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ORIGINAL RESEARCH

Mandibular Coronoid Fractures, How Rare?

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ABSTRACT

Background: To study the rarity of mandibular coronoid process fractures and treatment strategies based on the displacement of these fractures.

Materials and methods: A retrospective study of 11 cases of coronoid process fractures among 307 treated cases from 2008 to 2013 was conducted. Six patients were treated conservatively and 5 underwent ORIF with associated fractures. A statistical analysis of the data obtained after subjective and objective evaluation was done.

Results: The incidence of coronoid process fractures was 3.58% of all mandibular fractures analyzed. There was no statistically significant difference found between two treatment modalities, but differences in maximum interincisal opening (MIO) and pain in the postoperative period were significant.

Conclusion: We recommend that linear coronoid fractures with minimal displacement can be managed with conservative treatment. For patients with significant displacement of coronoid process, limited mouth opening or concomitant mid-face or lower-face fractures, rigid internal fixation is recommended.

Keywords: Coronoid fracture, Mandibular fracture, Open reduction, Internal fixation.

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INTRODUCTION

Mandibular fractures are common injuries seen in the maxillofacial setting, but fracture of the coronoid process is a relatively rare entity.[1] Coronoid fractures are the result of high velocity road traffic accidents, falls, interpersonal violence, and explosions. Clinical situations like mandibular third molar extraction and sagittal split osteotomy of mandibular ramus may lead to iatrogenic coronoid process fracture, but are rare.[2]

These fractures frequently present with restricted mouth opening and pain, which may be attributed to associated fractures or inappropriate management, eventually leading to adherence between the fracture segment and surrounding tissues.[3,4]

Although conservative management has been advocated for such fractures, surgery may be needed in cases with significant displacement of fragment, restriction of movement, poor candidates of maxillomandibular fixation (MMF) and those undergoing open reduction and internal fixation (ORIF) of associated fractures.

The traditional surgical approaches include both intraoral and extraoral incisions. In the present study we report follow-up results of 11 patients with coronoid fractures being treated from 2008 to 2013 at our oral and maxillofacial unit.

MATERIALS AND METHODS

A total of 307 patients with mandibular fractures were treated between 2008 and 2013. Among these, 11 patients had coronoid process fractures of which 6 patients (7 coronoid processes) were treated conservatively (Figs 1 and 2) and 5 patients (6 coronoid processes) underwent open reduction and internal fixation (ORIF) using extraoral and intraoral approaches according to concomitant injuries. (Table 1).

Detailed information regarding medical history, treatment method and follow-up results were obtained. Patients who were lost to follow-up were excluded. Written informed consent was obtained from the patients. Ethical committee and institutional review board approval was taken.

Patients were provided the standard visual analog scale (VAS) for pain assessment on preoperative, postoperative day 1, 4 weeks and 6 months. Objective

Fig. 1: Three-dimensional reconstruction of mandibular left coronoid fracture

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Table 1: Distribution of patients by gender and coronoid # side

Factors	*ORIF*	*%*	*Conservative*	*%*	*Total*	*%*
Gender						
Male	4	80.0	5	100.0	9	81.8
Female	1	20.0	1	20.0	2	18.2
Age						
Mean age	36.80		42.00		39.64	
SD age	6.98		10.04		8.79	
Coronoid # side						
Left	3	60.0	2	40.0	5	45.5
Right	1	20.0	3	60.0	4	36.4
Bilateral	1	20.0	1	20.0	2	18.2
Total	5	100.0	6	120.0	11	100.0

ORIF: Open reduction internal fixation, SD: Standard deviation

Table 2: Distribution of patients in two groups by associated fractures

Associated #	*ORIF*	*%*	*Conservative*	*%*	*Total*	*%*
Lefort II	0	0.0	1	20.0	1	9.1
Left body + b/l condylar	0	0.0	1	20.0	1	9.1
Left ramus + angle	1	20.0	0	0.0	1	9.1
Left ramus + body	1	20.0	0	0.0	1	9.1
Left ramus + left angle + right parasymphysis	1	20.0	0	0.0	1	9.1
Left ramus + right parasymphysis	1	20.0	0	0.0	1	9.1
Left zygomatic arch	0	0.0	1	20.0	1	9.1
Right condyle	0	0.0	1	20.0	1	9.1
Right condyle + symphysis	0	0.0	1	20.0	1	9.1
Right zygomatic arch	1	20.0	1	20.0	2	18.2
Total	5	100.0	6	120.0	11	100.0

data was collected by directly measuring the maximum interincisal opening (MIO) preoperatively, immediate postoperative and at 6 months follow-up.

