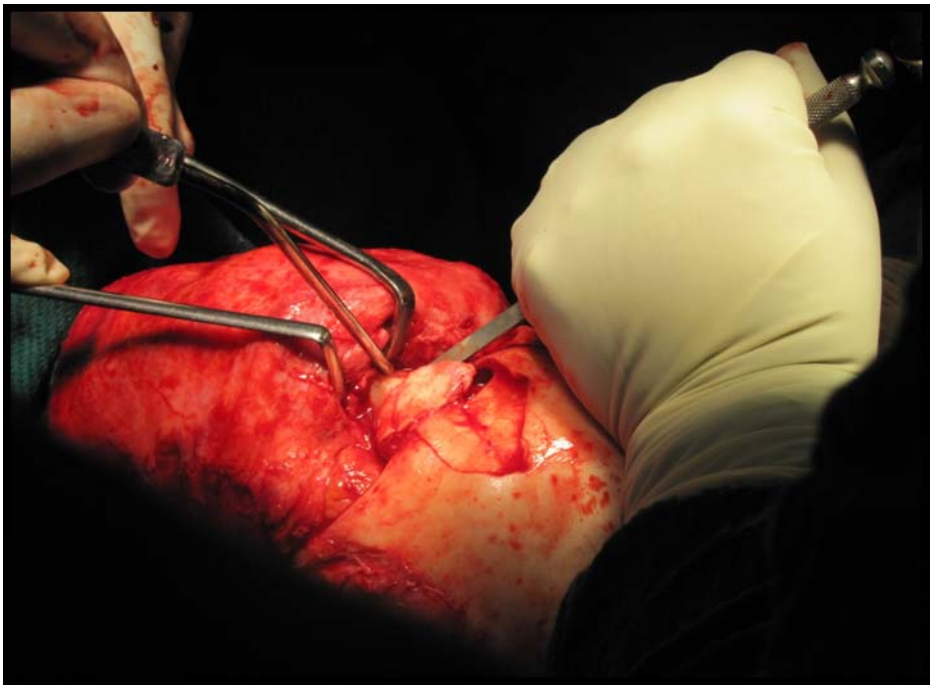
Exposure of the fracture site



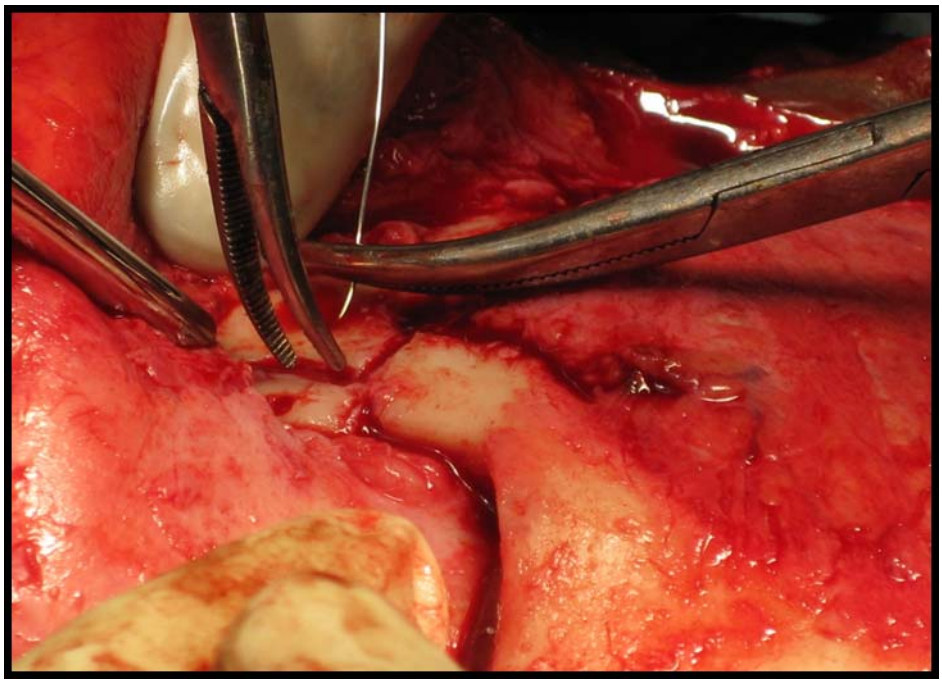
Exposure of the fracture site



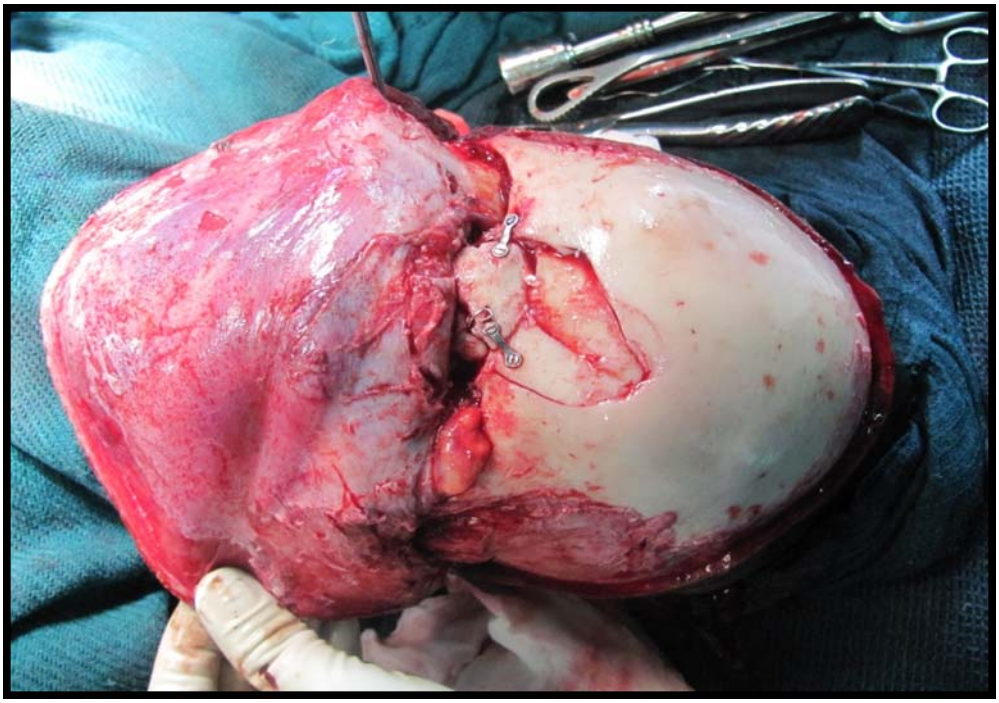
Reduction of fractures



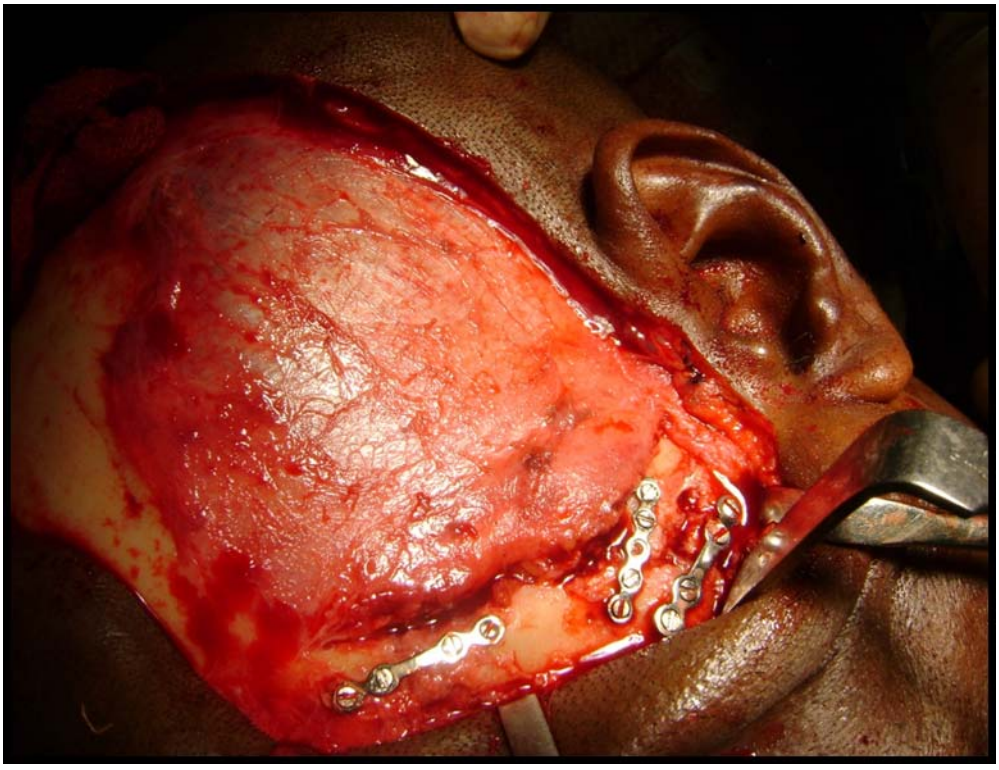
Osteotomy of fused fractures for anatomic reduction



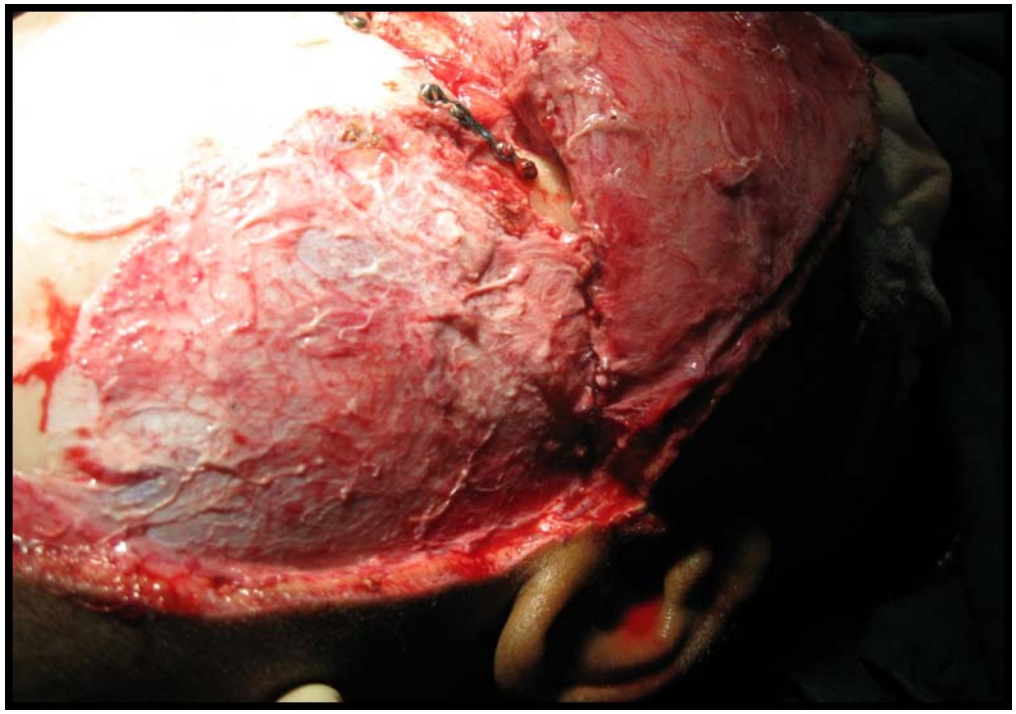
Fixation of fracture segments



Fixation of fracture segments



Fixation of fracture segments with miniplates



Closure of temporalis fascia with resorbable suture

Placement of suction drain

Closure of the incision

Final closure of bicoronal incision with prolene sutures

CASE REPORT -1

NAME : Mr. Elumalai

AGE/SEX : 21 / Male

CHIEF COMPLAINT:

Patient complains of pain and swelling over the face with difficulty in mouth opening

HISTORY OF PRESENT ILLNESS:

History of road traffic accident 3 days back with consequent swelling and pain in the right malar region and intraoral region

PAST MEDICAL/SURGICAL HISTORY:

No relevant medical or surgical history

GENERAL EXAMINATION :

Patient is moderately built and nourished.

LOCAL EXAMINATION:

Extra oral examination

- Multiple abrasions over the face
- B/L subconjunctival haemorrhage present
- Step deformity at right supraorbital rim
- Tenderness, crepitus and mobility of the nasal bones
- Swelling with tenderness on palpation on right malar region
- Tenderness and step deformity b/l over frontozgomatic suture
- Tenderness and step deformity at the right zygomatic arch

- Mouth opening restricted
- B/L condylar movements palpable

Intraoral examination

- Deranged occlusion
- Mobility of the maxilla felt at lefort III Level
- Ecchymosis in the right upper buccal sulcus
- Dentoalveolar segment mobility in relation to 31 33 33

RADIOGRAPHIC FINDINGS

- **PNS**: Comminuted fracture of right zygomatic complex and arch.

