Original Article - Retrospective Study

Experience with Airway Management and Sequencing of Repair of Panfacial Fractures: A Single Tertiary Healthcare Appraisal in Najran, Kingdom of Saudi Arabia - A Retrospective Study

John Spencer Daniels, Ibrahim Albakry, Ramat Oyebunmi Braimah[1], Mohammed Ismail Samara, Rabea Arafa Albalasi[2], Farzana Begum, Mana Ali-Mohamed Al-kalib

Department of Oral and Maxillofacial Surgery, King Khalid Hospital, [1]Department of Oral and Maxillofacial Surgery, Specialty Regional Dental Center, Najran, [2]Department Oral and Maxillofacial Surgery, Sharourah General Hospital, Sharourah, Kingdom of Saudi Arabia

Abstract

Introduction: Special cooperation is required among surgeons and anesthetists in airway management during repair of panfacial fractures, due to problems of shared airway and occlusion. Several methods have been proposed for airway management and sequencing of repair of panfacial fractures. The main objective of the current study was to share our experience in the airway management and sequencing of repair of panfacial fractures. **Methods:** This was a retrospective study of panfacial fractures in the Kingdom of Saudi Arabia from January 2008 to December 2018. Data collected included demographics, type of airway management, sequence of repair (as primary variables), and outcome of surgery (secondary variable), while surgeon and anesthetic expertise are confounders. Data were analyzed using IBM SPSS Statistics for Windows Version 25 (Armonk, NY, USA: IBM Corp). Results were presented as simple frequencies and descriptive statistics. Pearson Chi-square was used to compare categorical variables such as airway management and sequencing of repair with the panfacial fractures. Statistical significance was set at $P \leq 0.05$. **Results:** Overall, 1057 patients sustained different categories of maxillofacial bone fractures with 23 females and 1034 males (M:F of 46:1). A total of 43 male patients out of 1057 patients had panfacial fractures during the study period, giving a prevalence rate of 4.1%. Only the 43 male patients with panfacial fractures were analyzed. All cases were as a result of motor vehicular accident. Six (13.9%) patients had tracheostomy while 37 (86.1%) patients had submental intubation. "Bottom-up" and "outside-in" approach was used in 33 (76.7%) patients, while "top-bottom" and "inside-out" approach was used in 10 (23.3%) patients. **Discussion:** Submental intubation was the major airway management of panfacial fracture, and "bottom-up" and "outside-in" approach was the main sequence of repair in our series. These approaches have been mentioned in the literature. **Conclusion:** From our study, victims of pan-facial fractures were found to be exclusively male with MVA as the sole etiological factor. Barring severe head injuries, which may necessitate the use of tracheostomy to sustain breathing over a longer period, submental intubation is extremely reliable as a mode of airway management during surgical treatment of panfacial fractures. The sequencing of repair of panfacial fractures can only be determined according to the case presentation rather than a predetermined one.

Keywords: Airway, fracture, panfacial, submental, tracheostomy

Introduction

Management of extensive craniofacial injuries such as panfacial fractures has witnessed remarkable improvements with advances in airway management, full exposure of the craniofacial skeleton, and fixation of fractures with rigid internal fixation techniques.[1] Due to the problem of shared airway, special cooperation is required between a surgeon and an anesthetist for airway management when there are midface and panfacial fractures. Panfacial fractures are defined as

Access this article online

Quick Response Code:

Website: www.amsjournal.com

DOI: 10.4103/ams.ams_202_19

Address for correspondence: Dr. Ramat Oyebunmi Braimah, Department of Oral and Maxillofacial Surgery, Specialty Regional Dental Center, Najran, Kingdom of Saudi Arabia.
E-mail: bunmibraimah@gmail.com

Received: 02-09-2019 **Revised:** 27-06-2020
Accepted: 17-07-2020 **Published:** 23-12-2020

How to cite this article: Daniels JS, Albakry I, Braimah RO, Samara MI, Albalasi RA, Begum F, *et al*. Experience with airway management and sequencing of repair of panfacial fractures: A single tertiary healthcare appraisal in Najran, Kingdom of Saudi Arabia - A retrospective study. Ann Maxillofac Surg 2020;10:402-8.

