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Original Article

Dentistry Section

# Three Dimensional Morphological Grading of Ankylosed TMJ for Surgical Planning: A Retrospective Observational Study

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## ABSTRACT

**Introduction:** Temporomandibular Joint (TMJ) ankylosis remains an enigma in craniofacial surgery due to the challenges encountered while restoring mouth opening, facial form and airway to normalcy. Though TMJ ankylosis is a relatively simple diagnosis to make, the specific surgical plan depends on the nature and extent of the fusion of the mandible with the cranial base.

**Aim:** To classify the pattern of bone deformity found in TMJ ankylosis using three Dimensional (3D) Computed Tomography (CT) imaging and its role in determining the type of procedures required for effective gap arthroplasty.

**Materials and Methods:** This retrospective study was done to evaluate the 3D CT reconstructed images of 66 consecutive patients having 82 ankylosed joints treated from January 2007 to December 2019 with a standardised protocol. A grading system was used with the following criteria: coronoid hyperplasia, sigmoid notch to skull-base fusion and loss of residual joint space. The gap arthroplasty required for each grade of ankylosis was also analysed. The complete data in the present study was tabulated in Microsoft Excel sheet and frequency (n) analysis was done for all variables.

**Results:** Out of 66 patients (82 ankylotic joints) 37 males and 29 females), age range 2.5-51 years, average age 18.2 years) 27% of the total joints surveyed belonged to grade 1 type of ankylosis. None of these joints had complete bony fusion (absence of the radiolucent zone between the cranium and condyle). A 10% of the joints had moderate ankylosis (grade 2). None of them revealed complete bony fusion (absence of the radiolucent zone) or fusion of the sigmoid with the cranial base. Grade 3 ankylosis was the most widely seen pattern of ankylosis (63% of the present study subjects) and 92% had a history of childhood onset. A 90% of the joints in this group had ipsilateral coronoid hyperplasia. A 48% of the joints with severe ankylosis (grade 3) showed bony fusion with the cranial base, with loss or absence of the radiolucent zone {Fusion Line (FL)} between the cranial base and the condyle.

**Conclusion:** The extent and severity of TMJ ankylosis needs to be ascertained prior to planning TM Joint ankylosis surgery. A 3D CT assessment and subsequent radiologic grading provides a reliable guide for ankylosis release.


**Keywords:** Gap arthroplasty, Muscle interposition, Temporomandibular joint ankylosis

## INTRODUCTION

The TMJ ankylosis remains an enigma in craniofacial surgery due to the challenges encountered while restoring mouth opening, facial form and airway to normalcy. The distorted pathological anatomy seen in this disease varies from patient to patient and therefore the management of each case needs to be tailor-made in relation to the severity and extent of the disease. Clinical decision making in any modality of treatment needs to be guided by information processed from the individual patient's clinical features and investigations. In surgery especially, apart from the diagnosis, the technical procedures have to be customised to the level of difficulty of the individual case. Similarly, though TMJ ankylosis is a relatively simple diagnosis to make, the specific surgical plan depends on the nature and extent of the fusion of the mandible with the cranial base [1].

This retrospective study was an audit of a series of patients treated over a period of 12 years with an identical protocol and the same surgical team. A 3D radiographic study of the TMJ and its associated structures was done for each case to plan on the extent of bone removal and the approach needed to produce adequate release of trismus. Restoration of function and prevention of re-ankylosis is the primary goal of treatment in this disease [2]. The audit was conducted to elucidate and classify the patterns of bone deformity of the fused cranio-mandibular complex and the type of procedures which would be needed for each grade of complexity. The article highlights on the current standard of care in management of TMJ ankylosis at a tertiary care centre and proposes a morphological grading classification to aid in planning of surgery.

## MATERIALS AND METHODS

The retrospective study (IRB approval No. 11886/ Dated 27.02.2019) included only those patients who had CT imaging with 3D reconstructed images which were used for planning of surgery from January 2007 to December 2019. All the data and the skull radiographic images were taken from the electronic database saved and archived by the institution and were analysed during 2019-2020 retrospectively.