  Frontonasal separation with fracture nasal bones

  B/L frontozygomatic seperation
- **OPG** : Left coronoid process fracture separation
- **CT Scan**: confirms the above findings

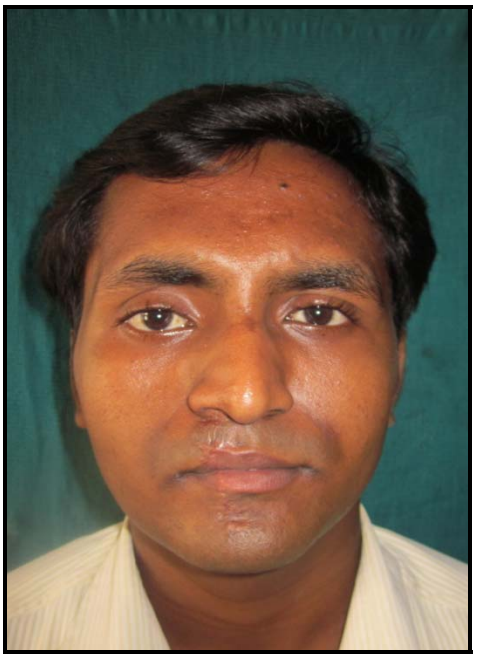
DIAGNOSIS

- Right side comminuted zygomatic complex and arch fracture
- Left side lefort III fracture
- Right side frontal bone fracture
- Nasal bone fracture
- Coronoid process fracture

TREATMENT PLAN:

Open reduction and internal fixation under G.A

PRE OP **POST OP**



PRE OP **POST OP**

PRE OP **POST OP**

PRE OP PNS **POST OP**

CASE REPORT – 2

NAME : Mr. Naresh

AGE/SEX : 48 yr / male

CHIEF COMPLAINT :

Patient complaints of pain in the right cheek and fracture of right jaw and difficulty in mouth opening

HISTORY OF PRESENT ILLNESS:

History of road traffic accident two weeeks back and difficulty in mouth opening and mastication

PAST MEDICAL/SURGICAL HISTORY

No relevant past medical or surgical history

GENERAL EXAMINATION :

- Patient is concious,oriented and afebrile
- Moderately built and nourished
- No pallor, cyanosis or clubbing

LOCAL EXAMINATION:

Extra oral examination

- Facial asymmetry present
- Bilateral circumorbital edema and ecchymosis
- Step deformity felt at right and left frontozygomatic region
- Tenderness and step deformity at the frontonasal region
- Swelling and tenderness over the right malar region

- Tenderness and step deformity at the right zygoma region
- Step deformity at the right lower border of mandible in parasymphysis region
- Mild restriction in mouth opening
- Left condyle not palpable

Intraoral examination :

- Deranged occlusion
- Sublingual ecchymosis present
- Fracture segment mobility present between 42 and 43
- Complete maxillary mobility seen

RADIOGRAPHIC FINDINGS

PNS: Fracture separation at left frontozygomatic region

- Fracture separation at right zygomatic body region
- Fracture separation at the frontonasal region
- Fracture separation with displacement at right parasymphysis
- Fracture of left condyle

DIAGNOSIS

- Bilateral lefort III fracture
- Fracture right zygoma body
- Fracture right parasymphysis
- Fracture left condyle

TREATMENT PLAN

Open reduction and internal fixation under G.A

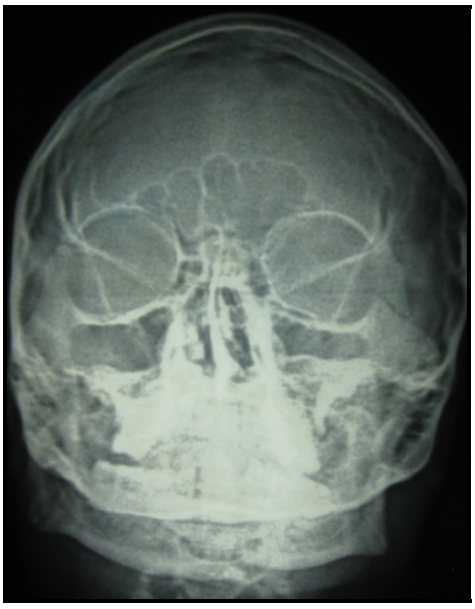
PRE OP **POST OP**


PRE OP **POST OP**


PRe OP

POST OP

PRE OP PNS



POST OP PNS

CASE REPORT – 3

NAME : Mr. Chidambaram

AGE/SEX : 24 yrs / male

CHIEF COMPLAINT :

Patient complaints of of pain in the left cheek and facial asymmetry and depression over the same with difficulty in mouth opening.

HISTORY OF PRESENT ILLNESS

History of road traffic accident 15 days back following which he developed numbness over the left side of face and facial asymmetry.

PAST MEDICAL/SURGICAL HISTORY

Patient underwent treatment for consuming poison 1 yr back.

GENERAL EXAMINATION

- Patient concious , oriented and afebrile
- Moderately built and nourished
- No signs of anaemia , icterus or clubbing

LOCAL EXAMINATION

Extra oral examination

- Facial asymmetry with depressed left malar region

- Left circumorbital edema and echymosis
- Subconjunctival hemorrhage in left eye
- Tenderness and step deformity at the left frontozygomatic and infraorbital region
- Tenderness and step deformity at left zygoma body region
- Ocular dystopia present
- Mouth opening restricted
- B/L condylar movements palapable

Intraoral examination :

- Deranged occlusion
- Tenderness over the left zygomatic buttress region

RADIOGRAPHIC FINDINGS

PNS view : Reveals comminuted fracture of the left zygoma and arch

- Fracture separation of the left frontozygomatic suture
- Fracture at zygomatic buttress region

