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CLINICAL PAPER

The Nuances of Temporomandibular Joint Ankylosis Surgery: Tips and Tricks

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Abstract
Introduction A plethora of surgical options have been described in the literature for the management of temporomandibular joint (TMJ) ankylosis, but one cannot subscribe to a modality that is infallible in regard to recurrence. The incidence of recurrence is attributed to poor surgical technique and poor patient compliance. This article proposes incorporation of subtle modifications into the surgical techniques that could prove to be helpful in the management and prevention of reankylosis.
Materials and Methods Twenty-one patients with TMJ ankylosis with an age range of 10–29 years (mean age 19 years) were operated, of whom six (28.5%) were bilateral and 15 unilateral (71.5%), and 14 (66.6%) had a history of previous surgery for ankylosis. The preoperative and intraoperative mean inter-incisal opening (MIO) was 4.4 mm and 43.2 mm, respectively. All patients fared well at the late postoperative evaluation at 24 months with a mean MIO of 36.9 mm.
Conclusion The subtle modifications address various aspects such as the adequacy of the preauricular approach, the use of a wide flame-shaped bur, the obliquity of the arthroplastic osteotomy, burnishing the residual ramal stump devoid of irrigation, temporalis muscle release and coronoidectomy, aggressive intermittent intraoperative jaw physiotherapy, mandatory use of a vacuum drain and rigorous postoperative jaw physiotherapy.

Keywords TMJ ankylosis · Gap arthroplasty · Lock jaw · Trismus · Craniomandibular ankylosis · TMJ ankylosis deformity

Introduction

Temporomandibular joint (TMJ) ankylosis is a common malady of the Indian subcontinent that frequently affects children and young adults [1, 2]. The literature is replete with data on various surgical modalities of management available that have been tried and tested over the last couple of decades [3–8]. However, recurrence has always been a daunting issue and one cannot subscribe to any single modality that has proved to be a reliable method that would prevent reankylosis [9–12], although the Kaban's protocol has been a useful directive in its management [13]. Salins has added a newer perspective to the management and prevention of recurrence especially in cases with recurrent ankylosis [14]. However, patient compliance has always been an arduous issue with younger patients, and hence, the incidence of recurrence is not uncommon [15–17]. Here, we present some new concepts that would obviate the need for adhering to stringent post-operative protocols in non-compliant subjects.

This paper illustrates the extrapolation of various newer concepts and techniques employed in 21 patients managed successfully.

Materials and Methods

Surgical Technique

A standard preauricular incision is made that extends a centimetre above the attachment of the helix down to the

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lower end of the lobule. The dissection is carried out through the avascular plane anterior to the tragus to approach the root of the zygomatic arch. Having identified the temporalis fascia at the superior end of the incision via blunt scissor dissection, a 'T' incision is made with a radiofrequency probe or a surgical diathermy on to the tenuous periosteal attachment of the arch and continued superiorly with the temporalis fascia and inferiorly with the periosteum overlying the ankylotic mass and the posterior border of the mandible. The sub-periosteal dissection is carried out in the anterior direction along the arch and the lateral aspect of the mandibular ramus all the way to the anterior border, thus exposing a part of the arch and the ankylosed joint including the anterior and posterior borders of the ramus. Now, two 10-mm malleable retractors are introduced at the anterior and posterior limits of the ramus to enhance the exposure of the entire lateral aspect of the ramus including the coronoid process (Fig. 1). The ankylotic mass is now resected using a surgical drill with a flame-shaped bur of 6–8 mm width. The bony cut is made from the depth of the sigmoid notch at a 30° angulation to the posterior border of the ramus in type I and II ankylosis [18] (Fig. 2). In types III and IV, the bony cut is made horizontally from the anterior border at the anticipated depth of the sigmoid notch from where it descends backward and downward towards the posterior border at an angle of 30° (Fig. 3). In both the situations, the cut is made just short of the medial cortex of the ramus and further release of the ankylosis is facilitated using prising forces of

Fig. 1 Adequate exposure of the ankylotic mass via the preauricular incision with 10-mm malleable retractors in place