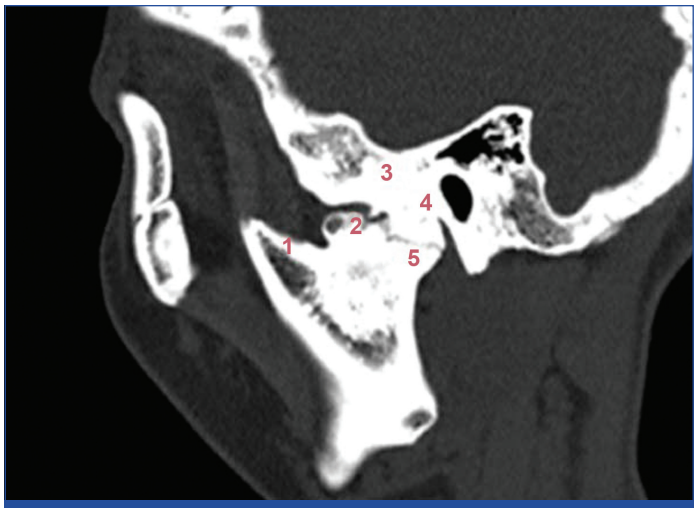
**Inclusion criteria:** Those cases of ankylosis of given time period with complete data and preoperative 3D CT images were included in the study.

**Exclusion criteria:** Those cases with incomplete data or radiographic images were excluded from the study.

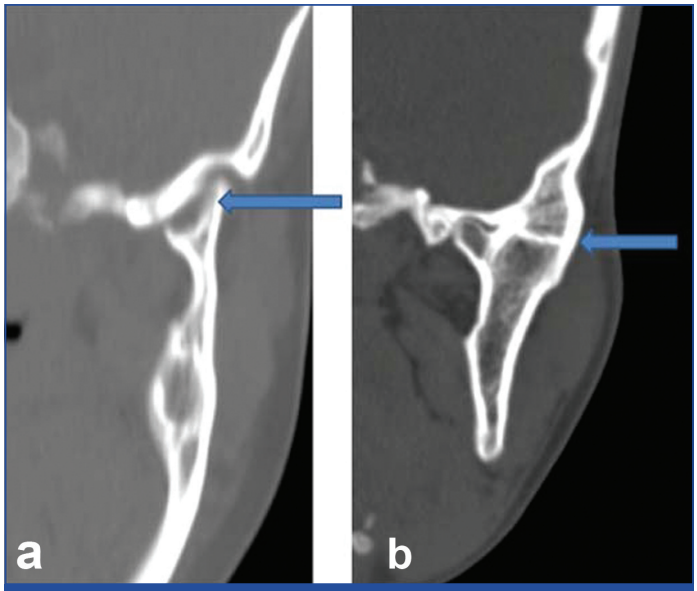
### Study Procedure

Sixty six patients having 82 ankylosed joints were analysed with a preoperative 3D computed tomographic image. Study of the deformed joint morphology in 3 dimensions assessed the extension of the ankylosis beyond the articular eminence, elongation of the coronoid, extracapsular fusion of the sigmoid notch to the cranial base, thickening of the cranial base above the ankylosis, extension of ankylosis laterally to zygomatic arch or posteriorly to involve the anterior tympanic plate [Table/Fig-1]. The residual joint space was assessed using multiple views [Table/Fig-2]. In addition, the transverse and anteroposterior width of the ankylosed joint was measured using the electronic scale for DICOM imaging [Table/Fig-3]. The analysed joints were then graded according to their morphological assessment [3]. Planned surgery corresponding to

the staging and grading of the ankylotic joint was performed [3]. Postoperatively the patients were then evaluated for the effectiveness of surgical planning based on assessment the adequacy of mouth opening, the surgical complications and follow-up evidence of progressive re-ankylosis.




**[Table/Fig-1]:** Sagittal view showing elongation of coronoid, sigmoid notch in relation to base of skull, expansion of cranial floor, fusion to anterior tympanic plate and loss of residual joint space. 1) Elongated coronoid; 2) Sigmoid notch obliteration; 3) thickening of cranial base; 4) fusion with anterior tympanic plate; 5) loss of residual joint space.