CT Scan : confirms the above mentioned findings

DIAGNOSIS

Comminuted left zygomatic complex fracture

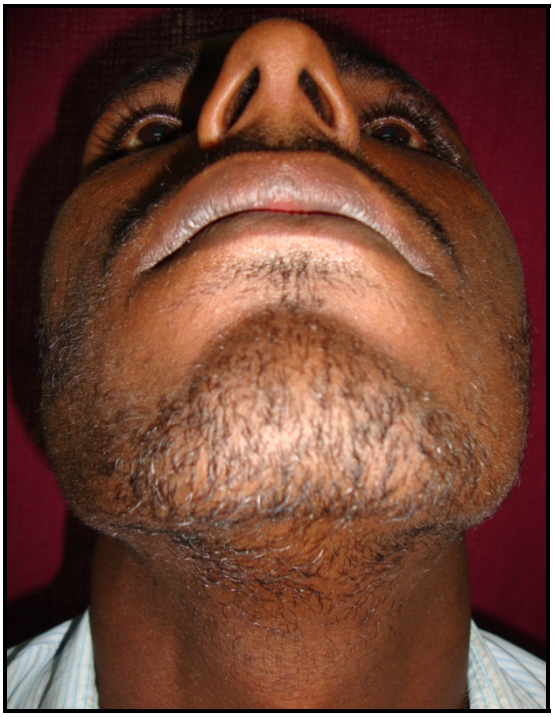
TREATMENT PLAN

Open reduction and internal fixation under G.A

PRE OP **POST OP**

PRE OP **POST OP**

PRE OP **POST OP**



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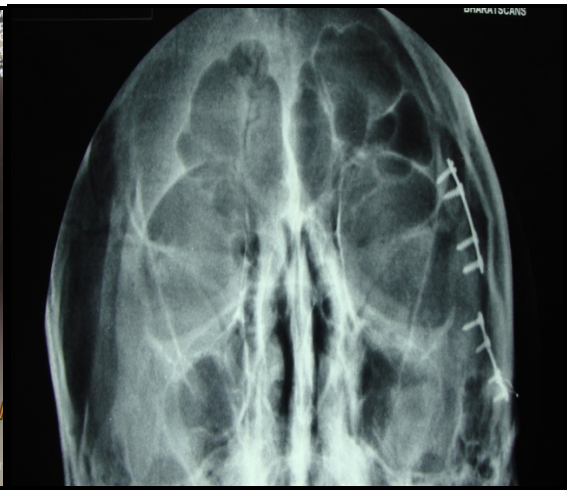


CASE REPORT 4

NAME : Mr. Tilak

AGE/SEX : 33 yrs / male

CHIEF COMPLAINT

Patient complains of pain and swelling in the face and inability to open the mouth

HISTORY OF PRESENT ILLNESS

History of road traffic accident 10 days back after which he developd pain and swelling over the face and difficulty in mouth opening.

PAST MEDICAL/SURGICAL HISTORY

No relevant past medical or surgical history

GENERAL EXAMINATION

Patient concious , oriented and afebrile

Moderately built and nourished

LOCAL EXAMINATION:

Extra oral examination

- Left circumorbital edema and ecchymosis
- Left subconjuctival hemorrhage
- Tenderness and step deformity at left supraorbital rim
- Tenderness and step deformity at left frontozygomatic
- Step deormity at zygomatic arch with depression
- Restricted mouth opening

- Bilateral condylar movements palpable
- Tenderness at the left body and angle region

Intraoral examination :

- Deranged occlusion
- B/L molar gagging present
- Mobility of maxilla felt at lefort I level
- Dentoalveolar segment mobility in relation to 11 12 13
- Step deformity and tenderness at left parasymphysis region

RADIOGRAPHIC FINDINGS

PNS :

- Fracture separation at left frontozygomatic suture
- Fracture separation at left supraorbital rim
- Fracture comminution of left zygomatic arch
- Bilateral fracture separation seen at lefort I level
- Fracture comminution of left body and angle of mandible

CT : Confirms the above findings

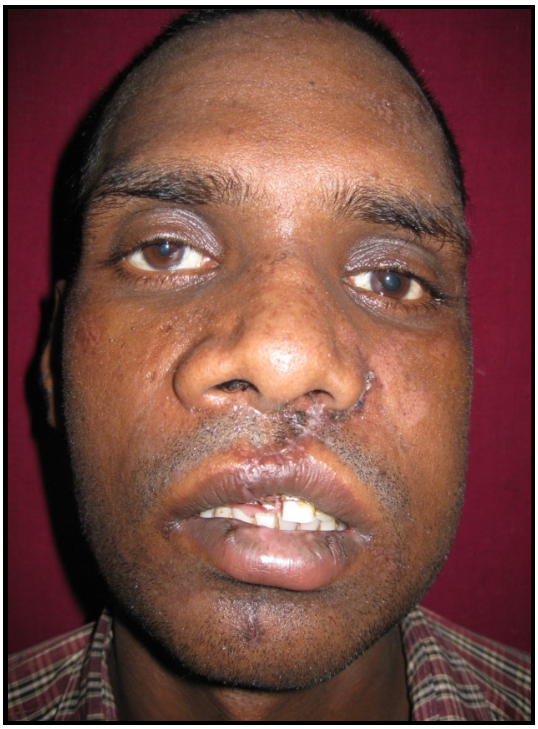
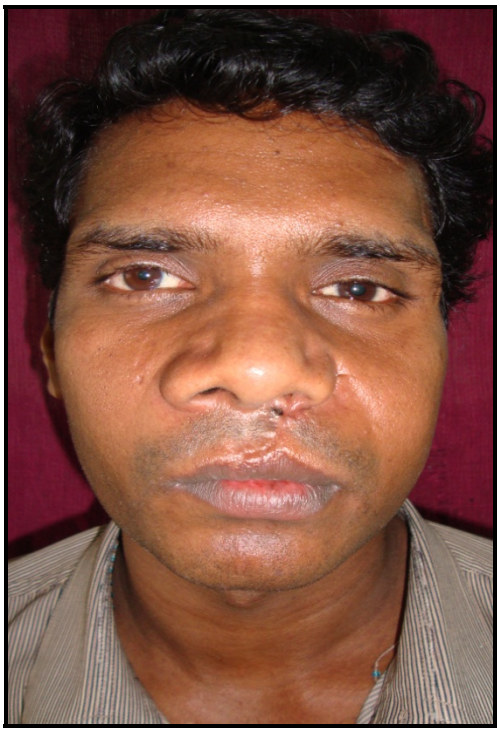
DIAGNOSIS

- Comminuted left zygomatic complex fracture
- Left frontal bone fracture
- Bilateral lefort I fracture
- Comminuted fracture parasymphysis body and angle