fractures of the cranio-maxillofacial complex involving bones in the lower, middle, and upper thirds of the facial skeleton.[1] Several methods have been proposed for airway management in these complex facial injuries.[2,3] Management of fractures in this region of the body involves not only restoration of facial appearance and symmetry to premorbid levels, but also restoration of functions such as vision, olfaction, breathing (i.e., airway management), mastication (i.e., restoration of teeth and occlusion), deglutition, and articulation.[4]

Management of panfacial fractures usually requires good radiographic evaluation to identify the bones involved and also to visualize stable struts required for fixation.[5] Since these injuries are always complex, computed tomography (CT scan) imaging studies with three-dimensional CT reconstruction and computer-generated models of the facial skeleton are often required to obtain ample evidence of the bony architecture and degree of disruption.[5]

With respect to restoration of occlusion, which is an important aspect in the management of facial bone fractures, temporary mandibulo-maxillary fixation (MMF) is required to re-establish the occlusion so as to ensure maximum occlusal function after healing of fractures in dentate patients.[1] The usual orotracheal intubation will prevent achievement of temporary MMF during surgery. The other option is nasotracheal intubation which is contraindicated in panfacial, naso-orbito-ethmoidal, and skull base fractures, because of the possibility of accidental intracranial intubation from the base of the skull and/or cribriform plate.[3] Literature search has revealed three cases of intracranial intubation with two cases in panfacial fractures[6,7] and one case in a premature neonate during routine nasotracheal intubation.[8] Other intubation options include submental,[3] submandibular,[9-11] retromandibular, and tracheostomy.[12] All these choices have their advantages and disadvantages. Choice of airway management is also based on concern for postoperative airway maintenance of the patient because of the problem of edema and nasal packing.[13] Tracheostomy will eliminate concern for both intraoperative and postoperative airway management in patients who require prolonged airway control postoperatively. Although tracheostomy-related complications are of concern, the risk of these complications is relatively low when compared with the risk of inadequate airway management postoperatively.[14]

Some facial trauma patients have also been reported to have psychosocial symptoms such as anxiety and depression, low self-esteem, posttraumatic stress disorder, and poor oral health-related quality of life.[15-17] To achieve functional and esthetic outcome and prevent these psychosocial symptoms, there must be sequencing in the repair of this complex region.[1,18] Several sequencing approaches have been mentioned in the literature to include "bottom-up," "inside-out," "outside-in," and "top-bottom" approach.[1,18,19] However, the ideal sequencing of a complex panfacial fracture remains the greatest challenge to every oral and maxillofacial surgeon.[18]

To the best of our knowledge, there have been no reports on airway management and sequencing of repair in panfacial fractures from the Kingdom of Saudi Arabia. Therefore, our main objective was to report our experience in airway management and sequencing of repair of pan-facial fractures in Najran, a southwestern city of the Kingdom of Saudi Arabia.

Methods

Study design

This was a retrospective cohort study of airway management and sequencing of repair of panfacial fractures seen and managed in a main referral hospital in Najran, southwestern region of the Kingdom of Saudi Arabia.

Study setting

Our hospital is the main referral hospital serving the entire Najran principality and adjacent parts of Asir area in the southwestern region of the Kingdom of Saudi Arabia. This study included patients who were admitted to the hospital and underwent surgery from January 2008 to December 2018.

Data collection

Data collected included demographics, type of airway management and sequence of repair (as primary variables), and outcome of surgery (secondary variable).

Inclusion criteria

Cases identified with fractures involving bones in the lower (mandible, mandibular dentoalveolar), middle (zygoma, naso-orbito-ethmoidal [NOE], maxilla, maxillary dentoalveolar), and upper third (frontal bone, fronto-orbital and sphenoid bone) of the facial skeleton as described by Ali and Lettieri.[1] To eliminate bias of accurate diagnosis of panfacial fractures, the cases were identified and diagnosed by two consultants and three specialists, oral and maxillofacial surgeons who treated the patients during the study period.

In addition, the type of airway management either submental intubation or tracheostomy was recorded. Submental intubation was approved when nasotracheal intubation is contraindicated in panfacial fractures involving Le-Fort II and III and NOE fractures. Tracheostomy was adopted when long-term airway management by ventilator was indicated, especially in severe head injury.