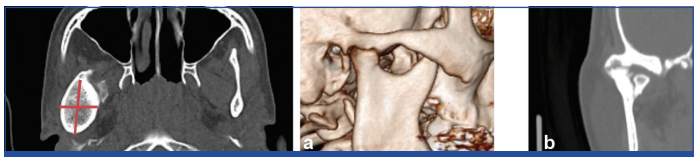



**[Table/Fig-2]:** a) (blue arrow) Incomplete and b) (blue arrow) complete fusion (loss of residual joint space).

## Morphological Classification

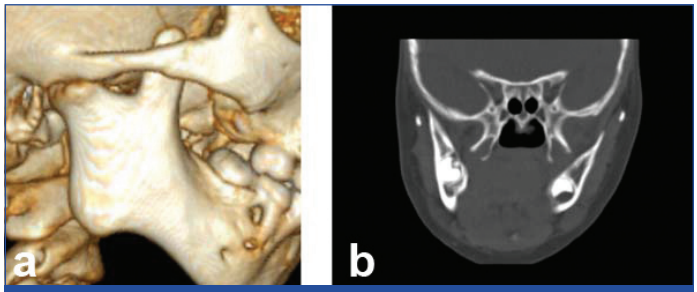
Using the above criteria, the severity of ankylosis was graded according to the presence or absence of: a) Coronoid hyperplasia; b) Extracapsular extension e.g., fusion of the cranial base with the ramus in the region of the sigmoid notch; c) The radiolucent zone at the junction of the cranium and the joint representing the residual joint space.

**Grade 1:** Ankylosis in Grade 1 joints was limited to the region of the joint and did not show extra-articular involvement or coronoid hyperplasia [Table/Fig-4a,b].



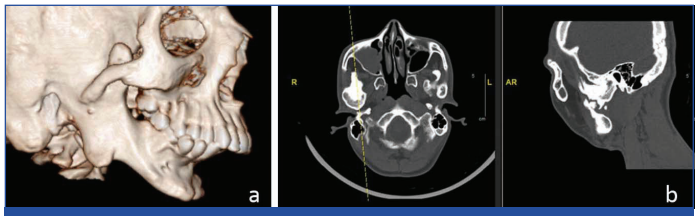

**[Table/Fig-3]:** (Red plus sign) Measurement of ankylosed joint seen in axial section.
**[Table/Fig-4]:** a) Grade 1 TMJ ankylosis shown at skull base b) Grade 1 ankylosis seen radiographically as radiolucent Fusion Line (FL). (Images from left to right)

**Grade 2:** Joints with Grade 2 (moderate) ankylosis had accompanying coronoid hyperplasia but absence of fusion of the ramus with the cranial base anterior to the eminence. The extent of coronoid hyperplasia was determined using the sagittal section view, lateral skull view using the 3D reconstruction and the use of coronal sections in the region of the bilateral coronoid region [Table/Fig-5a,b]. If the coronoid tip extended upto or beyond the superior edge of the zygomatic arch, it was considered hyperplastic.




**[Table/Fig-5]:** Grade 2 with ipsilateral hyperplastic coronoid a) Shown at skull base; b) Shown radiographically.

**Grade 3:** In the Grade 3 or the severe ankylosis group, the vertical ramus was found to be fused to the cranial base external to the original joint space in the region of the sigmoid notch, anterior to the articular eminence [Table/Fig-6a,b]. These kinds of joints even though have obliteration of sigmoid notch suggesting fusion external to the joint space, CT scan in the axial and coronal section still showed a radiolucent zone, however complete loss of the residual joint space (radiolucent zone) and bony fusion with the cranial base is more common finding in severe Grade 3 ankylotic group. There was also greater likelihood of fusion to anterior tympanic plate and the zygomatic arch in these cases.

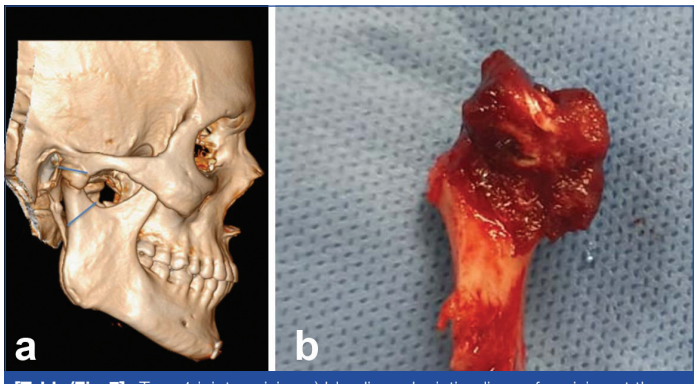



**[Table/Fig-6]:** a) Grade 3 with extra-articular fusion shown at skull base; b) Grade 3 with extra-articular fusion shown in two radiographic images.

## Surgical Protocol

The excision arthroplasty done for these joints was reviewed using the operation records from electronic archives. Based on the findings, 3 categories of bone excision could be differentiated.

