

Role of coronoidectomy in increasing mouth opening

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ABSTRACT

Aim: To evaluate the effectiveness of coronoidectomy in advanced (stage III-IV) oral submucous fibrosis (OSMF) and temporomandibular joint (TMJ) ankylosis. **Materials and Methods:** Five patients clinically diagnosed as grade III/IV OSMF (group 1) and seven patients clinically and radiographically confirmed as TMJ ankylosis (group 2) underwent surgery entailing coronoidectomy in addition to conventional surgical procedures required in both the conditions followed by vigorous mouth opening exercises. The results were evaluated using the interincisal distance at maximum mouth opening as the objective outcome over a follow-up period of 2 months. **Results:** OSMF patients (group I) showed a mean preoperative interincisal opening of 14.40 mm which increased to 24.60 mm after conventional procedures and showed further increment to 35 and 44.80 mm after unilateral and bilateral coronoidectomy, respectively; which was statistically significant ($P = 0.043$). Follow-up of 2 months showed a gradual increase in mean mouth opening compared to baseline which was also found to be statistically significant ($P = 0.043$). In TMJ ankylosis patients (group II), preoperative mean mouth opening of 6.71 mm increased to 24.29 mm after conventional procedures, and further to 37.29 mm after unilateral coronoidectomy which was statistically significant ($P = 0.018$). On subsequent follow-up of 2 months, a gradual increase in mean mouth opening compared to baseline was observed which was statistically significant ($P = 0.018$). **Conclusion:** Coronoidectomy is an effective adjunct in increasing intraoperative and stabilizing postoperative mouth opening.

Key words: Coronoidectomy, mouth opening, oral submucous fibrosis, temporomandibular joint ankylosis, trismus

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INTRODUCTION

Restricted mouth opening has serious health implications such as malnutrition due to impaired mastication, difficulty in speech, and compromised oral hygiene resulting in functional deficit of stomatognathic system.

Oral submucous fibrosis (OSMF) has been well-established in Indian medical literature since the time of Sushruta. In Sushruta Samhita, it is described as a swelling within

the throat with burning, prickling pain, hemorrhage, putrid, and necrosed muscle; and caused by "pitta" known as vidari, occurring in mouth, particularly in the side by which the patient lies.^[1] It was first described by Schwartz^[2] and has been reported almost exclusively across all socioeconomic strata in India as a result of increased popularity of the habit of chewing pan masala, betel leaves, and other similar products.

Reduced mouth opening can result from trismus as in case of OSMF, where accumulation of inelastic fibrous tissue in the juxtaepithelial region results in stiffness of oral mucosa. In addition to this, subsequent muscle degeneration leads to fibrosis and scarring of temporalis muscle, further enhancing the limitation in mouth opening. Other than trismus, mandibular hypomobility can also result from a variety of disorders that affect the temporomandibular joint (TMJ) and adjacent structures.

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Among these, TMJ ankylosis is a fairly common disability arising from any condition that induces fibrosis or bony ankylosis between the articular surfaces. This ailment is caused by various factors including trauma, systemic or local inflammatory conditions, and neoplasms in TMJ area.

Management of TMJ ankylosis requires aggressive surgical intervention, the main objectives of which are resection of ankylosed bone, restoration of form, and function and prevention of recurrence.^[3]

Coronoideotomy is recommended in conditions where there are chances of incurring trismus due to temporalis muscle spasm.

In the management of OSMF, coronoideotomy plays an important role in increasing mouth opening. Canniff *et al.*, recommended temporal myotomy or coronoideotomy to release severe trismus caused by the atrophic changes in the tendon of temporalis muscle secondary to the disease.^[4]

In TMJ ankylosis, there is hyperplastic ipsilateral or contralateral coronoid process that tends to impinge against the medial surfaces of the zygomatic arches and posterior surfaces of the body of the zygomatic bones resulting in painless yet mechanical restriction of the mouth opening.^[5,6] Thus, coronoideotomy holds an importance in the management of TMJ ankylosis by enhancing the mouth opening. Apart from this, if temporalis muscle/fascial flap are used in interpositional arthroplasty, there is scarring of the muscle, limiting mouth opening unless an ipsilateral or bilateral coronoideotomy is performed.^[7,8]

The present study was therefore undertaken to assess the benefits of coronoideotomy in mouth opening in the treatment of OSMF and TMJ ankylosis.

MATERIALS AND METHODS

Five patients clinically diagnosed as OSMF grade III/IV (moderately advanced) with significant reduction in mouth opening (less than 2 cm) and seven patients clinically and radiographically diagnosed as TMJ ankylosis, attending the Department of Oral and Maxillofacial Surgery in Babu Banarasi Das College of Dental Sciences, Lucknow, were included in the study irrespective of cast, creed, sex, and socioeconomic status.