TREATMENT PLAN

Open reduction and internal fixation under G.A

PRE OP **POST OP**

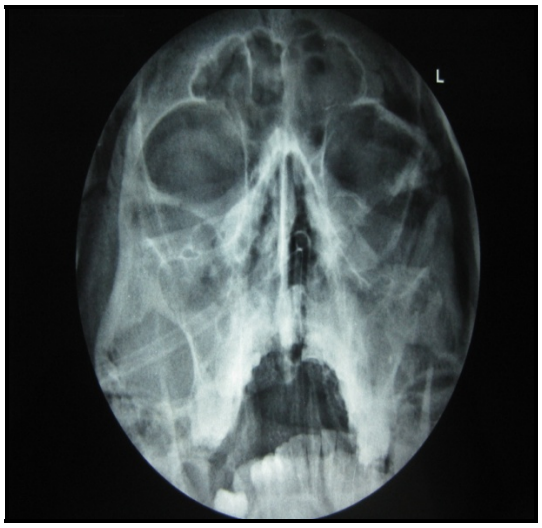



PRE OP **POST OP**

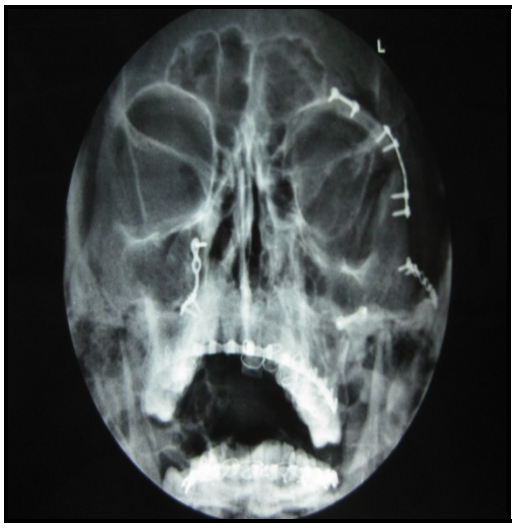

PRE OP

POST OP

PRE OP PNS



POST OP PNS



CASE REPORT -5

NAME **:** Mr. Dakshinamoorthy

AGE/SEX **:** 23 yrs / male

CHIEF COMPLAINT:

Patient complaints of pain over the face and difficulty in mouth opening and chewing.

HISTORY OF PRESENT ILLNESS

History of trauma by road traffic accident 26 days back following which the patient developed pain and swelling over the face with difficulty in mouth opening and chewing also

PAST MEDICAL/SURGICAL HISTORY

No relevant past medical or surgical history

GENERAL EXAMINATION

- Patient concious oriented and afebrile
- Moderately built and nourished
- No signs of pallor, icterus and clubbing

LOCAL EXAMINATION:

Extra oral examination

- Facial asymmetry present

- Bilateral circumorbital edema and echymosis
- Sutured scars on right nose and supraorbital region
- Traumatic telecanthus and ocular dystopia present
- Depression over the forehead
- Tenderness over the right frontozygomatic suture, right eyebrow,glabella and infraorbital region
- Step deformity at the medial supraorbital region and right
- frontozygomatic suture and right angle of mandible
- Increased nasal root width and depressed right lateral nasal wall and sutured scar at right ala

Intraoral examination:

- Deranged occlusion
- Mouth opening restricted
- Tenderness over the right zygomatic buttress region

RADIOGRAPHIC FINDINGS

PNS view:fracture separation at the right frontozygomatic suture

CT Scan : reveals fracture anterior table of frontal sinus

- Comminuted fracture nasal bones
- Fracture of right medial orbital wall
- Right frontozygomatic suture separation
- Fracture right coronoid process

OPG : shows comminuted fracture right ramus and coronoid

DIAGNOSIS

Comminuted right zygomatic complex fracture

- Frontal sinus fracture
- Nasoorbitoethmoid fracture
- Fracture ramus and coronoid process of mandible

TREATMENT PLAN :

Open reduction and internal fixation under G.A

PRE OP

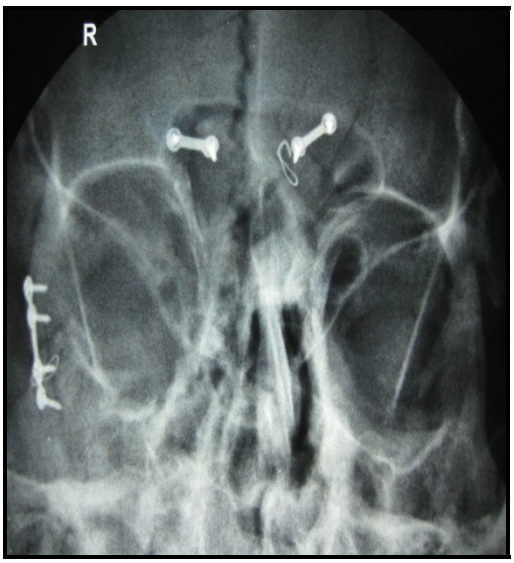
POST OP

PRE OP

POST OP

PRE OP **POST OP**

PRE OP PNS **POST OP PNS**



CASE REPORT – 6

NAME : Mr. Kuppan

AGE/SEX : 32yr / male

CHIEF COMPLAINT:

Patient complaints of pain in the left cheek region and facial asymmetry with difficulty in mouth opening

HISTORY OF PRESENT ILLNESS

History of road traffic accident one month back following which the patient developed swelling and pain over the left cheek region which subsided after few days with medication but now has complaint of pain and facial deformity of left side with restricted mouth opening.

PAST MEDICAL/SURGICAL HISTORY

No relevant past medical or surgical history

GENERAL EXAMINATION

- Pt concious oriented afebrile
- Moderately built and nourished

LOCAL EXAMINATION:

Extra oral examination

- Facial asymmetry pressent
- Flatness of the left zygomatic region

- Tenderness and step deformity at the left FZ suture region

- Step deformity at the infraorbital rim
- Sutured wound present at the left infraorbital region
- Laterally prominent left zygomatic arch region and step deformity
- Restricted mouth opening
- B/L condylar movements palpable

Intraoral examination :

- Occlusion normal
- Tenderness over the left zygomatic buttress region

RADIOGRAPHIC FINDINGS:

PNS view reveals comminuted fracture separation at left zygomatic complex region with zygomatic buttress fracture Laterally displaced comminuted zygomatic arch fracture.

CT Scan reveals comminuted zygomatic complex fracture.

DIAGNOSIS

Comminuted left zygomatic complex and arch fracture

TREATMENT PLAN

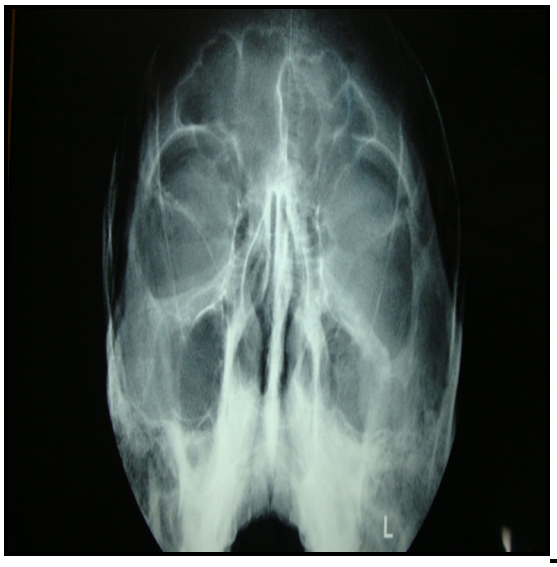
Open reduction and internal fixation under G.A

PRE OP **POST OP**


PRE OP **POST OP**


PRE OP **POST OP**

PRE OP



OBSERVATION & RESULTS

In this prospective study of coronal approach for management of upper and middle third of the face 6 patients were studied.All the patients in my series were male with mean age of 30 years.