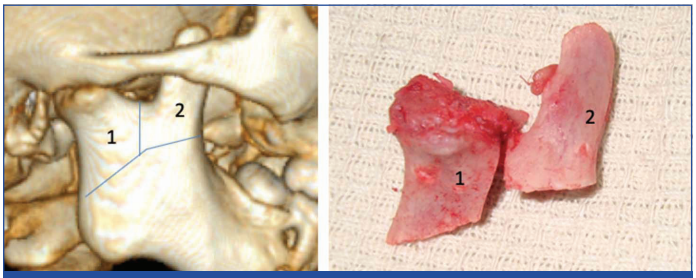
- Type 1 excision involved management of the TMJ region [Table/Fig-7].




**[Table/Fig-7]:** Type 1 joint excision a) blue lines depicting lines of excision at the skull base b) Excised joint specimen.

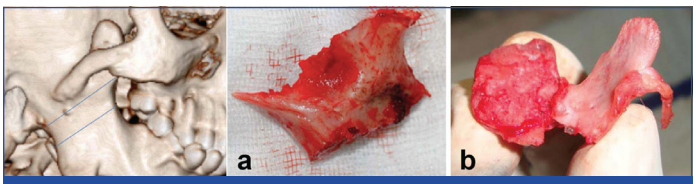
- Type 2 excision involved removal of the ipsilateral coronoid in addition to the condylar component. The incomplete zone of fusion or residual joint space could be negotiated and the deformed condylar head separated from the cranial base and

disarticulated by making a cut from the neck of the condyle to the sigmoid notch [Table/Fig-8].



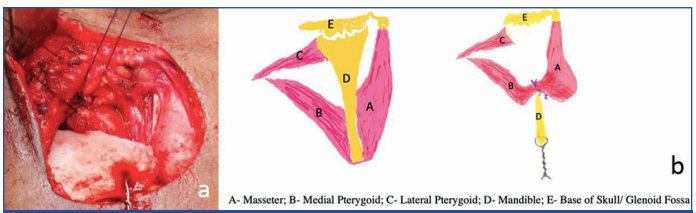

**[Table/Fig-8]:** Type 2 excision: 1) Joint complex; 2) elongated coronoid.

- Type 3 excision involved creation of a gap by resection of the superior ramus block. This was achieved by creating a cut through the thickness of the vertical ramus below the bulk of the fused ankylotic mass superiorly and a second parallel cut was made 1-1.5 cm below the first [Table/Fig-9]. The transverse thickness of the segment removed depended on the severity of the ankylosis and could measure upto 2.5 cm [Table/Fig-10]. A gap of 1-1.5 cm was created between the cranial base and the mandible and clearance was obtained in all three dimensions. Excision was deemed adequate only if the mouth opening was more than 2.5 cm in children and 3 cm in adults. Access to the joint was achieved through the use of Preauricular and submandibular incisions.



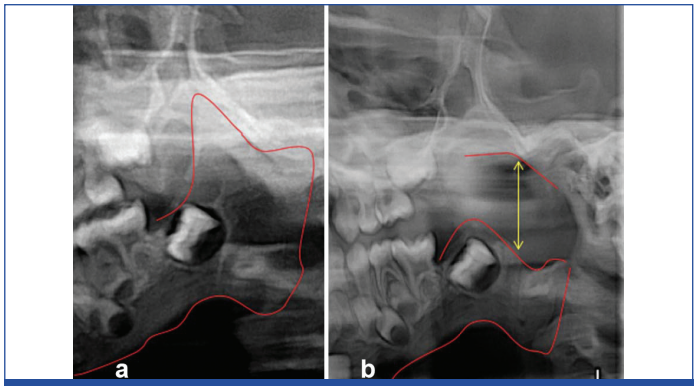

**[Table/Fig-9]:** Type 3 resection blue lines depicting the lines of resection.
**[Table/Fig-10]:** a) and b) Transverse full thickness of the ankylotic segment removed. (Images from left to right)

In Grade 1 cases, with removal of the condylar complex alone, the disc was repositioned when available otherwise no definitive muscle interposition was done. In all Type 2 and Type 3 excisions pterygo-masseteric interposition was done by mobilising the medial pterygoid muscle from the medial surface of the ramus and transferring it across the defect to be sutured to the masseter on the lateral aspect [Table/Fig-11a,b]. The interposition was facilitated by manually distracting the mandible downwards using traction wire passed through the bone above the lower border. In turn, this maneuver increased the gap of the arthroplasty to an average of 2.5 cm. The overcorrection produced a lateral and posterior open bite on the side of arthroplasty [Table/Fig-12a,b]. A bite block was fabricated postoperatively and cemented to the lower posterior teeth. After settling of the occlusion, the block was selectively reduced to allow eruption of the opposing arch dentition during the growth period in children [Table/Fig-13a-c]. Prosthetic joint replacement was done in adult patients with bilateral TMJ ankylosis [Table/Fig-14].