Sequencing of repair was also retrieved and recorded. The authors adopted the combination of "bottom-up and outside-in" sequence when the panfacial fracture involves the zygoma and "bottom-up and inside-out" sequence when NOE factures were involved with stable lateral component.

Primary variables

Types of airway management and sequence of repair of panfacial fractures.

Secondary variables

Outcome of airway management and sequence of repair.

Confounders

Surgeons and anesthetic expertise.

Exclusion criteria

Cases of facial fracture not involving the three components of the facial skeleton described above at the same time.

Sample size estimation

Required sample size was determined using the prevalence of 4.0% as the reported minimum prevalence of panfacial fractures[18] and a formula for a prevalence study[20] ($n = (z)^2 P(1-P)/d^2$) applied with a confidence level preset at 95%. With $z = 1.96$, $P = 0.04$, and $d = 0.05$, and substituting in the formula (1.96^2) $0.04\ (1 - 0.04)/0.05^2$) gave a minimum sample size of 59 cases. However, due to resource constraints, the ideal sample size cannot be met, and hence, a smaller and pragmatic sample[21] of 43 cohorts with panfacial facial fracture during the study period were investigated and analyzed.

Statistical methods

Data were stored and analyzed using IBM SPSS Statistics for Windows Version 25 (Armonk, NY, USA: IBM Corp). Results were presented as simple frequencies and descriptive statistics. Pearson Chi-square was used to compare categorical variables such as airway management and sequencing of repair with the panfacial fractures. Statistical significance was set at $P \leq 0.05$.

Ethical statement

Ethical clearance was obtained from the Ethics and Research Committee of the Hospital, on April 13, 2019, with IRB number H-11-N-08. The procedure adhered to the ethical guidelines of Declaration of Helsinki.

Results

Overall, 1057 patients sustained different categories of maxillofacial bone fractures with 23 females and 1034 males (M:F of 46:1). A total of 43 male patients out of 1057 patients had panfacial fractures during the study period, giving a prevalence rate of 4.1%. Only the 43 male patients with panfacial fractures were analyzed. Their ages ranged from 16 to 45 years with mean ± standard deviation (26.6 ± 8.3) years. The age group of 21–30 years had the highest frequency of panfacial fracture of 53.5%, while age group of 41–50 years had the least occurrence of 6.9% with a statistically significant difference ($P = 0.05$) [Table 1]. All the 43 cases of panfacial fractures were a result of motor vehicular accidents (MVA). Airway management in this group of patients includes 6 (13.9%) cases involving tracheostomy and 37 (86.1%) cases involving submental intubation. This attained a statistical significance of $P = 0.04$. Patients with multiple mandibular fractures with unstable upper airway had tracheostomy to secure the airway both intraoperatively and postoperatively [Table 2]. None of our patients had any complications attributed to the submental intubation or tracheostomy. All patients were treated with open reduction and internal fixation using titanium plates and screws. In terms of sequence of repair, "bottom-up" and "outside-in" approach was used in 33 (76.7%) patients, while "bottom-up" and "inside-out" approach was used in 10 (23.3%) patients [Table 3].

Table 1: Distribution of fractured bones in patients with pan-facial fracture

Age-groups	Pattern of fractured bones				Total (%)
	A (%)	B (%)	C (%)	D (%)	
11-20	0 (0.0)	6 (14.0)	2 (4.7)	1 (2.3)	9 (20.9)
21-30	5 (11.6)	4 (9.3)	13 (30.2)	1 (2.3)	23 (53.5)
31-40	2 (4.7)	1 (2.3)	4 (9.3)	1 (2.3)	8 (18.6)
41-50	0 (0.0)	3 (6.9)	0 (0.0)	0 (0.0)	3 (6.9)
Total	7 (16.3)	14 (32.5)	19 (44.2)	3 (6.9)	43 (100.0)

χ^2=16.938; df=9; P=0.05. Key: A (Mandible, maxilla, nasoethmoidal, orbital [roof and floor]), B (Mandible, maxilla, zygoma, nasoethmoidal), C (Mandible, maxilla, zygoma, frontal), D (Mandible, maxilla, nasoethmoidal, frontal)

Discussion

Literature search has shown that panfacial fractures account for 4-10% of all facial fractures.[18] In Korea, the incidence was reported to account for 6.59% of all facial bone fractures.[18] Our study has reported an incidence of 4.1%, which falls within the reported range of panfacial fractures worldwide.