Etiological factors in this series of cases was road traffic accident in all cases. In 65 % of cases bicoronal incision was alone sufficient. In 35% cases other incisions were also used.

Esthetically satisfying results were achieved in all the patients except one in whom telecanthus and nasal deformity could not be primarily corrected. None of the patients were troubled by visible preauricular scars which were almost inconspicious. No hypertrophic scar was seen in any of the patients.

No case of postoperative hemorrhage or hematoma was encountered. None of the patients in our study encountered any form of infection at the incision site or at the fracture fixation site. No stitch abscess was encountered.

Swelling at the supraorbital region developed in one case 15 days postoperatively which resolved following antibiotic therapy

Average time spent for flap elevation and exposure of fracture site was 42 minutes.

Surgical access to the fracture site was excellent in 90% of cases and good in other 10% of cases.

Mild weakness of the temporal branch of facial nerve was seen in 2 cases with difficulty in forehead wrinkle formation and eyebrow elevation which was transient and completely resolved in 2 months following physiotherapy. No permanent motor deficit was seen in either of cases.

In our series of patients, no ptosis or epiphora was encountered.

Unilateral Supraorbital transient sensory loss was seen in one patient which also recovered in 3 months.

Transient neurosensory deficits related to zygomaticofacial and auriculotemporal nerves though less avoidable,was less troblesome to the patients.

Neurosensory loss at at incision site was complained by one patient who is under follow up.

The follow up period in the study was three months to six months.

The observation and results reveals that bicoronal approach has been found very useful and versatile surgical approach in the management of comminuted and/or displaced fractures of upper and middle third of the face.

Patient	**Case1**	**Case2**	**Case3**	**Case4**	**Case5**	**Case 6**
Age	21 yrs	48 yrs	24 yrs	33 yrs	23 yrs	32 yrs
Sex	Male	Male	Male	Male	Male	Male
Etiology	RTA	RTA	RTA	RTA	RTA	RTA
Flap elevation time	43min	40min	45min	35min	32min	35min
Surgical access	Excellent	Good	Good	Excellent	Excellent	Excellent
Anatomic reduction	Excellent	Excellent	Excellent	Good	Good	Excellent
Post operative facial aesthetics	Good	Good	Good	satisfactory	Average	good

Post operative evaluation of complications

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Haemorrhage	–	–	–	–	–	–
Hematoma	–	–	–	–	–	–
Infection	–	–	–	–	–	–
Swelling	–	–	–	Mild	–	–
Temporary facial nerve perasthesia	–	–	–	Mild	–	Mild
Permanent facial nerve paralysis	–	–	–	–	–	–
Neurosensory loss	–	–	–	Present	–	–
Alopecia	–	–	–	–	–	–
Obvious scarring	–	–	–	–	–	–
Temporal hollowing	–	–	–	–	–	–

DISCUSSION

Since the beginning of time, the traumatic injuries of the face and their incidence is increasing at an alarming rate. The facial skeleton is a complex structure supported by horizontal and vertical buttresses of bone. Multiple and communited facial fractures of upper and middle third of the face are seen in grievious injuries. Bones involved in such fractures include frontal, nasal, ethmoidal, lacrimal, zygomatic and maxilla. Various fractures in such bones include lefort II and III fractures, naso orbitoethmoid and zygomatic complex fractures which are many a times comminuted

The ideal surgical approach to treat craniomaxillofacial fractures should provide maximum exposure of the fractured segments, ensure less potential for injury to facial structures and allow for good cosmetic results. Several approaches have been described. Limited access to the fracture site, lack of adequate exposure and subsequent facial scars are among a list of objections to most of these techniques. However, the coronal approach, a technique that is widely used for craniofacial osteotomies and neurosurgical access to the intracranial contents, is an excellent alternative.[8]

In formulating a treatment plan, selection of surgical approach is important because it could influence the ease of reduction and fixation of the fractured segments, the length of the operating time and length of the hospital stay. Even when the coronal approach is described in treatment of traumatic facial injuries, it has been reserved for severe and comminuted or multiple fractures of the upper and middle third of facial skeleton.[8]

The bicoronal flap was first described by HARTLEY and KENYON in 1907 and two decades later was advocated by SACHS for bilateral frontal lobe exposure. However, it did not gain widespread acceptance in maxillofacial surgery until the 1970's when TESSIER and later ANDERSON and JACKSON reported excellent access that it provided for lefort II and lefort III osteotomies.[44]

Careful initial evaluation is imperative to diagnose accurately the magnitude of injury, noting in particular any asymmetry, palpable deformity, bony mobility, ocular muscle imbalance and hypoesthesia and anesthesia indicative of nerve injury.

Diagnosis of such traumatic bony and soft tisssue injuries is crucial for management. Various diagnostic tools apart from most important and thorough clinical examination include

- PNS view
- Lateral cephalogram
- Orthopantamogram
- Submentovertex
- CT Scan(axial and coronal view)
- 3D CT reconstruction

Indications for coronal approach [8,9,11,14,24,25,27,39,52]

- Severe craniofacial dysjunction injuries including lefort type II and III ,frontal sinus and nasoethmoidal fractures
- Severe comminuted zygomatic arch and zygomatic bone fractures
- Simultaneous craniotomy procedures for intracranial injuries and treatment of facial fractures.
- Osteotomy for reduction of old fractures
- Access osteotomies for management of craniofacial deformities
- Harvesting of calvarial grafts

Advantages [9,14,26,37,38,40,41,49]

- Excellent access and exposure of the fracture site
- Excellent anatomical reduction and fixation of fractures
- Scar hidden in the hairline
- Graft harvest with the same incision from calvaria if required
- Excellent aesthetic outcome

A study by Richard C.Shaw in 1975 shows that proper reduction and fixation of severe fractures require adequate exposure and visualiztion of bony fragments for which coronal approach provides the needed exposure.

Marshall M A et al in 1988[35] and Shepherd DF et al in 1985[45] and and Abubaker et al in 1990[8] have all reported excellent access to the upper midfacial skeleton, supraorbital margin, frontonasal suture, nasoethmoidal suture and lateral orbital rims.[44] Our results correlate with the above repored findings.

