RESEARCH PAPER

Re-Assessment of Coronoid as a Graft for Condylar Reconstruction in TMJ Ankylosis Patients: A Prospective Study and Literature Review

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Abstract

Introduction Treatment for TMJ ankylosis aims at restoring joint function, improving the patient's aesthetic appearance and quality of life and preventing re-ankylosis. To rebuild a structurally and functionally satisfactory neocondyle is a challenging problem. Aim of this study is to re-assess the coronoid as a graft for condyle reconstruction.

Materials and Methods Twenty patients of TMJ ankylosis without involvement of the coronoid process in ankylotic mass, coming in age group elder than 14 years were selected for the study over a period 3 years from 2011 to 2014. Clinical examination, radiographs, and photographs were used postoperatively to evaluate the grafts and TMJ function. After osteoarthrectomy coronoid process was detached and fixed with a 4 hole L-shaped titanium miniplate to form neo condyle.

Result No donor site morbidity was observed as reported with other autogenous grafts. Satisfactory mouth opening was observed during follow up period with mean mouth opening 37.33 ± 4.20 mm except one case which required graft removal due to postoperative infection. Radiographically moderate amount of resorption of grafted coronoid

process was observed in nearly all the cases however satisfactory mandibular function and occlusion was observed.

Keywords Ankylosis · Autogenous graft · Coronoid · Reconstruction

Introduction

Temporomandibular joint (TMJ) ankylosis is a crippling condition commonly encountered among younger population in developing countries. Major culprits leading to the condition are trauma and joint infection; however, ankylosis may also be caused by systemic infections, autoimmune disease or may be as recurrence after failed surgery. Rowe [1] has defined TMJ ankylosis as a condition which involves pathological change in the anatomical and physiological integrity of joint surface leading to a negative impact on growth of the jaw, mastication and speech. More severe cases may have facial disfigurement and upper airway obstruction leading to obstructive sleep apnea that jeopardizes the quality of patient's life. Timely diagnosis and early surgical intervention must be the main agenda to prevent further damage to the patient. Sawhney [2] classified ankylosis as: Type I- presence of fibro-adhesions at the condyle; Type II- bony fusion of the misshaped head and the articular surface. No involvement of sigmoid notch and coronoid process; Type III- A bony block bridging across the ramus and the zygomatic arch. Medially an atrophic dislocated fragment of the former head of the condyle is still found; Type IV—complete bony block, total union of the mandibular ramus with the zygomatic arch.

Treatment for TMJ ankylosis aims at restoring joint function, improving the patient's aesthetic appearance and

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quality of life and preventing re-ankylosis. Kaban et al. [3] formulated a protocol for management of TMJ ankylosis which was later modified in 2009 [4]. The methods, techniques and materials used for the reconstruction of the mandible after surgical excision of the ankylosed joint are debated. Numerous materials have been used to reconstruct the TMJ including autogenous, alloplastic and xenogenic bovine bone grafts.

So far many autogenous grafts have been used for reconstructing a structurally and functionally satisfactory neocondyle of the mandible. However, restoring proper joint form and function and achieving occlusal stability is very difficult and therefore selecting an appropriate graft for condylar reconstruction is a challenging task. Recently coronoid process as free autogenous bone graft for repairing defects in the craniomaxillofacial field has been extensively applied owing to its fitting dimension and thickness. Table 1 mentioned the brief literature review on use of coronoid process as graft in maxillofacial region. In this study we report our experience while assessing the coronoid process as a graft for reconstruction of condyle in patients of TMJ ankylosis.

Patients and Method

Twenty cases were selected for the present study from the patients of TMJ ankylosis who reported to the Out Patient Department of Oral and Maxillofacial Surgery, over a period 3 years from 2011 to 2014.

Patient Selection: Patients having TMJ ankylosis without involvement of the coronoid process in ankylosed mass, irrespective of gender, caste, and creed, socioeconomic status, cause of ankylosis, side of ankylosis; unilateral or bilateral case of ankylosis; coming in age group elder than 14 year were included in the study. Pre informed consent was taken from all the subjects undergoing in the study.

Patients included in the study were evaluated with history, physical, clinical and radiological examinations (orthopantomogram, denta scan and coronal and axial CT scan). Amount of maximal mouth opening (MMO) was noted prior to surgery.

Assessment Criteria

Results were assessed at regular intervals postoperatively on the basis of clinical and radiological findings. Clinical parameters include: pain, swelling, infection, measurement of maximal mouth opening, occlusion status, paraesthesia, jaw deviation during mouth opening, frontal and lateral profile picture.

Radiographically panoramic radiographs were used to check the resorption status of the coronoid graft and to check if there was any re-ankylosis. During follow up period decrease in this ramus height value from immediate postoperative value was noted. Denta-scan and CT scan were also used wherever needed. Average follow-up period of all the patients was 18 months with longest follow-up noted at 27 months.