Males are generally reported to be more susceptible to trauma, and the group comprising second–third decades of age is the most exposed due to high activities in this age bracket.[22-24] This is similar to our findings as all of the patients with panfacial fractures were males and in their second–third decades of life. Generally, MVA, sports injuries, and occasional violent assaults, especially from animals such as camels and horses, may result in panfacial fractures, usually involving the lower, middle, and upper parts of the face.[25] In our series, all the cases were as a result of MVA unlike other studies where interpersonal violence has been identified as an etiology of panfacial fracture.[3]

Treatment of panfacial fractures commonly entails temporary MMF to achieve occlusion necessary for function with simultaneous access to the naso-orbito-ethmoidal (NOE) complex and nasal pyramid. Anesthetist and maxillofacial surgeons are competing for operating spaces because of the problem of shared airway in these groups of patients. Intraoperative and postoperative airway management then becomes a great concern.[13] There are four recognized mechanisms for the airway management in these group of patients: oral intubation, nasal intubation, submental intubation, and tracheostomy.[14] The latter three mechanisms allow temporary MMF intraoperatively in dentate patients; however, nasal intubation is contraindicated in NOE fractures and anterior and middle cranial fossae fractures that may be associated with panfacial fractures. This is because of the possibility of accidental intracranial intubation from the base of the skull and/or cribriform plate.[6,13] Literature search has revealed three cases of intracranial intubation with two cases in panfacial fractures.[6] and one case in a premature neonate during a routine nasotracheal intubation.[8] With this information, surgeons and anesthetists have adopted submental intubation as a suitable alternative to nasotracheal intubation in panfacial fractures.[3] In the current study, 86% of the patients

had submental intubation, while only 14% had tracheostomy. With maxillary fractures at Le Fort II and III levels as well as naso-orbito-ethmoidal fractures frequently involving the base of the skull and cribriform plate with resultant occasional cerebrospinal fluid leakage, there is already an established pathway between the nasal cavity and anterior cranial fossa.[6] In such scenarios, naso-tracheal intubation may inadvertently result in intracranial intubation.[6] Nasal intubation was avoided in these patients because of risk of intracranial penetration [Figure 1a and b]. Other potential complications of nasal intubation in such patients including meningitis, sepsis, sinusitis, and epistaxis have been reported in the literature.[3]

Submental intubation has been reported by researchers as a satisfactory alternative for airway management in patients with panfacial fractures when short-term postoperative control of the airway is expected.[3,26] Most of our cases (86%) had submental intubation because short-term postoperative airway control was anticipated [Figure 2a and b]. This technique has low morbidity because no serious perioperative shortcomings have been reported.[3] Reported risks related with this submental intubation include low oxygen saturation when changing the tube position from oral to submental before surgery and submental to oral at the end of surgery, difficulty while passing tube through the submental incision.[27] Furthermore, there could be accidental extubation, tube obstruction, and tube leaking.[2,27] However, with experienced anesthetists and use of reinforced endotracheal tubes, such pitfalls are avoided. None of our patients in the current study had any complications attributed to the submental intubation.

When long-term postoperative airway management was predicted, elective tracheostomy was performed for 14% of the patients [Figure 3]. This procedure has been accepted as the standard airway management in such patients that will require

Table 2: Distribution of airway management according to fractured bone combination

	Airway management		Total (%)
	Submental (%)	Tracheostomy (%)	
A	7 (16.3)	0 (0.0)	7 (16.3)
B	9 (20.9)	5 (1.6)	14 (32.6)
C	18 (41.9)	1 (2.3)	19 (44.2)
D	3 (6.9)	0 (0.0)	3 (6.9)
Total	37 (86.0)	6 (14.0)	43 (100.0)

χ^2=8.33; df=3; *P*=0.04. Key: A (Mandible, maxilla, nasoethmoidal, orbital [roof and floor]), B (Mandible, maxilla, zygoma, nasoethmoidal), C (Mandible, maxilla, zygoma, frontal), D (Mandible, maxilla, nasoethmoidal, frontal)

Table 3: Distribution of sequence of repair according to fractured bone combination

