**Case Report**

**Costochondral grafts for reconstruction of acquired mandibular defects involving the temporomandibular joint: Report of two cases**

**ABSTRACT**

Autogenous reconstruction of temporomandibular joint (TMJ) with costochondral graft (CCG) has been a popular method of growth center transfer in children. However, unpredictable growth pattern of CCG has been reported in children that often leads to dentofacial deformities in future. This institutional study describes the results of mandibular reconstruction with CCG in two growing children, one with plexiform ameloblastoma of mandible and the other with unilateral TMJ ankylosis. Long-term follow-ups showed a significant growth of the grafts in both the patients. However, there was a lack of uniformity in the amount and rate of growth. The authors support the theory that CCG possesses innate growth potential and is a desirable option for reconstruction of acquired mandibular defects involving the TMJ in pediatric population. However, regular postoperative monitoring is necessary for such patients as the graft shows an unpredictable growth pattern.

**Keywords:** Ankylosis, children, costochondral graft, mandibular reconstruction, temporomandibular joint

**INTRODUCTION**

Acquired defects after surgical resections in the temporomandibular joint (TMJ) region result in facial deformities and functional problems. When such defects occur in children, additional factors of age and residual growth of the child have to be considered while choosing the appropriate modality of reconstruction.

Costochondral grafts (CCGs), by virtue of their innate growth potential and anatomic similarity to the TMJ, have emerged as the first choice for TMJ reconstruction in children; the only drawback being the unpredictability of growth, leading to future dentofacial deformities and further need for treatment.[1]

This report highlights the postoperative outcomes in two young patients who underwent TMJ reconstruction with CCG.

**CASE REPORTS**

Since both patients underwent TMJ reconstruction with CCG, the authors have described the technique of graft harvesting separately before the case presentation. CCG was harvested from right side fifth rib in both cases. A curvilinear incision was placed approximately 2.5 cm below the nipple along the inframammary crease, extending from the mid-axillary line toward the sternum medially. Dissection was carried through the subcutaneous tissues, pectoralis major, and rectus abdominis muscles and fascia. The overlying rib periosseum was then excised along the height of contour in a longitudinal fashion. A cuff of periosseum and perichondrium was kept.

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intact over the costochondral junction to minimize the risk of cartilage separation. Following circumferential dissection of periosteum, a Doyen rib raspatory was used on the undersurface of the rib taking care not to injure the pleura. This helped prevent neurovascular bundle damage. Using guillotine rib cutter, a posterior osteotomy was made and a 6 cm long graft was harvested and reshaped. Approximately 3 mm cartilage was maintained on the graft, and the medial incision was completed using a blade. Anesthetist was asked to perform the Valsalva maneuver to check for any pleural tear. The chest incision was then closed in layers. The lining of the glenoid fossa was done with a temporalis myofascial flap or with the native disc, if it was salvageable. Graft was fixed in its ideal position and secured to the native mandible with 2.0-mm titanium miniplates. The cartilage cap was placed in the glenoid fossa of the temporal bone which would act as the future condyle.

The patients were followed up at 3-month interval to monitor the facial asymmetry, mouth opening, occlusion, dental midline, and lateral excursions. Growth of graft, neocondyle formation, and bony union were evaluated radiographically using orthopantomogram (OPG). As a protocol of any TMJ surgery, physiotherapy was advised to both patients in the postoperative phase.

**Case 1**

An 11-year-old boy reported with a painless swelling on the left lower third of face that had been present for a year. His medical history was unremarkable, and investigation parameters were within normal limits.

Clinical examination revealed a diffuse, smooth surfaced, hard swelling of approximately 4 cm × 3 cm size involving the left body and ramus of mandible [Figure 1a]. There were no signs of paraesthesia, overlying mucosal changes, pus discharge, or active bleeding. The patient had a satisfactory occlusion with no observable occlusal canting and dental midline asymmetry.