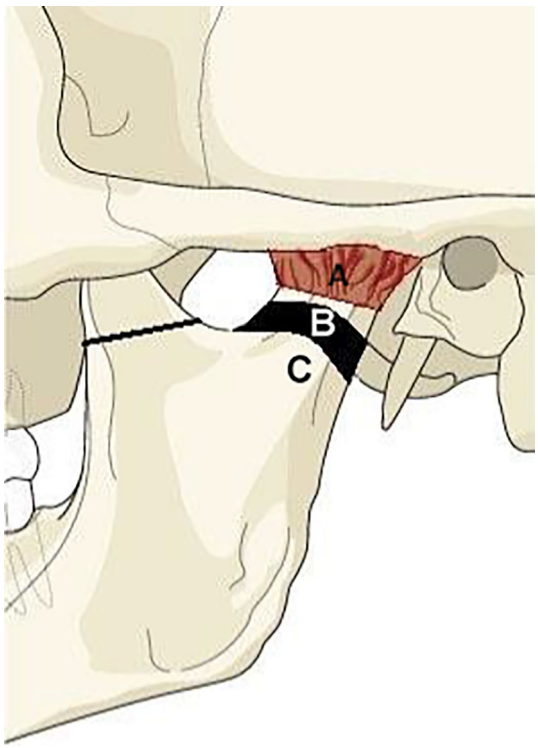

Fig. 2 Diagram depicting the coronoidectomy and the design of the arthroplasty in type I and II ankylosis. **a** Fibrous ankylosis, **b** arthroplastic design, **c** design of the recontoured ramal stump

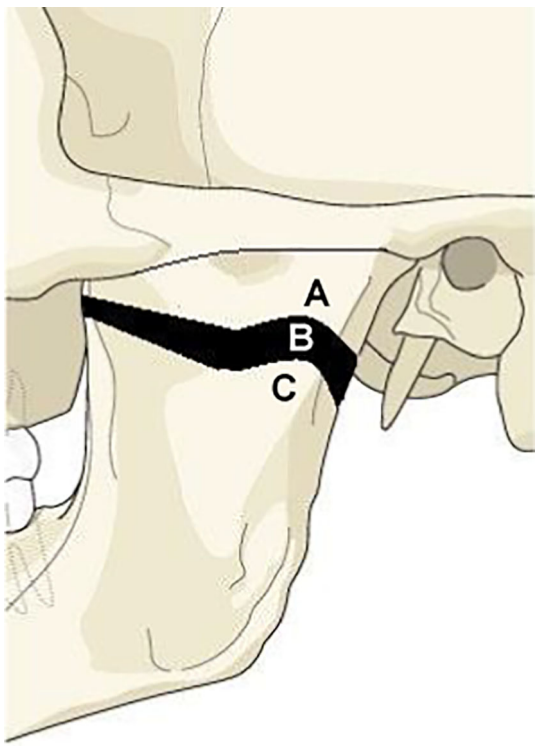

Fig. 3 Diagram depicting the en bloc resection and the design of the arthroplasty in type III and IV ankylosis. **a** Bony Ankylosis, **b** arthroplastic design, **c** design of the recontoured ramal stump

an osteotome. The ankylotic mass is now released from the cranial end using either osteotomes or a surgical drill. On the contrary, the ankylotic mass may be very well left in place [14] and a new glenoid fossa like cavity may be created where the meniscus is completely absent as in type III and IV ankylosis. In types I and II where a residual meniscus is present, it may be prudent to leave the meniscus in place that could act as a natural interposition. Following the excision, the condylar stump of the ramus as well as the newly created glenoid cavity is burnished well using a diamond fraise devoid of irrigation to produce a smooth contour (Fig. 4). The coronoid is excised as an isolated bony segment in types I and II and as a composite mass in types III and IV. The mouth is now forced open using a mouth gag (Molt's or Heister's) until a minimal inter-incisal mouth opening of 35 mm is achieved. Following this, rigorous and intermittent intraoperative jaw physiotherapy is carried out by grasping the chin mimicking translational and lateral excursive movements of the jaw over a period of 15–20 min. The wound is now closed in layers following good haemostasis and a mini-vacuum drain in place.

Method

Twenty-one patients with TMJ ankylosis managed using the techniques mentioned above were evaluated over a period of 24 months post-operatively. Of the twenty-one patients, fourteen had a history of one or more previous surgical interventions and recurrent ankylosis. Besides the routine preoperative investigations, data pertaining to TMJ ankylosis such as the cause and duration of ankylosis and details of previous surgery were recorded. Clinical examination aided by conventional radiographs and CT scans determined the nature, type, extent and the number of joints involved. The extent of mouth opening and the presence or absence of deviation of the jaw on opening were documented. The extent of the ankylosis and the degree of coronoid hyperplasia were also assessed.