	Sequence of repair		
	"Bottom-up and outside-in" (%)	"Bottom-up and inside out" (%)	Total (%)
A	0 (0.0)	7 (16.3)	7 (16.3)
B	14 (32.6)	0 (0.0)	14 (32.6)
C	19 (44.1)	0 (0.0)	19 (44.1)
D	0 (0.0)	3 (7.0)	3 (7.0)
Total	33 (76.7)	10 (23.3)	43 (100.0)

χ^2=9.619; df=9; *P*=0.00. Key: A (Mandible, maxilla, naso-ethmoidal, orbital [roof and floor]), B (Mandible, maxilla, zygoma, naso-ethmoidal), C (Mandible, maxilla, zygoma, frontal), D (Mandible, maxilla, naso-ethmoidal, frontal)

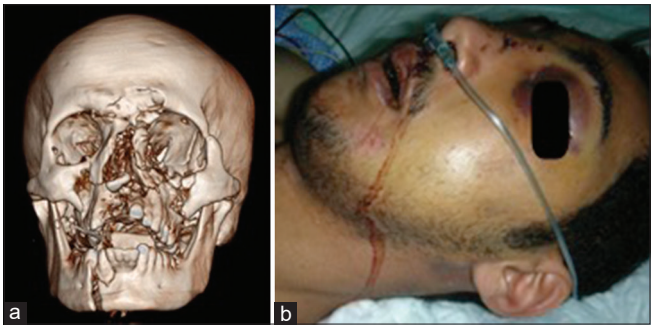

Figure 1: (a) Three-dimensional computed tomography scan of panfacial fracture showing severe nasoethmoidal complex disruption. (b) Patient with evidence of cerebrospinal fluid rhinorrhea in panfacial fractures

Figure 2: (a) Extraoral view showing the endotracheal tube coming out from the submental region in submental intubation. (b) View of the tube returned to the mouth after surgery and sutured submental access

Figure 3: Tracheostomy used in a patient with associated head injury who require prolonged postoperative airway management after surgery

long-time ventilator support.[12] Although tracheostomy has been fraught with complication rates between 5% and 45% and mortality of 2%, meticulous surgical and nursing care has helped reduce these concerns.[3,12] None of our patients had any complications as they were all managed in the intensive care units with properly trained nurses providing thorough nursing care.

To achieve both esthetic and functional outcome in panfacial fractures, researchers have developed an organized sequence of repair to be able to return patients with panfacial fractures to premorbid facial form and function. Two approaches have been mentioned in the literature in addressing this sequence of repair, "bottom-up and outside-in" and "top-down and inside out." The "bottom-up and outside-in" approach has been one of the guiding principles in the management of panfacial fractures.[18,28] This principle is based on addressing the outer facial frame with the bony pillars before addressing the interfacial frame.[3] Other principle is the "top-down and inside out" approach, which is based on the fact that the aesthetic core of the face (naso-orbital-ethmoid region), should be considered early in the sequencing of repair with occlusal restoration.[29] Researchers have compared the combinations of these approaches over the past two decades; however, none has compared top-down and bottom-up in isolation with inside-out and outside-in.[28] In reality, following a combined process is the best sequence of action since the primary goal is to restore function by occlusal restoration and esthetics by achieving premorbid facial width and height. From our study, the bottom-up and outside-in approach has been favored (76.7%) especially when there is zygomatic complex in the fracture bone combination [Figure 4a-m]. In this patient, tracheostomy was also performed because of long-time ICU admission. He also had multiple fractures of the lower limbs. Several authors have recommended this sequence in order to establish the outer facial frame and upper facial width and projection before the other bone combinations.[18,30] Furthermore, to establish facial width and projection, Kim *et al*.[18] have suggested fixing the fronto-zygomatic suture first. From the bottom, the mandible fractures were returned to its premorbid condition by MMF and occlusal restoration to set the maxillary component with the mandible as a single block that will articulate with the cranial base. This sequence has been reported by Imazawa *et al*.[31]