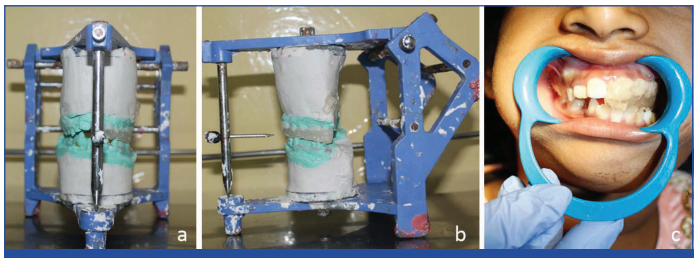



**[Table/Fig-11]:** a) Pterygo-masseteric transfer; b) Diagram of Pterygo-masseteric transfer.

Forced mouth opening exercises or aggressive painful physiotherapy after the surgery was not required since satisfactory mouth opening was obtained intraoperatively and the patients could open their mouths without difficulty in the postoperative period. They were encouraged to perform the mouth opening exercises several times a day. Patients were followed-up at yearly basis and assessment was done to identify any early sign of re-ankylosis of the joint. Reconstruction of the joints was delayed in children and planned as a secondary procedure after confirming persistent freedom in mouth opening and no recurrence of the ankylosis. Growth in children was monitored and documented.




**[Table/Fig-12]:** a) Preoperative compared with b) Postopertive Orthopantomogram (OPG) showing extent of gap and posterior open bite on the side of arthroplasty.




**[Table/Fig-13]:** a) Occlusal splint mounted on articulator; b) Occlusal splint mounted on articulator; c) Occlusal splint in position postsurgery.

**[Table/Fig-14]:** Bilateral TM Joint (TMJ) replacement.

## STATISTICAL ANALYSIS

The complete data was tabulated in Microsoft Excel sheet and frequency (n) analysis was done for all variables. The measurements of temporomandibular joint were calculated as average values.

## RESULTS

Out of 66 patients, age range 2.5-51 years, average age 18.2 years, (82 ankylotic joints) assessed 37 were males and 29 were females. A 52 of these patients had a history of childhood trauma (before the age of 13 years) and 14 of these had adult onset ankylosis. History of trauma was the most common aetiology of the ankylosis (62 cases) apart from 3 cases of joint infection and one patient with ankylosing spondylitis. There were 16 cases with bilateral TMJ ankylosis.

A 27% of the total joints surveyed belonged to Grade 1 type of ankylosis. None of these joints had complete bony fusion (absence of the radiolucent zone between the cranium and condyle) [Table/Fig-15a]. The transverse and Anteroposterior (AP) measurements were 36% and 54% larger than the normal condyle. Injury during adulthood was the common cause of ankylosis in this category. A 10% of the joints had moderate ankylosis (Grade 2). None of them revealed complete bony fusion (absence of the radiolucent zone) or fusion of the sigmoid with the cranial base. The transverse and AP

measurements were 47% and 78% larger than the normal condyle. [Table/Fig-15b]. All the cases of moderate ankylosis were seen in childhood onset ankylosis.

| Clinical characterstics of ankylosed joints | Grade 1 (n) | Grade 2 Moderate (n) | Grade 3 Advanced (n) | Total |
|---|---|---|---|---|
| Grade of joints | 22 | 8 | 52 | 82 |
| **Age of onset** | | | | |
| Adult | 18 | 0 | 4 | 22 |
| Childhood | 4 | 8 | 48 | 60 |
| **Coronoid hyperplasia** | 0 | 8 | 49 | 57 |
| **Bony fusion** | 0 | 0 | 25 | 25 |
| **Residual joint space** | 22 | 8 | 27 | 57 |
| **Cranial base thickening** | 4 | 7 | 42 | 53 |
| **Sigmoid ankylosis** | 0 | 0 | 49 | 49 |
| **Coronoid ankylosis** | 0 | 0 | 1 | 1 |
| **Tympanic plate ankylosis** | 0 | 0 | 14 | 14 |
| **Zygomatic arch fusion** | 0 | 0 | 2 | 2 |
| **Type of excision arthroplasty** | | | | |
| Type 1 arthroplasty | 18 | 0 | 0 | 18 |
| Type 2 arthroplasty | 4 | 8 | 22 | 34 |
| Type 3 arthroplasty | 0 | 0 | 30 | 30 |

