

Indications and Complications Associated with Coronal Approach to Upper Mid Face Fractures

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ABSTRACT

Background: Coronal approach has been widely used by maxillofacial surgeons around the world for wide exposure and fixation of upper midface fractures. Coronal approach hides the scar in hair and completely avoids any incisions on face thus providing better aesthetic outcome. Our aim was to describe the data on indications and complications associated with coronal approach in our patient population. **Methods:** Prospective longitudinal study was planned and data was collected from a study population of all patients treated with coronal approach for facial fractures from January 2016 to June 2019. Demographic variables, Type of fracture, hemicoronal or bicoronal approach used and early complications of hematoma, infection and dehiscence were recorded. Delayed complications of neurosensory disturbances, facial nerve weakness, temporal hollowing and alopecia scar in hair bearing area was recorded. **Results:** Isolated zygomatic arch fracture was most common indication with 14 cases followed by ZMC fractures with 12 cases, NOE fracture with 7 cases, Lefort III with 6 cases and Frontal bone fracture with 2 cases. Hematoma was not observed in any of our cases. Infection was observed in 2 cases (4.8%), Dehiscence was observed in 5 cases (11.9%), Neurosensory disturbance was observed in 12 cases (28.6%). Permanent neurosensory changes beyond 6 months of follow up was not observed. Alopecia scar was seen in 7 cases (16.7%) and Facial nerve weakness was observed in 4 cases (9.5%). **Conclusions:** Coronal approach is best approach in terms of exposure provided to upper midface fractures and can be safely performed with minimal complications.

Keywords: complications; coronal approach; upper midface fractures.

INTRODUCTION

Coronal scalp incisions have been widely used by neurosurgeons for various intracranial and extra cranial access and has been incorporated by maxillofacial surgeons in their repertoire of surgical approaches for accessing and treating upper mid face fractures. It was first described by Hartley and Kenyon in 1907,¹ and two decades later was advocated by Sachs for bilateral frontal lobe exposure. Tessier and later Henderson and Jackson started using it for Lefort II and III Osteotomies and gained popularity among maxillofacial surgeons for widespread access to upper mid face trauma.^{2,3} Coronal incision in the hair bearing scalp effectively hides the incision and allows wide and adequate exposure of the upper mid face including frontal, Nasal, Medial nasoorbitoethmoid (NOE), roof, lateral and medial wall of orbit, zygomatic body and zygomatic arch. This wide exposure provided by the coronal approach allows surgeons to adequately visualize and reduce complicated fractures of upper mid face in all three dimensions thus restoring the facial width, height and sagittal projection.⁴ Landmark Articles by Gruss et al regarding restoration of zygomatic arch continuity

to establish facial projection established the role of coronal incision to expose the zygomatic arch for accurate reduction and fixation.⁵ Complications associated with this approach can be classified as early and delayed complications. Early complications include infection, hematoma and dehiscence.^{6,7} Delayed complications are neurosensory deficit in scalp and frontal region, facial nerve paresis of frontal branch leading to lagophthalmos and weakness of frontal muscle, wide scar in scalp and alopecia. Shepard et al⁸ and Abubakar et al⁹ reported that the common complications seen with coronal incision are neurosensory disturbance associated with supraorbital and supratrochlear nerves which always resolve over a period of 3 months to two years. Modification of Alkayat Bramley which suggests dissection through temporal fat pad below the superficial temporal fascia towards the zygomatic arch reduces the risk of facial nerve injury as the nerve is protected under two layers of tissue.¹⁰ Minimal use of bipolar cautery and continuous suture over a sponge on scalp margin has been advocated by Frodel and Marantette.¹¹

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Unightly scar migration due to male pattern baldness should be accounted for by careful family history and modifications can be used to place the incision posteriorly or in frontal crease to avoid this complication.¹² Many modifications like Zigzag, wave and pre trichial incision placement has been advised to visible scar in hair.¹³ In children the scar can be minimized by post auricular placement of lower limb of incision and posterior placement of hair incision to account for scar migration due to growth of the child.¹⁴