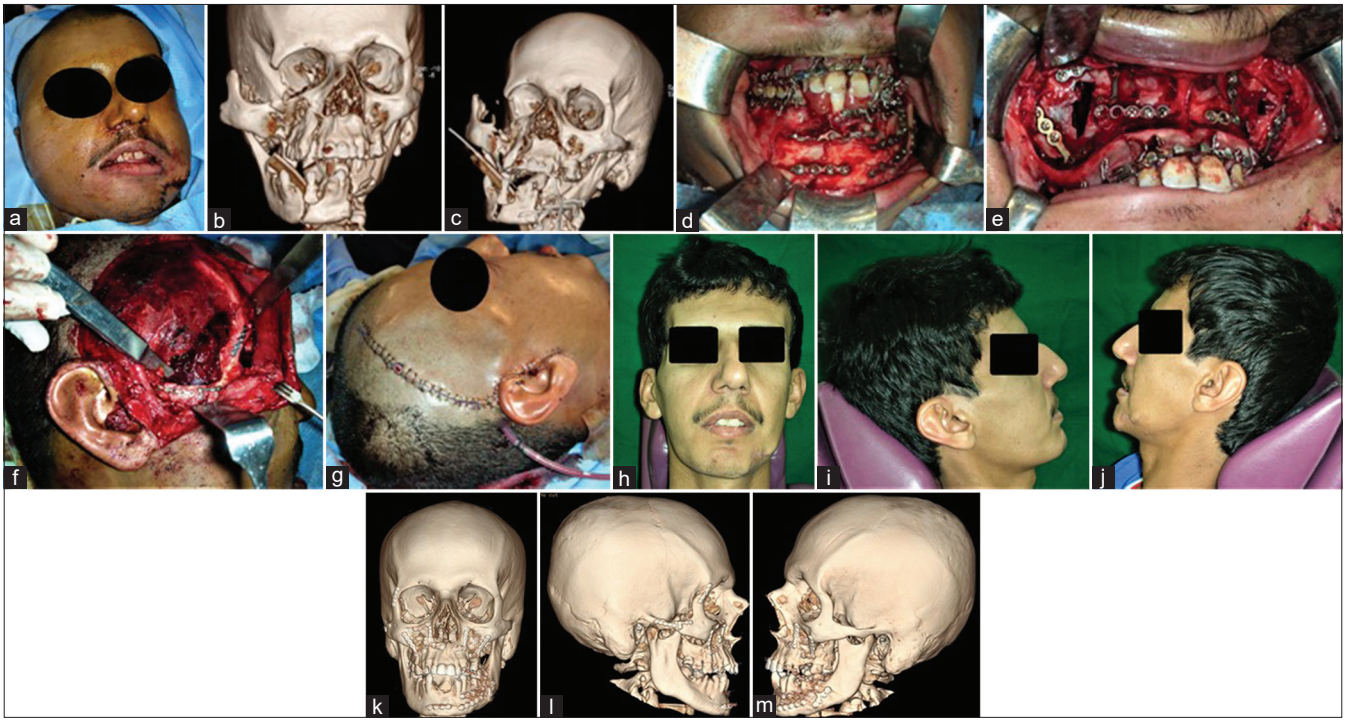

Figure 4: (a) Preoperative photograph of the patient with panfacial fractures. (b) Preoperative three-dimensional reconstructed computed tomography scan view of severe comminuted panfacial fractures associated with fractured zygomatic complex which required repair using the sequence of "bottom-up and outside-in" approach. (c) Preoperative three-dimensional reconstructed computed tomography scan view of severe comminuted panfacial fractures associated with fractured zygomatic complex which required repair using the sequence of "bottom-up and outside-in" approach. (d) Intraoperative photograph of the same patient showing ORIF of the comminuted mandibular fractures (e) Intraoperative photograph of the same patient showing ORIF of the comminuted maxillary fractures (f) Intraoperative photograph of the same patient showing ORIF of comminuted fractures of right zygomatic complex through uni-coronal approach. (g) Intraoperative photograph of the same patient showing closure of uni-coronal flap under vacuum drainage. (h-j) Six months' postoperative frontal view, right and left lateral view of same patient, (k-m) Six months' postoperative three-dimensional reconstructed computed tomography scan showing anterior posterior view, right and left lateral view of same patient.