Table 1 Literature review on coronoid process as a graft in maxillofacial region

Youmans and Russell [5]	1969	Introduced the use of coronoid process as a free autogenous graft for <i>repairing defects of the mandible, reconstruction of orbital and nasal defects and midface augmentation</i> and has been extensively applied in the maxillofacial area
Berry et al. [6]	1994	Reported a case describing rhinoplastic surgery in which <i>nasal dorsal augmentation</i> was accomplished using the mandibular coronoid process as an autogenous bone graft with successful result
Honig [7]	1996	Presented a new <i>technique of harvesting bone graft from the lateral cortical layer of the coronoid process</i> and advocated this region as well suited donor area because of its easy accessibility, the good shape and thickness of the graft and its corticocancellous nature
Mintz et al. [8]	1998	Compares the contour of the coronoid process with the orbital floor using 24 dried skulls and clinically <i>reconstructed the orbital floor using coronoid process in 8 patients</i> with orbital floor fracture
Choung et al. [9]	2001	Reported the use of coronoid process for <i>paranasal augmentation in the correction of midfacial concavity</i> in 54 patients. All patients showed improved facial esthetics without complications
Hong et al. [10]	2002	Reported satisfactory results in terms of function of the TMJ, the airway, and aesthetics, with the use of autogenous coronoid process grafts for <i>lengthening ramus</i> in patients with long standing bilateral TMJ ankylosis and severe mandibular retrognathia
Zhu et al. [11]	2008	Studied the clinical effects of <i>condylar reconstruction</i> by free grafting of autogenous coronoid process in 15 patients with TMJ ankylosis
Kim et al. [12]	2009	In a sinus lift procedure used the coronoid process as a graft for <i>sinus augmentation</i> in a 57 year old patient
Amrani et al. [13]	2010	Evaluated the utility of extended mandibular ramus and coronoid process bone grafts for <i>maxillofacial reconstructive surgery</i> in 12 patients involving deformities due to trauma, alveolar atrophy, or iatrogenic nasal deformity
De Riu et al. [14]	2012	Used coronoid process as graft for <i>mandibular alveolar ridge augmentation</i> for dental implant insertion in 15 patients

Surgical Procedure

The surgery was performed under general anesthesia using nasal intubation. The ankylosed joint was approached through standard Al Kayat and Bramley [15] incision. Using no 15 blade the incision was started at the temporal end and taken down to the temporalis fascia. The flap was raised safely avoiding injuries to superficial temporal vessels and nerves. The periosteum of the malar arch on its deeper surface was safely incised and raised with the flap. The zygomatic branch of the superficial temporal artery was ligated. Ankylosed bony mass was exposed and osteoarthrectomy was done to create a gap of 1.5–2 cm between zygomatic arch and the upper surface of the ramus (Fig. 1). The glenoid fossa was recreated using burs.

The coronoid process was then detached using straight fissure bur through postage stamping technique (Fig. 2). Graft was reshaped by minor trimming using bur and final position of the coronoid process in the glenoid fossa was determined by the position of the ramus when the teeth were placed into occlusion. The bone graft was fixed with a 4 hole L-shaped titanium miniplate (Fig. 3). A trial mouth opening was attempted and any fibrous tissue causing restriction of the mouth opening was removed. Pedicled temporal fascia was used as interpositional material.

Post-operative aggressive physiotherapy involving mouth opening exercises, using a metallic mouth gag (h-ester), were instituted in all the patients from the third postoperative day, and motivated to continue both active and passive exercises till 6 months to 1 year.

Fig. 1 Intraoperative view after osteoarthrectomy

Fig. 2 Harvested coronoid graft

Fig. 3 Graft fixed in position

Results

Satisfactory mouth opening was observed in nearly all the patients at post operative follow up with mean value of MMO noted was 37.33 ± 4.20 mm (Fig. 4). Only 1 patient reported after 1 and half month of surgery with reduction in mouth opening to 20 mm and pus discharge from pre-audicular region and required removal of the graft. Transient postoperative weakness of zygomatico-temporal branch of facial nerve was noted in 9 patients (45 %), which improved significantly over a period of 4–12 weeks and no

Fig. 4 17 year old patient with left TMJ ankylosis. Pre-operative mouth opening vs Post-operative mouth opening

Table 2 Comparison of weakness of Facial nerve branch at different time interval

	1 Week		1 Month		3 Month		6 Month	
	N	%	N	%	N	%	N	%
Present	09	45.00	06	30.00	02	10.00	–	–
Absent	11	55.00	14	70.00	18	90.00	20	100.00
Total	20	100.00	20	100.00	20	100.00	20	100.00

$$\chi^2 = 14.56 \text{ 'p' } = <0.01$$

weakness was observed in any of the patient during subsequent follow up (Table 2). The probable reason for nerve weakness was mainly due to excessive flap retraction during surgery. Radiographs showed certain amount of bony resorption of grafted coronoid process leading to reduction in ramus height during post operative follow up in nearly all the cases (Fig. 5). No patient developed a recurrence during the follow-up period and no occlusal discrepancies were noted.