METHODS

The study was a single center prospective cohort study where patients with upper mid face fracture operated with coronal approach to the fractures were followed up to evaluate the complications associated with coronal approach. All the patients admitted and operated for upper mid face fractures through coronal incision were included from January 2016 to June 2019. Convenient non probability sampling of all patients fulfilling the inclusion criteria was done during the study period. Consecutive patients fulfilling the inclusion criteria were included in the study. Inclusion Criteria: All patient with upper mid face fractures (NOE fractures, Frontal bone anterior table fractures, Zygomatic arch comminuted fractures, Lefort III fractures, Multiple Zygomaticomaxillary complex (ZMC) fractures or a combination of these fractures operated by hemicoronal or bicoronal incisions for reduction and fixation of fractures. Exclusion Criteria: Patients operated for neurosurgical diagnosis along with facial fracture and patients that cannot complete followup for at least 6 months. Ethical approval for the study was obtained from the IRB. Written Consent was taken from included patients for data collection. The study was funded by department of Oral & Maxillofacial surgery, College of medical sciences teaching hospital, Bharatpur, Nepal and no additional cost were born by the patients. All cases were and performed by primary author and variables were assessed by two independent operators Inter examiner reliability was not assessed because both the operators and assessors were of similar experience and qualifications and the data collected was not significantly diverse or heterogenous among both the operators.

Surgical Technique

Coronal incision (Hemicoronal and Bicoronal) was performed by primary author and fracture fixation was done using titanium plates and screws. No antibiotics were used preoperatively and patients head were not shaved routinely. We part the hair in small bundles with lignocaine jelly and rubber band to mark the scalp incision line (Figure 1 and 2). Scalp incision were modified according to the hair pattern in zigzag, wavy or pretrichial fashion



Figure 1.



Figure 2.



Figure 3.

(Figure 3). We used bipolar cautery to achieve homeostasis and blunt dissection was done to reach the root of zygomatic arch in a subgaleal plane. Subperiosteal dissection 2 cm above the supraorbital rim was done and connected to a releasing incision through temporalis fascia at the root of zygomatic arch. both subperiosteal dissection plane were connected at the superior body of zygoma at lateral orbital wall (Figure 4 and 5).

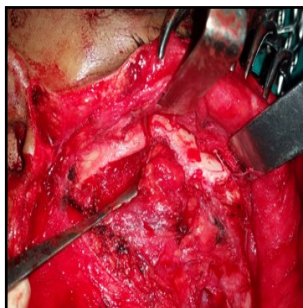


Figure 4.



Figure 5.

Similar subperiosteal dissection plane was followed upto the glabella to expose the NOE fractures. 3-0 Vicryl suture was used to suspend the periosteum of zygoma at a superior position and the incised temporalis fascia was also suspended at a superior posterior position. Scalp closure was done with 3-0 vicryl suture at subcutaneous level with two wide relaxation sutures passed at galeal level. Skin was closed with staplers in hair bearing area and 6-0 proline sutures in preauricular skin. Drain

was not used and a compression bandage was used for 48 hours postoperatively after which it was removed. IV antibiotics and analgesics were used for 48 hours postoperatively, after which they were converted to oral. Patients were discharged after 5 days of surgery and recalled for followup suture removal, evaluation and data collection. Preauricular suture were removed on 5th post operative day before discharge and scalp suture or staplers were removed on 10th post-operative day.

Baseline data regarding age, sex and type of fracture was recorded. Fracture indications were classified as comminuted Isolated zygomatic arch fracture, Isolated NOE fracture, Zygomatico-maxillary complex fracture and panfacial fracture. Outcome variables measured were divide into two categories.