**[Table/Fig-15a]:** Ankylosed joints- Grading and characteristics (n: number of joints in each category).

| TMJ | Grade 1 (mm) | Grade 2 (mm) | Grade 3 (mm) | Average overall (mm) | Normal condyle (mm) |
|---|---|---|---|---|---|
| Transverse | 20.3 | 22 | 24.2 | 22.8 | 14.9 |
| AP | 17.1 | 19.8 | 23.2 | 21.8 | 11.1 |

**[Table/Fig-15b]:** Transverse and Anteroposterior Measurements of the TM Joints (TMJ).

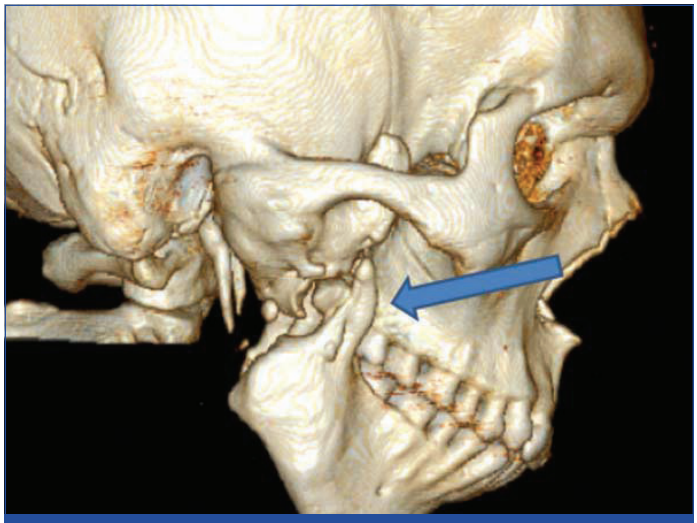
Grade 3 ankylosis was the most widely seen pattern of ankylosis (63% of total joints of present study) and 92% had a history of childhood onset. A 90% of the joints in this group had ipsilateral coronoid hyperplasia. A 48% of the joints with severe ankylosis (Grade 3) showed bony fusion with the cranial base, with loss or absence of the radiolucent zone (FL) between the cranial base and the condyle. The ankylosed mass in this group was on an average 62% larger than the average normal condyle in the transverse dimension and 96% larger in the AP dimension. A 48 (92%) of the 52 joints in this category were consequent to childhood trauma. Two of the adult's joints in this category were in a case of ankylosing spondylitis and were not secondary to trauma.

The method of arthroplasty used in this study when reviewed, revealed that 18 out of 22 cases of Grade 1 ankylosis required surgery of the TMJ complex alone without coronoidectomy (Type 1 surgery). Four cases of adult ankylosis in this category required resection of the coronoid in addition to condyle (Type 2 excision) due to restriction of mouth opening following removal of the TMJ complex. All eight of the Grade 2 joints required excision of the primary joint complex along with removal of the coronoid (Type 2 excision).

Grade 3 joints required Type 2 or Type 3 excision depending on the mobilisation of the ankylotic mass with respect to the cranial base. Of the 52 Grade 3 joints, 30 required Type 3 resection and 22 required Type 2 excision [Table/Fig-15a]. All the cases which had bony fusion with the cranial base (loss of radiolucent zone in CT axial/coronal cuts) required Type 3 arthroplasty.

Sixteen patients required bilateral joint ankylosis surgery and four cases of unilateral ankylosis underwent excision of the opposite side coronoid. Prosthetic joint replacement was done in seven adult patients with bilateral TMJ ankylosis.

Postoperative haematoma required re-exploration and evacuation in one case. Six cases had mild facial weakness which had resolved within three months. None of the patients expressed dissatisfaction with the appearance of the incision scars. By the end of one year, three patients (4 joints) showed reduced mouth opening and evidence of re-ankylosis. These recurrences were seen in Grade 3 type of ankylosis alone. Re-ankylosis began in the region of the amputated coronoid stump in all the cases [Table/Fig-16]. Six patients with bilateral moderate to severe ankylosis developed anterior open bite postoperatively [Table/Fig-17].