Patients were divided into two groups: Group I; coronoideotomy done in patients of OSMF together with resection of fibrous bands with buccal pad of fat interposition. Group II; coronoideotomy done in patients

of TMJ ankylosis along with interpositional arthroplasty with temporalis fascia.

Inclusion criteria

Group I: OSMF patients; grade III and IV (Khanna and Andrade, 1995).

Group II: TMJ ankylosis patients.

Exclusion criteria

1. Patients suffering from debilitating diseases.
2. Radiation therapy to the head and neck region within 12 months prior to proposed treatment.
3. Any signs of malignancy.
4. Previously operated cases.
5. Not willing to participate in the study.

Assessment of coronoid enlargement on orthopantomogram for TMJ ankylosis (Group II) [Figure 1]

To assess the coronoid enlargement in cases of group II, a line was drawn perpendicular to the posterior border of ramus of mandible passing through deepest point of the sigmoid notch. The length of both the processes was measured from the superior most point of coronoid and condyle, and coronoid/condyle ratio (CCR) was calculated.

Surgical procedure

All the procedures were carried out under general anesthesia using nasotracheal intubation.

Coronoideotomy in OSMF

Preoperative mouth opening was recorded [Figure 2] and patients were intubated and draped. Using Bard-Parker blade, intraoral incisions were made bilaterally along the buccal mucosa at the level of occlusal plane 1 cm from the corner of mouth and extended posteriorly up to the anterior faucial pillars and fibrous bands in cheek mucosa were cut. After fibrous bands were released all third molars present were extracted, and maximum mouth opening with help of Ferguson or Heister's mouth gag was recorded [Figure 3]. The coronoid processes were approached through the same incision along with stripping of the temporalis attachment on the anterior border of ramus. Coronoid was held with Kocher's forcep and the osteotomy cut was made extending from the depth of sigmoid notch to anterior border of the ramus. After completion of osteotomy, the coronoid was placed on traction with Kocher's forcep, and remaining temporalis muscle and tendon attachments were cut facilitating removal of coronoid [Figure 4].

After unilateral coronoideotomy, mouth opening was recorded [Figure 5] followed by bilateral coronoideotomy and recording of maximum mouth opening [Figure 6]. Buccal fat of pad (BFP) was then harvested bilaterally and sutured to the mucosal defect with 3-0 vicryl [Figure 7].

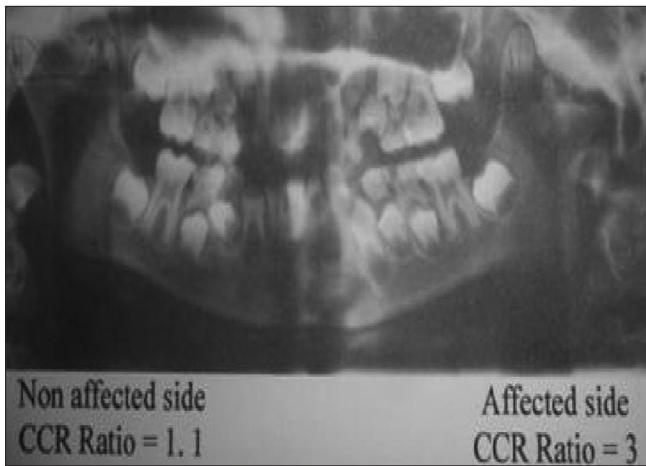


Figure 1: Assessment of coronoid enlargement on orthopantomogram



Figure 2: Preoperative mouth opening (11 mm)



Figure 3: Mouth opening after fibrous bands resection (22 mm)



Figure 4: OPG showing resected coronoid processes and extracted third molars



Figure 5: Mouth opening after unilateral coronoideotomy (26 mm)



Figure 6: Mouth opening after bilateral coronoideotomy (37 mm)

Postoperatively patients were put on Ryle's nasogastric tube feeding for 1 week. Physiotherapy was started from third postoperative day with the help of Ferguson/Heister's jaw exerciser and wooden spatulas to prevent contractures and relapse. Patients were trained

and encouraged to continue these exercises at home three to four times a day for 15 min each. Every patient was followed-up postoperatively at regular intervals till at least 2 months [Figure 8].