All patients were operated under general anaesthesia using a fibre optic intubation technique employing the surgical methodology mentioned earlier. Active jaw physiotherapy commenced on the 3rd post-operative day. Patients were reviewed on a regular basis over a period of 2 years, and an effortless normal range of mouth opening of 30 mm and above at the end of 2 years was considered to be a successful outcome.

Fig. 4 Burnished and smoothened surfaces of the newly created glenoid cavity and the condylar stump of the ramus

Results

The surgical outcomes of the 21 patients managed with the proposed surgical protocol are listed in Table 1. Significant improvement in mouth opening was observed in all the patients with stable results at the end of 2 years (MIO 36.9 mm), except in one male patient aged 10 years where a costochondral graft was used showed recurrence of ankylosis within the first 12 months. However, the rest demonstrated reasonably acceptable protrusive and lateral excursions. Also, the fourteen patients with a previous history of surgery and recurrent ankylosis showed similar results without evidence of reankylosis at 24 months.

Discussion

TMJ gap arthroplasty has been a successful modality of treatment for ankylosis for the past couple of decades [19]. However, recurrent ankylosis has always been a persistent problem particularly in the young due to patient compliance with jaw physiotherapy [16]. The factors that are attributed towards treatment failure are improper surgical technique, inadequate resection and patient compliance.

In our study, significant improvement in mouth opening was observed in all our patients with stable results at the end of 2 years, except in one male patient aged 10 years where a costochondral graft was used showed recurrence of ankylosis within the first 12 months. This may be attributed to the younger age with a higher osteogenic potential, the use of a costochondral graft, inadequate jaw mobilization and an overall lack of patient compliance. However, the rest demonstrated reasonably good mouth opening with acceptable protrusive and lateral excursive movements. We hereby discuss various techniques that can be employed to

Table 1 Summary of patient data = post-operative assessment

No	Age/Sex	Joints involved	No. of previous surgeries	Pre-op MIO* (mm)	Post-op MIO* (mm)	MIO* (mm) 24 months
1.	17/M	Unilateral (Lt)	1	8	44	34
2.	13/F	Unilateral (Lt)	0	2	42	36
3.	12/M	Unilateral (Rt)	1	4	34	30
4.	24/M	Unilateral (Rt)	2	6	42	36
5.	29/M	Bilateral	1	0	45	35
6.	19/M	Unilateral (Rt)	0	5	47	40
7.	24/M	Unilateral (Lt)	1	9	48	42
8.	10/M	Unilateral (Lt)	0	6	35	10
9.	26/M	Bilateral	5	0	40	34
10.	15/M	Unilateral (Rt)	1	7	47	42
11.	16/M	Unilateral (Lt)	1	9	49	44
12.	18/M	Unilateral (Rt)	1	5	48	40
13.	22/M	Unilateral (Rt)	2	7	42	32
14.	27/M	Bilateral	3	2	39	33
15.	18/M	Unilateral (Lt)	2	11	44	39
16.	25/M	Bilateral	3	2	43	32
17.	14/M	Unilateral (Rt)	1	6	46	42
18.	11/F	Unilateral (Rt)	0	5	40	32
19.	13/M	Unilateral (Rt)	0	0	42	37
20.	23/M	Bilateral	0	0	45	38
21.	25/M	Bilateral	0	0	47	36

MIO maximum incisal opening

facilitate and ease the surgical procedure to help circumvent the possibilities of reankylosis. All 21 cases were operated using the various tips and tricks mentioned below which are subtle modifications in the operative technique of a gap arthroplasty.