COMPLICATIONS[6,15,45,46,47,51]

Complications are divided into early and late complications[8]

Early complications

- Haemorrhage and hematoma under the flap
- Infection
- Swelling
- Transient sensory disturbances of supraorbital and preauricular areas
- Temporary nerve injury

Late complications

- Alopecia at the incision site

- Permanent ensory loss at incision line
- Permanent deficit of frontal branch of facial nerve leading to inability to form foreahed wrinkles and eyebrow elevation on the affected side and eyelid closure
- Temporal hollowing
- Widened scar

In order to prevent hematoma/hemorrhage continous transfixion sutures along the line of incision, local anaesthetic including adrenaline was injected under the galea aponeurotica[41]. During the operation, scalp clips , electrocautery and ligation of arteries helps prevent blood loss[41]. Achievement of complete hemostasis before closure prevents chances of hematoma formation postoperatively. Suction drain should be placed to prevent such complications.[44]

Hematoma and infection have also been reported in the literature[8,41,44,45] but in our cases none of the patients reported such complication. Suction drains and pressure dressings for 48 hours were applied in various studies[44.]and so for all cases in our study. With meticulous surgical technique and the use of high dose, short course prophylactic antibiotics and suction drainage, such complications can be reduced. Shepherd DF et al in 1985[45] and and Abubaker et al in 1990[8] have reported very few cases of hematoma as complication.

We have no cases of flap infection or stitch abscess. The findings are similar to other studies published. Frodel et al in 1993 reported that in the study conducted on 100 patients , no cases of flap infection occured.[27]

Nerve complications are usually transient and related to traction on the nerves intraoperatively[41]. Thorough knowledge of surgical anatomy and its application during the procedure helps prevent any direct transection of nerve leading to nerve injuries and permanent neural deficits.

Various studies have been done in the past to demonstrate the course of frontal branch of facial nerve and its relationship to various layers of the temporoparietal region.[2,5,13,18,22,32,43,48,55]

Studies by Mendenhall in the year 1997 demonstrated with cadaver dissections that frontal branch travelled within the innominate fascia as it crosses the zygomatic arch into the temporal region, a plane deep to SMAS and superficial temporal fascia.[2]

Frodel et al in 1993 [27] reported facial nerve weakness in 41.7% of his patients treated with coronal approach but resolved in one month except 2 patients in whom permanent facial weakness was seen. In our study 2 cases showed mild weakness of the frontal branch of facial nerve

with inability to form wrinkles and elevate the eyebrow most probably due to retraction or less probably due to direct nerve damage which resolved within 2 months. A dual plane approach is described by Srinivasan et al in 2010 for avoiding damage to temporal branch of facial nerve[47]

In a study by Campiglio in 2007 the author's dissection confirms that the frontal branch, despite the variations in branching pattern, has an anatomical relationship with a surrounding fascia that can be deemed constant and predictable[55]. Damage to the nerve can be prevented if dissection is within the confines of anatomical restrictions but this complication can sometimes be seen even in the most skillful and experienced hands.

Sensory disturbances with coronal approach are related to supraorbital and supratrochlear and zygomaticofacial nerves. Studies by Frodel et al in 1993 [27] reported permanent neurosensory loss of scalp in in few cases which recovered in some of them. One of our case reported anaesthesia of the forehead which resolved completely in 3 months. Traction over the nerve during flap retraction is the most common cause.

Coronal incision can sometimes leave an unsightly results in patients with male pattern baldness. Therefore, this incision should be

carefully modified or not used in these patients[23]. In our study male pattern baldness was put as an exclusion criteria.

Additionally, many facial fractures can be reduced and fixed through concomitant overlying facial lacerations, which eliminates the need for coronal approach in male pattern baldness patients.

When performing a procedure with cosmetic concerns, the final appearance of the scar is of paramount importance. In children such considerations are further magnified by detrimental postoperative forces, including growth and cross incisional muscle tension[3] .Camoflouge and minimization of scar in the hair bearing tissues centers around maintainence of the presence of orientation of hair follicle in the final scar.

In the series by Zhang et al (2006)[26] few cases suffered scar wider than 0.5 cm. In study by Abubaker in (1990)[8] one case out of 28 suffered a scar of 3 cm. In our study none of the patients had a scar greater than 0.5 cm at 3 months.

Various modifications of the technique are reported in the literature to reduce scar widening . Hypodermic incision were used in one study to eliminate wound tension which minimizes visibility of scar to the naked

eye.[21] Geometric pattern incisions were also used in various studies for the same[4]. Use of wedge shaped incison with relaxation sutures have also been mentioned to serve the same purpose in the past.[26]

Initial scalp incisions should always be performed with the scalpel to immediately below the hair follicles after which electrocautery may be used as in our cases. Studies by Papay and Stein in 1998 have shown that cold scalpel provides better outcome when compared to use of electrocautery for incisions.[38.] Incision at 50 -70 degrees from the skin surface avoids damage to the hair follicles.[26]

For the last many years many authors have eliminated hair shaving for all coronal incisions, a technique being more accepted by surgeons now a days, although we planned full scalp shave for all our patients just to be on the safer side.

Various hair braiding techniques are used as an adjunct for intraoperative management of the scalp in patients undergoing craniofacial surgery especially in female patients[40] .However, in our cases all our patients were male.

Despite all the improvements mentioned in the literature, there is often a late problem with the straight line coronal incision which is appreciated more when the hair gets wet[31,37].The zig zag incision or

stealth incision eliminates this problem to a great extent.[31,37] This incision is particularly useful for very short hairstyles such as crew cut or in very short, tightly curled hair. The concept of invisibility of scar and the shape of the stealth bomber suggested the name of stealth approach. Extension of the incision in the postauricular region is also used by some authors to hide the scar behind the auricle.[4,53]

Postoperative temporal hollowing following coronal flap elevation was related to decrease in superficial temporal fat pad volume in patients whom have dissections within the superficial temporal fat pad and postoperative weight loss.[16] . A dual plane approach is described by Srinivasan et al in 2010 for avoiding temporal hollowing. [47] In our study temporal hollowing was not seen in any of the cases.

In our study we calculated the time taken for exposure of fracture from the moment the incision is placed and dissection is carried out upto the zygomatic arch. The timings ranged from 32 minutes to 45 minutes with mean time of 38.3 minutes. Marshall et al (1988)[35] and Zhang et al (2006)[41] have reported longer operating times with this incision.[44]

Different studies were done on fracture fixation by using different materials like stainless steel and titanium.[16,17.18,25,29] In our study we used stainless steel plates for fracture fixation along with stainless steel

transosseous wires. None of the cases reported plate infection or requires removal.

Alopecia at the incision site is sometimes associated with coronal incision due to direct injury to the hair follicles. Various modifications of the techniques are offered to prevent this complication[26 38]. None of the cases in this study suffered this complication.