Coronoideotomy in TMJ ankylosis

After recording preoperative mouth opening [Figure 9], the patients were intubated and draped. The TMJ region was exposed through standard Al-kayat and Bramley

incision. Resection of the ankylotic mass was carried out and maximum forceful mouth opening using Fergusson mouth gag was recorded [Figure 10]. Then the ipsilateral coronoid process was exposed through the same exposure stripping temporalis attachment. Coronoid was held with Kocher's forcep and the osteotomy cut was made extending from the depth of sigmoid notch to the anterior border of ramus. After the osteotomy was completed, the coronoid was placed on traction with Kocher's forcep and remaining temporalis muscle and tendon attachments were cut and the entire coronoid was removed [Figure 11].

After coronoideotomy, Fergusson mouth gag was applied to record achieved maximum mouth opening [Figure 12].

Interpositional arthroplasty was carried out using temporalis fascia which was rotated over the arch into the joint. The flap is sutured medially, anteriorly, and posteriorly to the soft tissue with 4-0 vicryl. A vacuum suction drain was inserted and flap was closed in layers.

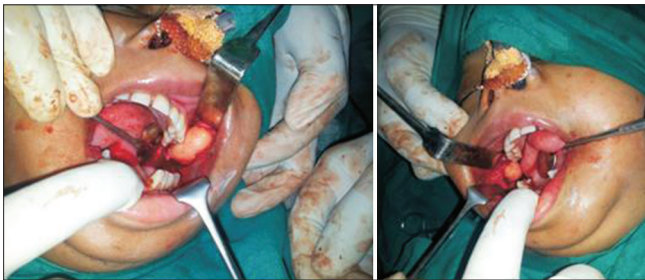


Figure 7: Harvested buccal fat pad



Figure 9: Preoperative mouth opening (9 mm)



Figure 11: Resected coronoid process



Figure 8: Mouth opening postoperative 2 months (27 mm)



Figure 10: Mouth opening after ankylotic mass resection (19 mm)



Figure 12: Mouth opening after ipsilateral coronoideotomy (44 mm)

Patients were given appropriate antibiotics and analgesics as required. Chlorhexidine mouthwash was advised and the patients were instructed to maintain good oral hygiene.

Patients were monitored postoperatively at immediate postoperative, 1st postoperative day, 2nd postoperative day, 3rd postoperative day, 1st postoperative week, 2nd postoperative week, 3rd postoperative week, and at 2 months interval [Figure 13].

RESULTS

In Group I all the patients were above 25 years of age, whereas in group II except for one patient (14.3%), all the other patients (85.7%) were aged ≤ 25 years. Restricted mouth opening was the most common presenting complaint universally present in all the cases irrespective of group. A total of four (33.3%) cases, two each in groups I and II complained of difficulty in mastication. Burning sensation while eating spicy food was reported by 2 (16.7%) patients, and both of them belonged to group I. All the five (100%) cases in group I reported within 2-5 years of onset of symptoms. In group II, three (42.9%) patients reported ≤ 1 year, three (42.9%) between 2 and 5 years, and one (14.3%) after 5 years of onset. While all the cases in group I had adverse oral habits as the etiology. In group II, five (71.4%) had trauma and two (28.6%) had infection as the etiology.

All the cases in group II had mouth opening ≤ 10 mm (mean 6.71 ± 3.2 mm). A total of four (80%) cases in group I had mouth opening between 11 and 15 mm and one patient (20%) had mouth opening of 19 mm. Mean mouth opening (MMO) in group I was 14.40 ± 3.13 mm [Table 1].

In Group I, after the fibrous bands resection, MMO of 24.60 mm with a mean increase of 10.20 mm from preoperative mouth opening (mean 14.40 mm) was



Figure 13: Postoperative (2 months) mouth opening (34 mm)

achieved. After unilateral coronoidectomy, MMO of 35 mm with a mean increase of 20.60 mm from preoperative mouth opening was achieved, and a further improvement after bilateral coronoidectomy was seen with a MMO of 44.80 mm and mean increase of 30.40 mm from preoperative mouth opening [Table 2]. In group II, after the ankylotic mass resection, a MMO of 24.29 mm was achieved with a mean increase of 17.57 mm from the preoperative mouth opening (mean 6.71 mm) and after unilateral coronoidectomy, a MMO of 37.29 mm was achieved with a mean increase of 30.57 mm from the preoperative mouth opening [Table 3].

DISCUSSION

Restricted mouth opening may be caused by various reasons like OSMF, TMJ ankylosis, oral cancer, radiation therapy, zygomatic fractures, infections of oral cavity like pericoronitis, masticatory space infection, or coronoid hyperplasia.