**[Table/Fig-16]:** Blue arrow: Ossification of the temporalis tendon responsible for the initiation of the process of bony recurrence.

| Complication | Number of cases |
|---|---|
| Mild to moderate temporary facial weakness immediately following surgery (resolved in within three months) | Six cases |
| Immediate postoperative haematoma requiring exploration | One case |
| Re-ankylosis or evidence of reduction in mouth opening | Three cases out of 52 cases of Grade 3 ankylosis |
| Anterior open bite (seen in bilateral ankylosis release) | Six out of 16 cases of bilateral ankylosis |

**[Table/Fig-17]:** Postoperative immediate and late complications.

## DISCUSSION

Morphological studies of the ankylosed TMJ have been conducted in the past and these have been the basis of planning surgery for release of the fused skeletal structures. Sawhney CP in 1986, proposed a classification of the ankylosed joint skeletal structures using plain X-rays and correlated his radiological interpretation with the operative findings [3]. He D et al., studied the coronal scans of ankylosed joints and proposed a classification similar to that of Sawhney CP [3,4], and highlighted the relation of the medially displaced condylar segment to the intracapsular ankylosis. El-Hakim IE and Metwalli SA in their study of 33 cases found that CT images are a vast improvement over plain X-rays and recommended the use of coronal and axial scans for the preoperative planning of TMJ surgery [5].

Xia L et al., studied the significance of a radiolucent plane within the joint between the condylar and cranial articular surfaces in CT sections and found that its presence or absence correlated to the clinical maximal inter-incisal mouth opening and developed a classification using this finding to modify the existent classifications based on Sawhney CP study [1,3]. In the new proposal, Type 4 ankylosis referred to those cases which had complete bony ankylosis with disappearance of the radiolucent line. Their surgical findings corroborated the radiological findings and the interpretation of increased difficulty during surgery was confirmed. This zone has also been called the residual joint space or FL and its existence has been proven histologically as a junction of osseous and fibro-cartilagenous tissue in which bone can continue to grow

by endochondral ossification [6]. The current classifications have enabled surgical decision making in the transverse (coronal) and vertical plane. However, the decision to include the coronoid and the vertical ramus in the arthroplasty should also be determined prior to surgery. This can be done by investigating the ankylosis in the sagittal plane.

In the present study, the extent of the ankylosis in the anteroposterior dimension has been studied in addition to transverse and vertical dimensions. CT visualisation of the sagittal plane has been recommended for various joint conditions but its role in the study of the anteroposterior extent of TMJ ankylosis has not been adequately emphasised [7]. A 3D CT reconstruction is a valuable adjunct to the two dimensional (2D) images obtained in different planes using conventional CT and helps the surgeon judge the nature and extent of the skeletal pathology and plan surgery more effectively. This is especially relevant in craniofacial surgery [8,9]. Use of the DICOM modality on the workstation makes the archived CT images available for further study by the individual surgeon who can rotate and view the reconstructed skull from different angles. The present retrospective study of ankylosed TMJ availed this facility.

The displacement of the traumatised condylar segment anteriorly may explain the fusion of the sigmoid notch region of the mandible with the base of skull. This is clearly visualised in the sagittal sections which also reveal the extent of the coronoid enlargement. Elongation of the coronoid is also evident in the 3D reconstruction of the cranium when seen from the lateral aspect. This view enables the observation of the external auditory meatus and the presence or absence of fusion of the ankylotic mass with the anterior tympanic plate [10]. Grade 1 and grade 2 ankylosis do not show extra-articular extension. Teremek AT used absence of involvement of the sigmoid notch as the selection criteria for his study of 15 cases of TMJ ankylosis [11]. Coronoid hyperplasia on the side of the ankylosis was the most common feature of the childhood onset ankylosis and was not seen in the adult onset joints. Overgrowth of the coronoid is consequent to the ongoing development of the paediatric mandible and the unbalanced pull of the Temporalis muscle. Resection of the coronoid is required in cases with hyperplastic coronoids. A 25% of the joints did not require coronoid excision and primary joint surgery alone was adequate for these cases. Kaban LB et al., has recommended aggressive management of TMJ ankylosis including ipsilateral coronoid excision for all cases and contralateral coronoid excision when necessary [12]. Contralateral coronoid hyperplasia can also be determined using the same CT views. Need for resection of the contralateral coronoid can be determined preoperatively and confirmed during the surgery if the mouth opening following excision of the ankylosed joint does not exceed 3 cm intraoperatively [13]. Type 3 excision was required for most of the joints with severe (Grade 3) ankylosis and for all cases which showed complete fusion and had lost the residual joint space.