Conservative Management

A total of 6 patients presenting with coronoid fracture were managed conservatively using MMF for 3 to 4 weeks. Three had associated fractures in mandible and three had concomitant fractures of midface and zygomatic arch (Table 2).

Operative Management

Five patients underwent ORIF for the coronoid fractures via intraoral and extraoral retromandibular approach (Figs 3 and 4). Four patients (5 coronoid processes) had associated ramus and condyle fractures, which were reduced and fixed at the same time. One patient had coronoid fracture and zygomatic arch fracture on the same side with limited mouth opening and no associated fractures of mandible, and underwent ORIF via intraoral approach (Table 2). Fractured fragments were reduced and fixed using miniplates based on the stress trajectory of the mandible under physiologic conditions.

Statistical Analysis

Analysis of the data was performed using Mann-Whitney U Test and Wilcoxon Matched Pairs test to compare the preoperative and postoperative data. A p-value of < 0.05 was considered significant.

Fig. 2: Conservative management of mandibular left coronoid fracture

Fig. 3: Orthopantomograph of associated mandibular left coronoid fracture

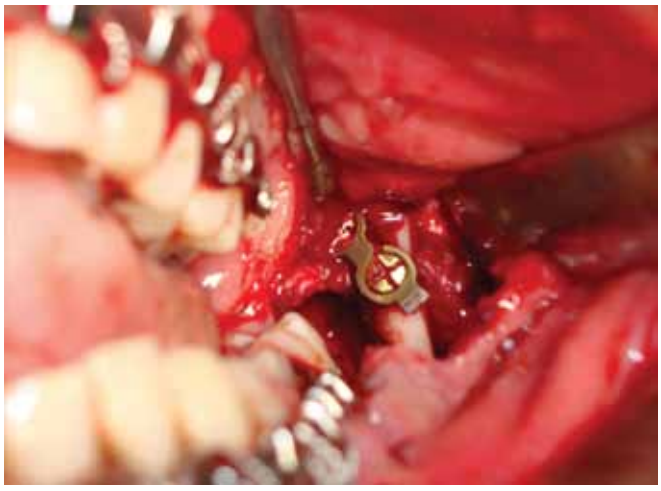


Fig. 4: Open reduction and internal fixation of associated mandibular left coronoid fracture

RESULTS

Coronoid fractures accounted for 3.58 % of all mandibular fractures (n = 11). Average age of patient in our study was 39.63 years (Range = 28-55 years). There were 9 males and 2 females. All the patients presented within 4 weeks of injury and all the injury occurred due to road traffic accident. Two patients had bilateral coronoid fractures while 9 had unilateral. Seven patients had associated fractures of mandible and four had associated midface fractures. Patients were followed up for 6 months.

Conservative management was employed in a total of 6 patients. There was significant improvement in mouth opening from preoperative to postoperative 6 months with $p < 0.05$ (Table 3). All patients showed improved results on pain assessment with reduced pain (Table 4).

Five patients underwent surgery, four of them had other associated mandibular fractures and one had zygomatic arch fracture on the same side. Open reduction and internal fixation was done for these fractures along with coronoid fixation. Follow-up results showed significant improvement in mouth opening and pain scores in all the patients (Graphs 1 and 2).

Postoperative maximum intercuspation was achieved and maintained even at 4 weeks follow-up. No complications like facial nerve injury, sialocele associated with retromandibular approach, malocclusion or deviation of the mandible were noted in either of the groups at 6 months follow-up. Maximal interincisal opening was 46 mm in conservative group and 48 mm in ORIF group after 6 months follow-up.

DISCUSSION

Fractures of coronoid process of mandible, because of direct trauma, are very uncommon due to their protected position under the zygomatic complex. Fracture may be caused due to the reflex contraction of temporalis muscle consequent to the fall and hit on the face. Similar mechanism has been proposed for the fracture of genial tubercle of the mandible.[1]

The coronoid process may also sometimes fracture during the procedures like third molar extractions and sagittal split osteotomy.[2]

The frequency of coronoid process fracture is reported to be 1 to 3% of all mandibular fractures and 0.6 to 4.7% of all maxillofacial fractures.[2-5] Coronoid fractures usually occur concomitantly with other fractures, such as neck of the condyle or zygomatic bone. Our study found incidence of coronoid fractures as 3.58% of all mandibular fractures, whereas incidence of isolated coronoid fracture (without associated mandibular fracture) was noted to be 0.01%.