OSMF is a chronic progressive disorder and the treatment is based on the severity of the disease. Typically, if the disease is noted before the development of trismus, conservative management could be carried out; but once trismus has developed, the disease is considered mild to moderate and surgical intervention becomes essential.^[9,10]

Surgical management not only relieves the trismus, but also facilitates regular inspection of the oral cavity for early detection and management of malignant transformation, adequate nutritional intake, dental hygiene, and speech.^[11] Adequate surgical release results in bilateral buccal soft tissue defects which tend to contract and shrink if left to heal by secondary intention. Thus, the resulting soft tissue defect requires resurfacing with well-vascularized tissue of adequate dimensions, where BFP seems to be a convenient choice with satisfactory postoperative results. In our study, BFP was used bilaterally in all the patients of OSMF for reconstruction of the cheek defect. It has the advantage of being simple and easy to use, proximity of donor site to recipient site, no visible scar in donor area, and its rich blood supply which epithelizes by 6 week.^[12,13]

Various authors suggests buccal fat pad as a very logical, convenient, and reliable technique for the treatment of

Table 1: Preoperative mouth opening

Variable (mm)	Total (%)	Group I (n = 5) (%)	Group II (n = 7) (%)
≤ 10	7 (58.3)	0	7 (100)
11-15	4 (33.3)	4 (80)	0
> 15	1 (8.3)	1 (20)	0

Table 2: Comparison of mouth opening at different time intervals among cases of group I as compared to baseline (preoperative) status

Time interval	Mouth opening in (mm)		Change from baseline (mm)		Significance of change (Wilcoxon's signed-rank test)	
	Mean	SD	Mean	SD	z	P value
Baseline	14.40	3.13				
After fibrous bands resection	24.60	4.16	10.20	3.96	2.023	0.043
After U/L coronoideotomy	35.00	3.54	20.60	4.72	2.023	0.043
After B/L coronoideotomy	44.80	4.32	30.40	6.88	2.023	0.043
Day 1	18.60	1.67	4.20	3.27	2.032	0.043
Day 2	18.40	1.67	4.00	3.87	1.625	0.104
Day 3	20.40	2.70	6.00	5.10	1.826	0.068
1 st week	25.80	4.02	11.40	6.95	2.023	0.043
2 nd week	28.40	3.36	14.00	6.04	2.023	0.043
3 rd week	29.20	1.79	14.80	4.15	2.023	0.043
2 months	30.00	3.08	15.60	5.73	2.023	0.043

SD: Standard deviation, U/L: Unilateral, B/L: Bilateral

Table 3: Comparison of mouth opening at different time intervals among cases of group II as compared to baseline (preoperative) status

Time interval	Mouth opening in (mm)		Change from baseline (mm)		Significance of change (Wilcoxon's signed-rank test)	
	Mean	SD	Mean	SD	z	P value
Baseline	6.71	3.20				
After resection of ankylotic mass	24.29	3.45	17.57	4.39	2.371	0.018
After U/L coronoideotomy	37.29	2.29	30.57	4.04	2.366	0.018
Day 1	21.86	2.41	15.14	3.48	2.366	0.018
Day 2	22.43	2.37	15.71	2.50	2.371	0.018
Day 3	23.00	2.16	16.29	2.75	2.371	0.018
1 st week	25.71	1.60	19.00	3.32	2.371	0.018
2 nd week	28.43	2.44	21.71	4.68	2.375	0.018
3 rd week	29.86	3.98	23.14	3.98	2.371	0.018
2 months	33.00	4.93	26.29	4.79	2.375	0.018

SD: Standard deviation, U/L: Unilateral

OSMF and noted improvement in the suppleness and elasticity of the buccal mucosa on clinical examination.^[14]

In OSMF, there is atrophy in the tendon of temporalis muscle secondary to the disease leading to trismus; therefore masticatory muscle myotomy and coronoideotomy is recommended as adjuvant procedures to relieve trismus in stage III and IV OSMF to facilitate aggressive postoperative rehabilitation and maintain adequate mouth opening for relapse free, long-term results.^[4,15-17]

In the entire group I patients, bilateral coronoideotomy was carried out and the increment in mouth opening after fibrous bands resection and coronoideotomy was recorded. A significant increase in mouth opening was observed after fibrous bands resection, which increased further after unilateral and subsequently after bilateral coronoideotomy ($P = 0.043$). At day 1, 2, and 3 postoperative intervals, although the MMO was slightly higher than baseline but not significant statistically ($P > 0.05$). On follow up intervals at 1st week, 2nd week, 3rd week and 2 months respectively a gradual increase in MMO was observed as compared to baseline which was also significant statistically ($P = 0.043$).