i. The preauricular incision has been misconstrued to be of limited access to the joint particularly in its access to TM joint ankylosis surgery and hence the genesis of various modifications. In our opinion, the preauricular approach is sufficient to gain adequate visibility and access from the posterior to the anterior limits of the ankylotic mass. It is the ingenious use of two malleable retractors at the anterior and posterior limits of the ramus that facilitates the exposure of the entire bony concrescence including the coronoid process much beyond the normal confines of conventional retractors.
ii. The use of conventional surgical drills and saws could inevitably lead to unintended damage to vital structures on the medial aspect of the ramus due to inadvertent sinking of the drills and saws. The use of a wide flame-shaped bur (6–8 mm) creates a wedge-shaped trench in the bone, thus providing adequate visualization at the cutting front of the bone towards the medial limits of the ankylotic mass and the ramus. The flame-shaped bur by virtue of its shape, creating a wedge-shaped bony trench, does not allow accidental sinking of the bur into the medial soft tissues, thus preventing inadvertent damage to the vital structures, namely the maxillary artery or the inferior alveolar neurovascular bundle.
iii. As per previous protocols, it has always been an accepted norm that it is essentially a gap of 1 cm that is imperative in the prevention of reankylosis [20]. Although a reasonable gap is mandatory, we are of the opinion that it is the obliquity of the arthroplastic osteotomy by an angulation of 30° towards the posterior border that is vital for an effective gap arthroplasty. It is this design in the arthroplasty that facilitates greater translation of the surgically created pseudo-arthrosis on to the articular eminence.
iv. The Kaban's protocol suggests interposition gap arthroplasty as a vital measure in the prevention of recurrence [13]. However, it is our belief that burnishing of the residual ramal stump as well as the newly created glenoid cavity with a diamond fraise devoid of irrigation produces significant osseous thermal damage resulting in the death of osteoblasts and osteoclasts, thus reducing the osteogenic potential at the two bony interfaces. Besides, apposition of two smooth surfaces makes union quite unlikely.

v. The temporalis muscle is a powerful adductor of the mandible, and any muscular spasm of the temporalis leads to significant restriction in the mouth opening. Resecting the coronoid processes bilaterally releases the temporalis muscles, thus facilitating the mouth opening further. The ipsilateral coronoid is always excised as a rule in unilateral ankylosis, and a contralateral coronoidectomy should always be done in situations where the mouth opening of more than 35 mm cannot be accomplished [13]. However, bilateral removal of the coronoids in bilateral ankylosis is mandatory.

vi. In long-standing ankylosis, the lack of jaw mobility over a prolonged period could render the abductors of the mandible relatively weaker due to the prolonged phase of disuse. In addition, the periarticular fibrosis and the tenuous periosteal sleeve around the ankylotic mass in continuity with the cranial base and the rest of the mandible further restrict the mobility of the jaw even following the release. Hence, intermittent aggressive intraoperative jaw physiotherapy following the arthroplasty over a prolonged period stretches and shears the tenuous periosteal sleeve, thus releasing the fibrous adhesions in and around the joint. In addition, the entire adductor and the abductor group of muscles (the pterygomasseteric sling, the lateral pterygoids and the infra-mandibular group of muscles) that have gone into disuse over the prolonged phase of ankylosis are also stretched and stimulated.

vii. The huge void created as a consequence of the gap arthroplasty could act as a dead space for the accumulation of a haematoma increasing the possibilities of early consolidation, scarring, fibrosis and consequent reankylosis. The use of a vacuum drain aids significantly in the prevention of a haematoma in the dead space created by the gap arthroplasty. Also, avoidance of a haematoma minimizes the degree of pain and oedema, thus allowing commencement of jaw physiotherapy as early as the 3rd post-operative day.

Inferences

Hence, the proposed protocol mandates the following.

a. *A preauricular approach* provides adequate visibility and access to the ankylotic mass.
b. *The use of a wide flame-shaped bur* (6–8 mm) avoids accidently sinking of the bur into the medial soft tissues, thus preventing inadvertent damage to the vital structures.
c. *The obliquity of the arthroplastic osteotomy at a* 30° *angulation* is vital for an effective gap arthroplasty that also facilitates greater translation.
d. *Smoothening* and *burnishing of the residual ramal stump and the neo-glenoid fossa devoid of irrigation* produce significant thermal damage at the bony interfaces reducing the osteogenic potential at the ankylotic front.
e. *Release of the temporalis muscle and excision of the coronoid process* enhance and facilitate greater mobility of the jaw.
f. *Aggressive intermittent intraoperative jaw physiotherapy* stretches and shears the tenuous circum-ankylotic periosteal sleeve.
g. *The use of a vacuum drain* helps in the prevention of a haematoma and consequent reankylosis.
h. *Rigorous post-operative jaw physiotherapy* in view of the modifications suggested above rigorous post-operative jaw physiotherapy may not be of great significance in the non-compliant patient although some degree of active jaw exercises maybe beneficial.

Apart from the conventional protocols of management that are believed to avoid recurrence, we firmly believe that incorporation of subtle modifications as described with our surgical technique will further minimize the risk of reankylosis.

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Compliance with Ethical Standards

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

Informed Consent Informed consent was obtained from all individual participants included in the study.

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