The temporalis muscle is large and fan shaped, arising from a broad base and inserting into the medial and anterior aspect of the coronoid process. The function of temporalis is to elevate the mandible while the posterior

Table 3: Comparison of preoperative, postoperative and 6 months with respect to maximum incisal opening in open reduction internal fixation and conservative groups by Wilcoxon matched pairs test

Groups	*Time*	*Mean*	*SD*	*Mean diff*	*SD diff*	*Change (%)*	*z-value*	*p-value*
ORIF	Preoperative	21.60	3.91	–23.00	4.00	–106.48	2.0226	0.0431*
	Postoperative	44.60	2.30					
	Preoperative	21.60	3.91	–20.20	3.96	–93.52	2.0226	0.0431*
	Six months	41.80	3.42					
	Postoperative	44.60	2.30	2.80	1.30	6.28	2.0226	0.0431*
	Six months	41.80	3.42					
Conservative	Preoperative	31.33	5.96	–10.50	5.05	–33.5	2.2014	0.0277*
	Postoperative	41.83	3.06					
	Preoperative	31.33	5.96	–9.33	5.16	–29.8	2.2014	0.0277*
	Six months	40.67	2.73					
	Postoperative	41.83	3.06	1.17	1.33	2.8	1.6773	0.0935
	Six months	40.67	2.73					

*p < 0.05, ORIF: Open reduction internal fixation, SD: Standard deviation

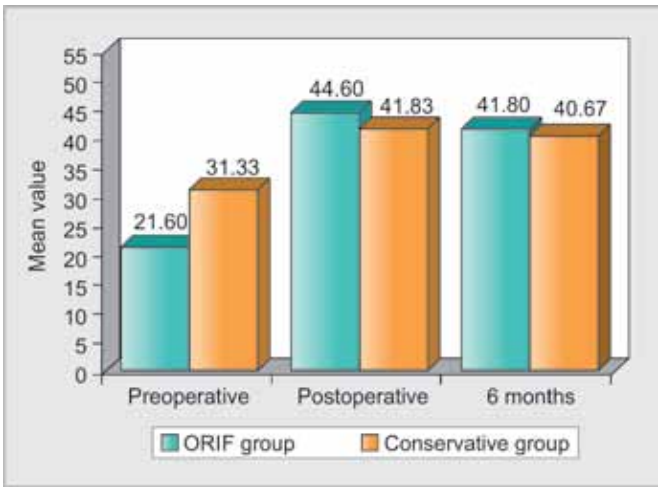
Table 4: Comparison of preoperative, postoperative and 6 months with respect to pain scores in open reduction internal fixation and conservative groups by Wilcoxon matched pairs test

Groups	*Time*	*Mean*	*SD*	*Mean diff*	*SD diff*	*Change (%)*	*z-value*	*p-value*
ORIF	Preoperative	8.60	0.89					
	Day 1	8.00	1.00	0.60	1.67	7.0	0.7303	0.4652
	Preoperative	8.60	0.89					
	Four weeks	2.40	0.55	6.20	0.84	72.1	2.0226	0.0431*
	Preoperative	8.60	0.89					
	Six months	0.00	0.00	8.60	0.89	100.0	2.0226	0.0431*
	Day 1	8.00	1.00					
	Four weeks	2.40	0.55	5.60	1.52	70.0	2.0226	0.0431*
	Day 1	8.00	1.00					
	Six months	0.00	0.00	8.00	1.00	100.0	2.0226	0.0431*
	Four weeks	2.40	0.55					
	Six months	0.00	0.00	2.40	0.55	100.0	2.0226	0.0431*
Conservative	Preoperative	8.17	0.41					
	Day 1	5.00	0.89	3.17	0.75	38.8	2.2014	0.0277*
	Preoperative	8.17	0.41					
	Four weeks	1.33	0.52	6.83	0.41	83.7	2.2014	0.0277*
	Preoperative	8.17	0.41					
	Six months	0.50	0.55	7.67	0.82	93.9	2.2014	0.0277*
	Day 1	5.00	0.89					
	Four weeks	1.33	0.52	3.67	1.03	73.3	2.2014	0.0277*
	Day 1	5.00	0.89					
	Six months	0.50	0.55	4.50	1.05	90.0	2.2014	0.0277*
	Four weeks	1.33	0.52					
	Six months	0.50	0.55	0.83	0.75	62.5	1.8257	0.0679