Although some authors highlight the importance of coronoideotomy in the protocol for management of

OSMF,^[17] others prefer coronoideotomy in only those cases where the intraoperative mouth opening achieved was less than 35 mm, thereby facilitating increased mouth opening.^[18]

TMJ ankylosis is a condition in which there is immobility of the joint characterized by the formation of an osseous, fibrous, or fibroosseous mass fused to the base of the skull.^[19] It occurs in both children and adults. It has been classified into true ankylosis (intracapsular) and pseudoankylosis (extracapsular). True ankylosis results from any condition that induces fibrosis or bony ankylosis between the articular surfaces. False ankylosis results from pathological conditions not directly related to the joint.^[20]

In TMJ ankylosis, there is hyperplastic ipsilateral or contralateral coronoid process, thus before performing coronoideotomy it is important to evaluate the increment in coronoid length by determining CCR which can be confirmed radiographically.^[21]

CCR of affected side was found to be higher as compared to that of unaffected side in all the cases. Maximum difference was observed to be 2.1, whereas minimum difference was observed as 0.1. Mean CCR of affected side was 1.96 ± 0.62 as compared to 0.92 ± 0.37 for unaffected

side, thereby showing a mean difference of 1.04 ± 0.85 . On comparing the data statistically, the difference between affected and unaffected sides was found to be significant ($P = 0.018$). Since there is no elongation of coronoid process in OSMF, CCR was not calculated in any of the cases of group I.

Early management of TMJ ankylosis aids in improving mandibular function and allowing for possible growth of the jaw in young patients.^[11] Besides these benefits, improved psychological development because of a more normal appearance, improved nutrition, oral hygiene, and ability to obtain dental treatment can be accomplished by increased mouth opening.

Interpositional arthroplasty is widely accepted as the primary surgical treatment for TMJ ankylosis in an attempt to create a partition between the opposing surfaces of healing bone after removal of the ankylotic mass, thus preventing fibrous/osseous adhesions across the gap.

Various autogenous and alloplastic materials have been tried for interpositional arthroplasty. In this study, temporalis fascia was used as an interpositional material in all the patients of TMJ ankylosis. Its principal advantage is that it is autogenous, resilient, has adequate blood supply, and proximity to the joint; allowing for a pedicled transfer of vascularized tissue into the joint area.^[7,8,22,23] The importance of using temporalis muscle or fascia lies in the fact that even if the coronoid is not sufficiently enlarged on the affected side to cause mechanical obstruction, postoperative scarring of temporalis muscle would again lead to trismus and therefore forms another reason to perform at least ipsilateral coronoidectomy where this interpositional material is used.

Although some authors recommend contralateral coronoidectomy if the maximal incisal opening (MIO) remains less than 35 mm after ipsilateral coronoidectomy,^[11,24] others however, suggest contralateral coronoidectomy, if the mouth opening is less than 25 mm and there is no bony interference on the operated side.^[25] In our study, all the patients had a mouth opening of more than 35 mm after arthroplasty and ipsilateral coronoidectomy; hence removal of the contralateral coronoid was deemed unnecessary. Although there is limited sample size in our study, but based on the result we opine that ipsilateral coronoidectomy should be performed to increase intraoperative mouth opening in most cases and where mouth opening is less than 35 mm after ipsilateral coronoidectomy, contralateral coronoidectomy should also be considered.

In both the groups included in our study, maximal mouth opening achieved in the postoperative period was less as compared to intraoperative mouth opening recorded.

This was because at the time of surgery, the muscles were in a flaccid state resulting in minimal resistance to forceful mouth opening.

In our study, 10 intraoral coronoidectomies ($n = 5$) were performed in group I cases where no sign of facial nerve injury was seen postoperatively. However, in seven extraoral coronoidectomies ($n = 7$) in group II, three patients showed temporary paresis of the frontal and temporal branch of the facial nerve lasting for 4-6 weeks postoperatively. This could be attributed to excessive flap retraction during surgery. Complications like mucosal tear of soft palate and faucial pillars was seen in two patients and tear of oral commissures was seen in one patient of group I. This was due to over stretching of mucosa while performing intraoral coronoidectomy.

It is important to note that early postoperative exercise, active postoperative physiotherapy, and strict follow-up are essential to prevent postoperative shrinkage and adhesions in OSMF and TMJ ankylosis, respectively. Motivation to do postoperative active physiotherapy and tolerance of discomfort at that time is regarded as key factors in determining success in maintaining postoperative mouth opening. Relapse and failure to perform mouth opening exercises is mainly due to pain intolerance caused by the stretching action of degenerated strong mouth opening muscles.

Based on the results of our study, it can be concluded that coronoidectomy is an effective adjunct in increasing intraoperative and stabilizing postoperative mouth opening, however a larger sample size with a longer follow-up is required to validate our results. Yes it is required.

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