OPG showed a well-defined multilocular radiolucency extending from the left first molar region to whole of the ramus and part of the coronoid process [Figure 1b]. There was bone erosion, leading to thinning of the inferior border of mandible. Histopathologic examination was suggestive of plexiform ameloblastoma.

Nasotracheal intubation was done to administer general anaesthesia. Segmental resection of left body of mandible with condylar disarticulation was performed through an extended submandibular approach. The specimen included bone margins of 1.5 cm and resulted in a defect approximately 6 cm in length. A CCG of 6 cm length with 3 mm cartilage cap was used to reconstruct the surgical defect [Figure 2]. The neck incision was closed in layers to achieve a watertight closure. Immediate postoperative interincisal opening was 40 mm. A removable dental prosthesis was given to the patient after the third postoperative month in order to maintain space till cessation of growth and to facilitate his mastication.

Five years postsurgery, the patient had developed facial asymmetry with slight deviation of chin to the left side [Figure 3]. The patient was satisfied with the look and did not want any further interventions. Ramal length was comparatively shorter over the side of surgery, and there was canting of the occlusal plane. The patient had an interincisal opening of 38 mm, satisfactory intercuspation and was able to perform 1.5 mm of lateral excursions. The patient had no postoperative TMJ problems. Although healing of recipient site was satisfactory, donor site developed a hypertrophic scar. OPG showed a complete bony union between the graft and the mandible [Figure 4].

**Case 2**

A 14-year-old girl presented with the inability to open her mouth. She had a history of trauma at about 3 months of age and had gradually developed ankylosis of the right TMJ. The patient had asymmetry of the lower third of face, with chin deviated to the right side [Figure 5]. There was a noticeable occlusal cant and a dental midline shift of 4 mm toward right side. The patient gave no history of obstructive sleep apnea or other medical conditions.

OPG showed a 7 mm shortening of ramal height over the right side of the mandible [Figure 6a]. Computed tomography scan was suggestive of a Sawhney Grade IV ankylosis on the right side [Figure 6b].

General anaesthesia was administered to the patient after securing the airway with a tracheostomy. Alkayat-Bramley incision was used to expose the ankylosic mass over right TMJ region. Gap arthroplasty along with ipsilateral coronoidectomy was performed to release the ankylosis. Reconstruction of the ramus-condyle unit was done with a 3 cm long CCG with 3 mm of cartilage which formed the articular surface of the neocondyle [Figure 7]. An intraoperative mouth opening of 35 mm was achieved. Closure of the preauricular incision was done in layers.

Three years postsurgery, the patient showed a significant improvement in facial asymmetry implying growth of the

**Figure 5:**

**Figure 6a:**

**Figure 6b:**

**Figure 7:**
graft [Figure 8a]. Ramal height was now only 2 mm short on the right side indicating growth of the graft along with the native mandible. There was an improvement in the occlusal cant. A correction of 3 mm was seen in the dental midline on habitual occlusion. The patient had an interincisal opening of 35 mm, satisfactory intercuspation and was able to perform 1 mm of lateral excursions [Figure 8b]. The patient gave no history of postoperative TMJ or respiratory problems. Unlike Case 1, healing of recipient and donor sites
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were satisfactory with no hypertrophic scar formation. OPG showed a complete bony union between the graft and the mandible [Figure 8c].

Table 1 details the two cases presented in this report and summarizes their final postoperative results.

**DISCUSSION**

The TMJ is a dynamic joint with a complex functioning. Defects of the TMJ require special reconstructive considerations, especially in growing patients to avoid future deformities and functional problems. Wherever ablative surgery of TMJ is performed, reconstruction with immediate autogenous bone grafting/alloplastic TMJ prosthesis becomes necessary to prevent facial deformity.

Alloplastic TMJ reconstruction seems feasible for conditions in children like recurrent ankylosis, failed tissue grafts, and refractory cases of inflammatory TMJ arthritis. However, alloplastic materials have certain disadvantages such as lack of growth potential, prosthesis failure due to infection and high cost.