Figure 5: (a) Preoperative three-dimensional reconstructed computed tomography scan of the right lateral view showing panfacial fracture with nasoethmoidal fracture and intact zygoma repaired using the "bottom-up and inside-out" sequence of approach. (b) Preoperative three-dimensional reconstructed computed tomography scan of the frontal view showing panfacial fracture with nasoethmoidal fracture and intact zygoma repaired using the "bottom up and inside out" sequence of approach. (c) Preoperative three-dimensional reconstructed computed tomography scan of the left lateral view showing panfacial fracture with nasoethmoidal fracture and intact zygoma repaired using the "bottom-up and inside-out" sequence of approach. (d) Postoperative three-dimensional reconstructed computed tomography scan of the right lateral view showing open reduction and internal fixation of the panfacial fracture. (e) Postoperative three-dimensional reconstructed computed tomography scan of the frontal view showing open reduction and internal fixation of the panfacial fracture. (f) Postoperative three-dimensional reconstructed computed tomography scan of the left lateral view showing open reduction and internal fixation of the panfacial fracture

When bony fragments did not involve the lateral zygomatic bones, the "bottom-up and inside-out" sequence was followed in 10 (23.3%) patients [Figure 5a-f]. This approach has been reported by Kim *et al*.[18] where there is comminution of the naso-ethmoidal complex. They started the fixation around this complex early in the sequence, thereby restoring the central portion. Other researchers have also suggested this approach of fixing the central portion of the fracture components before putting the lateral component in consideration.[28,30]

Conclusion

Management of panfacial fractures is complex and challenging. It starts with appropriate airway management and suitable sequencing of repair. We have reported the "submental intubation" as the major airway management of panfacial fracture and "bottom-up" and "outside-in" approach as the main sequence of repair in our series. The main limitation of the present study was the retrospective nature of the study design; however, a prospective study is already in process. More road traffic laws should be enforced to prevent such pattern of injuries.

Acknowledgments

The authors are grateful to the medical record staffs for assisting in the retrieval of patients' data.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Ali K, Lettieri SC. Management of panfacial fracture. Semin Plast Surg 2017;31:108-17.
2. Chandra PM, Ali FM, Singhai A, Mudhol A, Ustad F. Submental orotracheal intubation: A better alternative to tracheostomy in panfacial fractures. Anesth Essays Res 2013;7:415-7.
3. Rodrigues WC, de Melo WM, de Almeida RS, Pardo-Kaba SC, Sonoda CK, Shinohara EH. Submental intubation in cases of panfacial fractures: A retrospective study. Anesth Prog Fall; 64:153-61.
4. Curtis W, Horswell BB. Panfacial fractures: An approach to management. Oral Maxillofac Surg Clin North Am 2013;25:649-60.
5. Singh M, Ricci JA, Caterson EJ. Use of intraoperative computed tomography for revisional procedures in patients with complex maxillofacial trauma. Plast Reconstr Surg Glob Open 2015;3:e463.
6. Yamamoto T, Flenner M, Schindler E. Complications associated