The observation and results by various studies in the past reveals that bicoronal approach has been found very useful and versatile surgical approach in the management of comminuted and/or displaced fractures of upper and middle third of the face.[4,1426,37,38,40,41,49]

SUMMARY & CONCLUSION

The bicoronal approach has been found very useful and versatile surgical approach in the management of comminuted and/or displaced fractures of upper and middle third of the face.

The coronal incision offers advantages like an excellent and extensive approach to the frontal, nasal, superior and lateral orbit and zygomatic complex and zygomatic arch fractures which no other single approach can provide. Coronal incision aids in ensuring exact anatomical reduction of the fracture and also a well hidden scar within the hairline and achieves overall superior functional and aesthetic results.

Bicoronal approach can be used for gaining access to severe craniofacial dysjunction injuries including multiple or comminuted zygomatic complex fractures, Lefort II and III, frontal sinus and nasoethmoidal fractures.

With an adequate knowledge of surgical anatomy and some modifications with the incision, facilitates the procedure with minimal or no significant complications.

Although the number of cases were not too many in our study, the approach has shown successful results.

Patient selection and application for the indications for this incision are of paramount importance. This incision should not be overused and should be judiciously used.

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INFORMED CONSENT

Study title: “Management of upper and middle third of the face fractures through bicoronal access”.

Patient’s identification no:_____ Patient’s name:_____

Patient’s DOB:__ /__ /____

I conform that i have read and understood the information sheet for the above study. I have had the opportunity to ask questions and all my questions and doubts have been answered to my complete satisfaction.

I understand that my participation in the study is voluntary and that i am free to withdraw anytime without giving any reason, without my legal rights being affected.

I understand that my clinical study personel, the ethical committee and the regulatory authorities will not need my permission to look at my health records both in respect of current study and any further research that may be conducted in relation to it, even if i withdraw from the study. I agree to this access. However, i understand that my identity will not be revealed in any information released to third parties or published, unless

as required under the law. I agree not to restrict the use of any data or results that arise from this study.

I agree not to withhold any information about my health from the investigator and will convey truthfully.

I agree to take part in the study and to comply with the instructions given during the study and to faithfully co-operate with the study team, and to immediately the study staff that if i suffer from any deterioration in my health or well being or any expected or unusual symptoms.

I hereby consent to participate in the study and I understand that I will be treated with surgical procedure under general anaesthesia by open reduction and internal fixation with stainless steel miniplate and screws for upper and middle third of the face fractures through scalp incision.

I consent to give my medical history, undergo complete physical examination and diagnostic tests including haematological, biological and urine examination etc.

Signature/Thumb

Impression:_____place_____date_____

Patient’s name and address:

_____.

Signature of the investigator:_____Place:_____Date_____

Study investigator’s name:_____

Institution name:_____

*Signature of the witness:_____Place:_____Date:_____

*Name and address of the witness: _____

_____

*mandatory to uneducated patients(where thumb impression has been provided above)

<u>சுய ஒப்புதல் படிவம்</u>

ஆய்வு செய்யப்படும் தலைப்பு

வை கொரோனல் அறுவை சிகிச்சை மூலம்

மேல் மற்றும் நடுப்பகுதி முக எலும்பு முறிவு சிகிச்சை செய்தல்

ஆராய்ச்சி நிலையம் : அரசு பல் மருத்துவக்கல்லூரி,
சென்னை - 600 003.

பங்கு பெறுபவரின் பெயர் :

பங்குபெறுபவரின் எண் :

பங்குபெறுபவரின் பிறந்த தேதி: ...../ ...../ .....
தேதி மாதம் வருடம்

அறுவை சிகிச்சை சம்பந்தமாக நான் மேலே கூறப்பட்ட தகவல் படிவத்தை முழுமையாக படித்துப் பார்த்தேன் என்று உறுதி கூறுகிறேன்.

நான் இது தொடர்பான அனைத்து கேள்விகளுக்கும் நிறைவான பதில்கள் பெறப்பட்டேன்.

இந்த ஆய்வின் எனது பங்கு தன்னிச்சையானது என்றும் எந்த நேரத்திலும் இந்த ஆய்வில் இருந்து சட்ட உரிமைகள் பாதிக்கப்படாமல் விலகிக் கொள்ள சம்மதிக்கிறேன்.

மருத்துவ ஆய்வு அதிகாரிகள், எனது சிகிச்சை தொடர்பான பதிவேடுகளை பார்வையிடவும் எந்த நேரத்திலும், ஆய்வில் இருந்து நான் விலகினாலும் பார்வையிட சம்மதிக்கிறேன். எனது அடையாள குறிப்புகள் மூன்றாவது நபருக்கு தெரிவிக்கப்படமாட்டாது என்று புரிந்து கொண்டேன்.

இந்த ஆய்வு அறிக்கைகளை பயன்படுத்தவும், வெளியிடவும், நான் சம்மதிக்கிறேன். ஆய்வாளர் எனது மருத்துவக் குறிப்புகளை வெளியிட தடையாக இருக்க மாட்டேன் என உண்மையாக சம்மதிக்கிறேன்.

நான் இந்த ஆய்வுக்கு முன்னர் கூறிய மருத்துவ குறிப்புகளின்படியும் உண்மையாக சம்மதிக்கிறேன். மேலும் எனக்கு உடல்நிலை சரியில்லாத பட்சத்தில் ஆய்வாளர்களுக்கு தெரியப்படுத்த சம்மதிக்கிறேன்.

பொது மயக்க மருத்துவ முறையில் நடு உச்சி மண்டை ஓட்டு தோலின் மீது போடப்படும் அறுவை சிகிச்சை கோடு மூலமாக முறிவு பகுதி திறக்கப்பட்டு அந்த இடத்தில் உலோகத் தகடுகளும், ஸ்குரூக்களும் பொருத்தப்பட்டு எனக்கு அறுவை சிகிச்சை அளிக்கப்படுகிறது என்பதை நான் அறிந்து கொண்டேன். இந்த அறுவை சிகிச்சை முறையில் ஏற்படும் அனைத்து பக்கவிளைவுகளையும் மருத்துவர் மூலம் அறிந்து கொண்டு இந்த ஆய்விற்கு என்னை உட்படுத்திக் கொள்கிறேன்.

நான் எனது மருத்துவ குறிப்புகளை தரவும், மேலும் முழு உடல் பரிசோதனைக்கும் இரத்தம், சிறுநீர் மற்றும் உயிர் வேதியியல் நோய் அறிதல் சோதனைகளுக்கும் முழு ஒப்புதல் அளிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம் ..... இடம் ..... தேதி

கட்டைவிரல் ரேகை

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....

ஆய்வாளரின் கையொப்பம் ..... இடம் ..... தேதி

ஆய்வாளரின் பெயர் .....