CCG is a popular autogenous growth center transplant for mandibular condyle reconstruction in growing children. Other autogenous options include sternoclavicular joint and second metatarsal flap.

The advantages of using CCG in growing children are its intrinsic growth potential and remodelling capacity. CCG is anatomically similar to the TMJ as it provides a cartilaginous articular surface. Furthermore, there is minimal donor site morbidity and reduced operating time when compared to vascularized bone flaps.

One of the major drawbacks of CCG is a lack of predictable growth pattern. Other disadvantages include separation of the cartilage cap and possibility of graft resorption due to poor medullary and cortical bone quality. Unlike vascularised bone flaps, immediate dental rehabilitation is not possible when using CCG for mandibular reconstruction. Donor site complications such as pneumothorax, pleural tear, and atelectasis have also been reported in rare instances.

Length of the surgical defect is important criteria for the selection of the type of autogenous graft. Failure rates with nonvascularised bone grafts increase when length of the defect is more than 6 cm, and caution has been advised by Pogrel et al. for grafts above 9 cm length. In this report, the authors were able to perform successful reconstruction with CCG in both the cases. This may be because both the cases had defects of ≤6 cm size.

The length of cartilage cap influences the degree of growth that occurs in the graft. Not only does a longer graft contain more germinative cells, but these cells are also influenced in turn by extrinsic humoral factors or masticatory forces which determines the final growth. Excessive amount of grafted cartilage can cause overgrowth and facial asymmetry. According to Perrott et al., approximately 3–4 mm of cartilage cap is required for prevention of reankylosis and transfer of growth centre.

In case 1, mild facial asymmetry was noted on close observation, which may be due to impaired cartilage growth or graft resorption. On the contrary, CCG helped to correct the facial asymmetry caused by the ankylosis in
Table 1: Details of the two cases presented in this report and their final postoperative results

|                      | Case 1                                      | Case 2                                      |
|----------------------|---------------------------------------------|---------------------------------------------|
| Age on first visit (years) | 11                                          | 14                                          |
| Gender               | Male                                        | Female                                      |
| Diagnosis            | Plexiform ameloblastoma of left mandible    | Unilateral right TMJ ankylosis              |
| Preoperative mouth opening (mm) | 40                                          | 0                                           |
| Preoperative occlusal cant     | Absent                                      | Present                                     |
| Size of defect (cm)       | 6                                           | 3                                           |
| Size of graft (cm)        | 6                                           | 3                                           |
| Follow up (years)         | 5                                           | 3                                           |
| Postoperative mouth opening (mm)* | 38†                                         | 35†                                        |
| Lateral excursions (mm)*  | 1.5†                                        | 1†                                        |
| Postoperative facial asymmetry* | Present                                    | Improved                                   |
| Postoperative occlusal cant* | Present                                   | Corrected                                  |
| Dental intercuspation*    | Satisfactory                                | Satisfactory                                |
| Midline deviation on habitual occlusion* | 0 mm                                         | 1 mm towards right side                     |
| Bony union of the graft*  | Present                                     | Present                                     |
| Scarring*               | Hypertrophic scar in donor site             | Absent                                      |

*Results of cases 1 and 2 at the end of 5 and 3 years respectively. †Measured On Range Of Motion Scale (therabite corp.). TMJ: Temporomandibular joint

To sum it up, when the soft-tissue coverage is adequate at the recipient site and no postoperative radiotherapy is planned, nonvascularised bone grafts such as CCG are a good alternative to vascularized bone flaps in terms of restoration of function, donor site morbidity, operating time for reconstruction of mandibular defects of ≤6 cm length, and involving the condyle. Vascularized free flaps may be preferred for reconstruction of defects of more than 6 cm length if other factors are not conducive.

In the authors’ experience, CCG is a desirable option for the reconstruction of acquired mandibular defects involving the TMJ in paediatric population. However, long-term follow-up and timely interventions are necessary for such patients as the graft shows unpredictable growth pattern.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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