Early Complications of Hematoma, Infection and dehiscence. Delayed complications: Neurosensory disturbance, Facial nerve paresis, Visible scar in hair bearing scalp and Temporal hollowing. Clinical data of complications was filled in a Table form on 1 week, 1 month and 6 months after surgery. For the early complications variables, clinical assessment was done by 2 investigators. Hematoma was defined as blood collected in periorbital area seen as black eye. Infection was defined as increased WBC count above 10000/cc or frank pus discharge from suture site. Dehiscence was defined as failure of at least 2 consecutive sutures / staplers leading to opening in scalp layers. For the delayed complications, standard assessment methods were used. Neurosensory disturbances were assessed by neurosensory testing. Facial nerve paresis was assessed by House Brackman scale for facial nerve weakness. House Brackman scale¹⁵ is a time tested and reliable valid tool for assessment of regional facial nerve weakness. Alopecia scar was assessed with the Patient scar assessment questionnaire¹⁶ which is a reliable, valid and reproducible tool for assessment of linear scars. Temporal hollowing was assessed with clinical judgement by 2 investigators though internal examiner reliability testing was not performed. Data was analyzed with SPSS software version 20. Descriptive analysis was done and frequencies were derived for age, sex, type of fracture and complications.

RESULTS

Total of 53 patients were operated for upper mid-face fractures through coronal approach from January 2016 to June 2019 out of which 11 patients were lost to follow up and 42 patients were followed up for data collection upto six months as planned. The most likely reason for loss to follow up is there were patients who were from India or far districts of Nepal and had suffered road traffic accidents nearby Bharatpur thus were treated by our

unit but couldn't continue follow up because of poor transport infrastructure. Out of 42 patients who were followed up for study duration, 17 were female and 25 were male. The mean age of patients was 30, with range from 18 to 44 and standard deviation of 6.981. Isolated zygomatic arch fracture was most common indication with 14 cases followed by ZMC fractures with 12 cases, NOE fracture with 7 cases, Lefort III with 6 cases and Frontal bone fracture with 2 cases. One case was combined Zygomatic arch with neck of condyle fracture in which neck of candle was fixed through coronal approach with pre auricular extension. 15 cases were operated through bicoronal approach and 27 cases were operated through hemicoronal approach. Early Complications: Hematoma was not observed in any of our cases. Infection was observed in 2 cases (4.8%) which resolved after daily dressing and extended IV antibiotics use for 7 days. Dehiscence was observed in 5 cases (11.9%) which was managed by local debridement and dressing followed by primary closure. Delayed Complications: Neurosensory disturbance was observed in 12 cases (28.6%) in supraorbital region which was transient and resolved within one month of follow up. We didn't observe any permanent neurosensory changes beyond 6 months of follow up. Alopecia scar was seen in 7 cases (16.7%) which persisted beyond 6 months of follow up. Facial nerve weakness was observed in 4 cases (9.5%) in immediate post operative and resolved within 3 months of follow up. No permanent facial nerve weakness was observed. Temporal hollowing was not seen in any cases.

DISCUSSION

Coronal approach to upper midface provides the best possible wide exposure required to reduce and fix the bones of upper midface in frontal, NOE and comminuted ZMC fractures. Multiple fractures of zygomatic arch with periosteal tear are unstable after closed reduction and lead to cosmetic deformity which is not tolerated by younger patients and also cause functional impairment of mandibular movements.⁵ These fractures are best suited to be treated with wide exposure through coronal approach and fixation with single long spanning miniplate and screws.^{9,10} As seen in our study the most common indication for coronal approach is Zygomatic arch fractures followed by comminuted ZMC and central midface fracture of NOE and frontal bone. Similar indication was recommended in various studies.^{17,18} Some authors also suggest patients desire to not have facial incisions as indication for coronal approach as the incision scar in hidden inside hair and there is no visible scar on face.¹¹ The early complications of hematoma were never observed in our cases probably because we obtained meticulous homeostasis through dilute adrenaline injection before starting the incision and electrocautery when