Discussion

In TMJ ankylosis osteoarthrectomy alone offers incomplete treatment. Planning for treating ankylosis must also include condylar reconstruction and correction of facial asymmetry. Main motive behind condylar reconstruction is restoration of form and function, reduction of disability and preventing re-ankylosis. Condyle maintains the vertical height of the jaw and prevents deviation during function. Reconstruction with autogenous tissues have advantage over alloplastic grafts in terms of host acceptance, fewer chances of rejection, resorption and infection, and lesser harm to patients.

If the coronoid process is not involved, then it is a well suited donor area, because of its easy accessibility, the good shape and thickness of the graft and its corticocancellous nature. In most cases of TMJ ankylosis, there is

coronoid process enlargement which suits its placement after gap arthroplasty. Also elongation of the coronoid process in TMJ ankylosis caused by hyperactivity of temporal muscle has been documented in literature by Isberg et al. [16]. The stretchy coronoid process thus is expedient to restore the height of the mandible ramus.

Incidence of unilateral involvement of TMJ ankylosis has higher documentation in literature than bilateral involvement. Elgazzar et al. [17] in their study over 101 cases of ankylosis reported 92 % unilateral involvement with 54 % were on the right side. In our present study also 95 % of total cases were unilaterally involved of which 55 % were on the right side and 40 % on the left side, while there was only 1 case (5 %) of bilateral involvement. In this bilateral case of TMJ ankylosis, coronoid process of only right side was available for condylar reconstruction while left side coronoid was involved in the ankylotic mass. So in this case condylar reconstruction was done only on one side with autogenous coronoid graft. This prevented the occurrence of open bite which is commonly seen in cases of bilateral TMJ ankylosis after ankylotic mass removal without reconstruction.

The main cause of TMJ ankylosis in the present study was trauma which has an exact correlation with finding of Roychoudhury et al. [18] who retrospectively studied 50 cases of TMJ ankylosis and showed that TMJ trauma was documented as a major etiologic factor in 86 % of cases and concluded it as the main cause of ankylosis in India. However, according to Raveh et al. [19], the condylar trauma is not very important for the development of TMJ ankylosis and can be prevented by early diagnosis and proper early treatment of condylar fractures.

In our study 7 patients had preoperative nil mouth opening and the mean preoperative mouth opening of other 13 patients was 4.95 ± 4.70 mm. Average mouth opening achieved intraoperatively following ankylotic mass removal and coronoid grafting was 37.95 ± 3.50 mm. But

Fig. 5 Panoramic radiographs showing preoperative, immediate post-op and 18 month follow up view. Moderate amount of bony resorption of grafted coronoid process noted

RADIOGRAPHS (OPG)

it was seen that there was a significant reduction in mouth opening during first week of postoperative period with mean mouth opening 22.6 ± 4.54 mm. With time interval as reduction in swelling and pain occur and aggressive physiotherapy was practiced, the mean mouth opening gradually increased to 37.33 ± 4.20 mm over 15 days and was maintained during postoperative follow up without any recurrence. Our finding correlates with the study of Liu et al. [20] in which 48 patients of TMJ ankylosis underwent surgical management and condylar reconstruction with coronoid process, the average mouth opening achieved was 36.0 ± 6.8 mm following surgery.

Radiographically, during post operative follow up, moderate amount of bony resorption of grafted coronoid process was seen in nearly all the cases in our study. At 1 month follow up no notable bony resorption was found, with a mean decrease of height of mandible ramus being 1.2 ± 0.6 mm. But at 6 months follow up considerable amount of bony resorption was seen with a mean decrease in ramus height being 5.2 ± 1.8 mm which also correlates with the study of Liu et al. [20]. In their study also mean decrease of 4.2 ± 1.2 mm in height of mandible ramus was noticed radiographically during follow up. But instead of considerable resorption satisfactory mandibular function

was being observed during follow up without any occlusal discrepancies.

The common factors that are involved in deciding the choice of autogenous graft for condylar reconstruction like difficulty in accessibility and donor site morbidity are not being observed during autogenous coronoid grafting. It is easily accessible from same surgical site without any additional donor site morbidity. Also surgical management of excision of the ankylosed joint alone is usually insufficient to provide a satisfactory improvement in mouth opening, additional coronoidectomy is necessary in most patients. The other donor site complications that has been reported in literature while harvesting various other autogenous grafts, such as pneumothorax, intracerebral hemorrhage, cerebrospinal fluid leak, sagittal sinus perforation as reported by Skouteris et al. [21]; pleural tear, pleural effusion, atelectasis, empyema, pneumonia as reported by El-Sayed [22]; altered gait, herniation of abdominal contents, ilium fracture, peritonitis, and retroperitoneal hematoma as reported by Laurie et al. [23]; could not be encountered in this study.

Based on the present study we concluded—coronoid process can be harvested safely and easily but moderate amount of bone resorption occurs postoperatively. Also if the ankylosed segment involves the coronoid process, then it cannot be used as a substitute for condylar reconstruction. This clinical study suggests that autogenous coronoid process could be considered as a new donor source for reconstruction of the mandibular condyle but may not a best alternative for condyle reconstruction due to significant resorption.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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