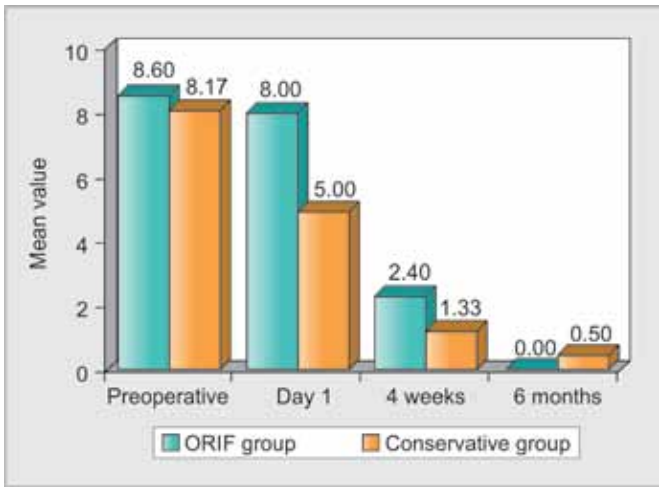
*p < 0.05, ORIF: Open reduction internal fixation, SD: Standard deviation

fibers help in mandibular retrusion. It is also known that, when a muscle is stretched, the myotactic reflex can lead to sudden excitation of muscle spindles and reflex contraction of the large skeletal muscle.[6] The symptoms of coronoid fracture vary according to the extent of injury. Isolated episodes can cause limitation of mouth opening, lateral cross-bite and mild to moderate swelling in the zygomatic arch region.[7]

Traditionally, coronoid fractures are managed conservatively but surgery may be indicated in a few exceptions, especially those who are not good candidates for prolonged MMF. Treatment is controversial and is based on the amount of displacement of the coronoid segment and associated symptoms.[2] Kruger and other authors advocate conservative treatment when there is no displacement and some have advised no treatment.[8] Rapidis



Graph 1: Comparison of open reduction internal fixation and conservative groups with respect to maximum incisal opening at preoperative, postoperative and 6 months



Graph 2: Comparison of open reduction internal fixation and conservative groups with respect to pain scores at preoperative, postoperative and 6 months

et al in their analysis of 52 cases of coronoid process fracture discussed about conservative treatment of such fractures.[3] Takenoshita et al in their report of five cases of fracture of coronoid process advocated nonsurgical modalities.[5] Other case report by Philip et al[9] presented bilateral reflex fracture of coronoid process of mandible, treated conservatively and showed no complication and adequate healing of the fragments. Shen et al[10] in their retrospective study of 39 cases advocated conservative treatment for minimal displacement coronoid fracture cases and open reduction for fractures with significant displacement and other concomitant fractures via modified retromandibular approach.

Our study is in agreement with the previous authors for the choice of treatment modality and fixation of coronoid. The splinting by the temporalis muscle is mostly adequate to hold the coronoid in position until it heals.[6,11,12] Fractures with minimal displacement or restricted mouth opening can be managed conservatively with MMF for 3 to 4 weeks followed by soft diet and active physiotherapy. Fractures with significant displacement that limits mandibular movement can be treated with internal fixation via intraoral incision, pre-ramus approach or a retromandibular approach. Johnson recommended removal of coronoid process in the presence of temporalis fibrosis.[4] Walker,[13] however, has warned that any active movement undoubtedly increases the displacement and delays union. Furthermore, nonunion in fractures of the coronoid process may be more common than generally suppotred.[13] MMF for 3 weeks relieves discomfort and prompts healing.[11]

Although Shen et al[10] has provided a treatment algorithm for management, only two cases could be done according to it, because of lack of unified classification systems for coronoid fractures in the literature. According to the classification proposed, six patients had fracture of coronoid process and the ramus, three had fracture of the coronoid base, and two had fracture of upper coronoid process.

By comparing the data between the two-treatment options, we found no significant difference between the two treatment modalities. But within the group there were some difference for example, mouth opening improved significantly from preoperative to immediate postoperative day in open reduction as compared to closed reduction. After follow-up of 6 months, patients in both the groups showed no significant difference in the mouth opening. Pain in immediate postoperative period was significantly reduced in conservative treatment as compared to open reduction, but showing no difference in postoperative 6 months period.

Therefore, we recommend that linear coronoid fractures with minimal displacement or restricted mouth opening can be managed with conservative treatment, provided no osseous adhesion to surrounding soft tissues take place. If progressive trismus develops due to osseous adhesion between coronoid process and the zygomatic arch, (which was not encountered in our study) it should be managed surgically.

For patients with significant displacement, limited mouth opening, concomitant mid-face or lower-face fractures, rigid internal fixation is recommended.

Rationale for open reduction and internal fixation of coronoid process in our study was to improve the functioning of the temporalis muscle, as it is solely attached to the coronoid process. Moreover, open reduction and internal fixation provided primary stabilization and improved mouth opening within few weeks reducing the recovery time.

CONCLUSION

The choice of treatment plan should be based on the type of fracture pattern, time of the fracture, the presence or absence of other concomitant fractures and the severity of clinical symptoms.

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