with nasotracheal intubation and proposal of simple countermeasure. Anaesthesiol Intensive Ther 2019;51:72-3.
7. Lee MC, Tseng KY, Shen YC, Lin CH, Hsu CW, Hsu HJ, *et al*. Nasotracheal intubation in patients with limited mouth opening: A comparison between fibreoptic intubation and the Trachway®. Anaesthesia 2016;71:31-8.
8. Cameron D, Lupton BA. Inadvertent brain penetration during neonatal nasotracheal intubation. Arch Dis Child 1993;69:79-80.
9. Banerjee PK, Jain A, Behera B. Submandibular intubation as an alternative for intra-operative airway management in maxillofacial fractures - our institutional experience. Indian J Anaesth 2016;60:573-7.
10. Hassanein AG, Abdel Mabood AM. Can submandibular tracheal intubation be an alternative to tracheotomy during surgery for major maxillofacial fractures? J Oral Maxillofac Surg 2017;75:508.e1-5.
11. Beeram RK, Seelam S, Prasad K. Stoll's submandibular intubation: A safety alternative to Altemir's submental technique and traditional tracheostomy. J Oral Maxillofac Surg Med Pathol 2016;28:215-21.
12. Barak M, Bahouth H, Leiser Y, Abu El-Naaj I. Airway management of the patient with maxillofacial trauma: Review of the literature and suggested clinical approach. Biomed Res Int 2015;2015:724032.
13. Rosenberger E, Kriet JD, Humphrey C. Management of nasoeth- moid fractures. Curr Opin Otolaryngol Head Neck Surg 2013;21:410-6.
14. Mittal G, Mittal RK, Katyal S, Uppal S, Mittal V. Airway manage- ment in maxillofacial trauma: Do we really need tracheostomy/submental intubation. J Clin Diagn Res 2014;8:77-9.
15. Braimah RO, Ukpong DI, Ndukwe KC, Akinyoola AL. Self-Esteem following maxillofacial and orthopaedic injuries: Preliminary observations in sub Saharan Africans. Oral Maxillofac Surg 2019;23:71-6. [doi.org/10.1007/s10006-018-0735-5].
16. Braimah RO, Ukpong DI, Ndukwe KC, Akinyoola AL. Health-related quality of life (HRQoL) in Nigerian patients following maxillofacial and orthopaedic injuries. A comparative study. J Orthop Traumatol Rehabil 2018;10:49-53.
17. Braimah RO, Ukpong DI, Ndukwe KC, Akinyoola AL. Comparative study of anxiety and depression following maxillofacial and orthopedic injuries. Study from a Nigerian University Teaching Hospital. Clin Exp Dent Res 2017;3:215-9.
18. Kim J, Choi JH, Chung YK, Kim SW. Panfacial bone fracture and medial to lateral approach. Arch Craniofac Surg 2016;17:181-5.
19. Pau M, Reinbacher KE, Feichtinger M, Navysany K, Kärcher H. The mandibular symphysis as a starting point for the occlusal-level reconstruction of panfacial fractures with bicondylar fractures and interruption of the maxillary and mandibular arches: Report of two cases. J Craniomaxillofac Surg 2014;42:e51-6.
20. Daniel WW. Biostatistics: A Foundation for Analysis in the Health Sciences. 7th ed. New York: John Wiley & Sons; 1999.
21. Arya R, Antonisamy B, Kumar S. Sample size estimation in prevalence studies. Indian J Pediatr 2012;79:1482-8.
22. Al-Bokhamseen M, Salma R, Al-Bodbaij M. Patterns of maxillofacial fractures in Hofuf, Saudi Arabia: A 10-year retrospective case series. Saudi Dent J 2019;31:129-36.
23. Samman M, Ahmed SW, Beshir H, Almohammadi T, Patil SR. Incidence and pattern of mandible fractures in the madinah region: A retrospective study. J Nat Sci Biol Med 2018;9:59-64.
24. Almasri M, Amin D, Aboola AF, Shargawi J. Maxillofacial fractures in Makka City in Saudi Arabia; an 8-year review of practice. Am J Public Health Res 2015;3:56-9.
25. Shere JL, Boole JR, Holtel MR, Amoroso PJ. An analysis of 3599 midfacial and 1141 orbital blowout fractures among 4426 United States Army Soldiers, 1980-2000. Otolaryngol Head Neck Surg 2004;130:164-70.
26. O'Connell JE, Kearns GJ. Submental intubation: A retrospective review of 45 cases. Ir J Med Sci 2013;182:309-13.
27. Oshima N, Shiraishi T, Kawauchi T, Oba J, Sato D, Fujiki M, *et al*. A simple and reliable submental intubation technique for maxillofacial fractures. J Craniofac Surg 2018;29:1952-5.
28. Degala S, Sundar SS, Mamata KS. A comparative prospective study of two different treatment sequences i.e., bottom up-inside out and topdown-outside in, in the treatment of panfacial fractures. J Maxillofac Oral Surg 2015;14:986-94.
29. de Melo WM, Brêda MA Jr., Pereira-Santos D, Pereira CC, Sonoda CK, Araújo MM. Submental endotracheal intubation: A valuable resource for the management of panfacial fractures. J Craniofac Surg 2012;23:1851-3.
30. de Melo WM, Sonoda CK, Shinohara EH, Garcia IRJ. Using the "bottom-up and outside-in" sequence for panfacial fracture manage- ment: Does it provide a clinical significance? J Craniofac Surg 2013;24:479-81.
31. Imazawa T, Komuro Y, Inoue M, Yanai A. Mandibular fractures treated with maxillomandibular fixation screws (MMFS method). J Craniofac Surg 2006;17:544-9.