needed. Closure was always done in layers and tight approximation of tissues was achieved. Infection rate of 4.8% was observed which was controlled with empirical broad spectrum antibiotics and meticulous incision toilet. As some of these cases also involved simultaneous intraoral approach to zygomaticomaxillary segment there is a possibility of contamination of scalp incision with oral microbes. So, our antibiotic regimen included anaerobic coverage. Dehiscence of incision site usually occurs due to either failure to approximate the incision or infection at suture site.⁷ We observed that closure of scalp layer with staplers led to better approximation and less dehiscence that when closed with Nylon sutures. So, we always use staplers to close scalp incision in hair bearing area and 6-0 Prolene suture to close the pre auricular limb of incision. Neurosensory changes were always seen to occur during the first post operative month and resolved spontaneously. Most common complaint was hypoesthesia of supraorbital region which is probably due to traction on supraorbital nerves. No permanent neurosensory changes were observed beyond the first postoperative month. Alopecia was observed in some of our cases (16.7%) where we shaved the patients head for better visualization of incision during closure and when we used simple linear incision. Initially we used raney clips for homeostasis. We modified our approach and started to part hair with lignocaine gel and rubber bands and plan the incision in wavy or zigzag pattern and homeostasis was achieved with bipolar cautery and running silk suture rather than raney clips after which we observed much better healing of incision and least scarring in hair bearing area. We recommend not to shave the patients head and part the hair on operation table as it provides the surgeon with direction of hair follicles so that incision could be placed parallel to the hair follicles.^{19,20} We also recommend not to use raney clips or hemostats as they tend to damage the hair follicles (Figure 6 and 7). The worst complication

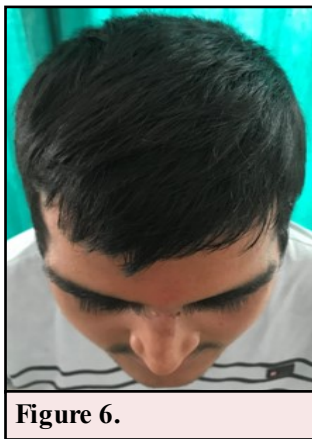


Figure 6.



Figure 7.

of coronal approach is permanent facial nerve weakness which was not seen in any cases in our study. Transient facial nerve weakness was seen in

very few cases compared to other studies, probably due to the fact that we use a longer pre auricular limb to reduce tension on lower part of flap and our dissection towards the fractured zygomatic arch is always through the temporal fat thus ensuring that there are two tissue layers between our plane of dissection and the facial nerve.¹¹ Temporal hollowing was not observed in our cases. Some authors report temporal hollowing after coronal incision but probably those dissection was through the temporals muscle which might have damaged the deep temporal arterial blood supply to temporalis muscle and subsequent atrophy.¹¹ Our study was a non randomized, longitudinal follow up of a cohort of patients operated with coronal approach. A major limitation of our study was short follow up time, but regular follow up in our country is very uncommon as patients come from villages far and wide with very less transport infrastructure thus will be a burden to the patients. Though standardized tools were used for assessment of clinical complications, some complications like temporal hollowing were assessed subjectively. Blinding of surgeons is very difficult if not impossible, though we tried to reduce observer bias by performing assessment of complications by two independent operators, and one of the limitations of the study was not including inter examiner reliability testing and lack of pilot to establish inter examiner reliability. A multi-center study with matched controls and compared to facial incision approach for upper midface fracture is recommended for future.

CONCLUSIONS

Coronal approach to upper midface fractures especially comminuted Zygomatic arch, ZMC and NOE fractures are still exception rather than norm. Many surgeons still prefer closed reduction and conservative management of zygomatic arch fractures and multiple facial and orbital incisions for NOE and ZMC fractures. This study shows that coronal approach can be used extensively for every indication as recommended by this study and other similar studies with minimal complications and has better outcome in terms of anatomic reduction of fractured facial bones made possible because of wide exposure. Coronal approach also has the ability to hide the scar in hair and avoid any incision on face without compromising the exposure provided.

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