Surgery for TMJ ankylosis needs to be tailor-made according to the extent and severity of the bone fusion causing restriction of mouth opening. Three-dimensional extent of surgery needs to be carefully estimated prior to surgery to avoid errors in execution. Aggressive removal of the ankylotic bone including the medial aspect of the ankylosis is essential for success [12]. The three types or levels of excision are customised to deal with the specific needs of each case according to the bone morphological pattern of each ankylosed joint.

Access to the entire ankylosed bone skeleton is essential and this is provided by the dual approach using the preauricular and submandibular incisions. The submandibular approach provides passage to both the inferior and anterior extent of the ankylosis, including the coronoid, without risking damage to the facial nerve through stretching the preauricular incision downwards. The approach enables downward traction on the mandible to increase the gap and also allows the medial pterygoid muscle to be mobilised. Use of the medial pterygoid as an interpositional muscle flap is advantageous because it is locally available and can be stretched across the exposed cut bony edge of the residual ramus. Since, it is sutured laterally to the masseter, it may partly mimic the activity of the disc [Table/Fig-11]. The submandibular incision also enables anchoring of the joint prosthesis to the residual ramus. The aesthetics of the scar was also acceptable to all of the patients treated. Anterior open bite is a frequent complication of surgery for bilateral TMJ cases and was seen in six of the 16 bilateral cases. This is again because of the unbalanced pull of the retractor muscles on the mandible and the shortening of the mandible which may also explain the greater tendency for bilateral TMJ ankylosis cases to recur.

Recurrence of ankylosis is a postoperative complication which needs to be avoided as far as technically possible [2] and this requires a policy of "Get it right first time". Adequate planning and choice of excision based on the pattern of bone fusion will reduce the incidence of recurrence [12]. However, the few cases of recurrence (3 out of 66 patients) seen in the present study subjects, indicates that despite radical excision and muscle interposition, recurrence can occur in severe TMJ ankylosis. Reattachment and ossification of the temporalis tendon, which retracts the mandible upwards and backwards, may be the initiator of the process of bony recurrence as noticed in the review CT scans [Table/Fig-17].

Prosthetic joint replacement combined with proportional jaw lengthening may provide a solution for bilateral and recurrent Grade 3 ankylosis in adults [14]. This is obtained by maintaining the gap across the length of the arthroplasty and correcting the muscular imbalance caused by unopposed backward and upward pull of the retractor muscles of the mandible to prevent the shortening of the ramus. This was successfully obtained in all ten of present study patients (seven bilateral and three unilateral) treated with alloplastic joint prosthesis [Table/Fig-13]. Ramus lengthening would also help to address the issues of obstructive sleep apnoea and skeletal deformity correction needed in these patients [15].

Various authors have opined that release of the ankylosis and restoration of mouth opening was the first priority in children since function and the muscular envelope could correct the loss of the growth centre as postulated by Moss ML and Salentijn L [2,10,11,16]. The protocol followed in present study centre is similar and we advocate delay in definitive reconstruction and facial deformity correction after ensuring persistent and adequate mouth opening, in children. In the interim, myofunctional appliances like the bite block used in the present study subjects would help direct the growth.

### Limitation(s)

The number of joints studied (n=82) in this study centre may not be representative of the global population of all patients with TMJ ankylosis. This could be addressed by having a multicentre evaluation of the 3D morphology of the ankylosed TMJ to classify complexity and estimate prevalence of each grade of disease.

## CONCLUSION(S)

Pathological anatomy of the ankylosed craniofacial skeleton can be classified according to the grades of severity depending on the extent of bony fusion and coronoid involvement. A 3D imaging of the joint, especially in the sagittal plane, is a reliable guide for planning the extent of gap arthroplasty. Grade 3 ankylosis requires radical excision of bone in three dimensions (Type 3 excision). The submandibular incision affords good access for adequate bone resection and for use of the medial pterygoid muscle as an interpositional flap. Prosthetic joint reconstruction is required in adults with bilateral TMJ ankylosis. Since the approach and extent of surgery of the ankylosed joint is determined by the extent of involvement of the ankylosis in all dimensions, careful preoperative planning and study of the 3D CT scans is mandated.

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