Systematic Review

Controversies in the Management of Temporomandibular Joint Ankylosis Using Distraction Osteogenesis - A Systematic Review

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Abstract

Background: The three commonly employed sequences of distraction osteogenesis (DO) in the management of temporomandibular joint (TMJ) ankylosis with dentofacial deformities include post-arthroplastic distraction osteogenesis (PAD), simultaneous arthroplastic distraction osteogenesis (SAD), and pre-arthroplastic distraction osteogenesis (PrAD). **Objective:** The aim of this systematic review is to compare the effectiveness of various sequences of DO in the management of TMJ ankylosis with micrognathia/and obstructive sleep apnea syndrome (OSAS). **Data Sources:** A comprehensive online and manual search of English language literature with no date restrictions was done on March 2020. **Eligibility Criteria:** Inclusion criteria were case series and prospective and retrospective studies involving adult/paediatric human subjects with unilateral/bilateral TMJ ankylosis and micrognathia/OSAS treated with DO. **Study Appraisal and Synthesis Methods:** Of 73 studies identified, only 10 were included in the qualitative synthesis. The outcomes assessed were as follows: maximum mouth opening (MMO), posterior airway space (PAS), polysomnography variables, reankylosis, mandibular length, and chin and mandible position. **Results:** All the included studies showed high risk of bias. MMO and mandibular length increased, chin and mandibular position improved by the end of treatment in all the three sequences, and polysomnography variables and PAS significantly improved in PrAD compared to PAD and improved in SAD compared to baseline. Reankylosis was significantly less in PrAD. **Conclusion:** More well-designed studies comparing the three sequences of DO should be carried out to arrive at a consensus.

Keywords: Ankylosis, arthroplasty, congenital abnormalities, distraction osteogenesis, temporomandibular joint

Introduction

Temporomandibular joint (TMJ) ankylosis is the bony or fibrotic union of mandibular condyle to the articular/glenoid fossa. It may occur as a unilaterally or bilaterally compromising form, function, and psychology of the patient. In all cases, it causes restricted mouth opening and in a paediatric population, it poses additional risks of debilitating the growth of the mandible, thereby leaving the jaw micrognathic and in a retruded position, producing an overall unaesthetic facial appearance. In addition, in severe cases, it displaces the tongue posteriorly and reduces the dimension of the oropharyngeal airway, eventually leading to upper airway obstruction and obstructive sleep apnoea syndrome (OSAS). Hence, growing children often present a triad of symptoms, as follows: TMJ ankylosis, micrognathia/dentofacial deformity, and OSAS.[1,2]

As proposed by Andrade *et al*., the primary goal of treating paediatric TMJ ankylosis is:[1]

- To release ankylosis and increase mouth opening
- Correct dentofacial deformities such as micrognathia and retrognathia
- Treat any associated OSAS
- Prevent reankylosis.

While the release of ankylosis necessitates removal of ankylotic mass followed by gap/interpositional arthroplasty or total joint replacement if feasible, the correction of dentofacial deformity can be achieved by the following ways:[3]

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1. Orthognathic surgery
2. Costochondral graft (in the case of growing patient only)
3. Distraction osteogenesis (DO).

If a surgeon's treatment plan includes DO for the correction of dentofacial deformity associated with TMJ ankylosis, one among the following sequence of treatments should be opted [Table 1]:[4]

1. Prearthroplastic distraction osteogenesis
2. Postarthroplastic distraction osteogenesis
3. Simultaneous arthroplasty and distraction osteogenesis.

The aim of this systematic review was to analyze the existing literature to compare the effectiveness of various sequences of DO in the management of TMJ ankylosis with micrognathia and OSAS. The following was the structured question for this review: is there any difference in the outcomes between various sequences of DO? The primary outcomes considered were maximum mouth opening (MMO), posterior airway space (PAS), and reankylosis. Secondary outcomes considered were anteroposterior position of mandible, chin position, mandibular length, and polysomnography variables.

Methodology

This study was registered in PROSPERO under the registration number CRD42021239524.

Inclusion criteria

Studies including patients of any age and gender with unilateral or bilateral TMJ ankylosis with micrognathia and OSAS were included in this systematic review. Criteria for considering studies for the quality assessment were as follows: randomized controlled trials, clinical trials, retrospective studies, prospective studies, and case series of at least five cases.

Search strategy

Databases of PubMed Advanced Search, Cochrane Database of Systematic Review, and Google Scholar were searched. Two independent reviewers searched for the following keywords: "temporomandibular joint ankylosis," "distraction osteogenesis," "prearthroplastic distraction osteogenesis," "simultaneous arthroplastic distraction osteogenesis," "postarthroplastic distraction osteogenesis," "mouth opening," "pain," "reankylosis," "chin position," and "SNB angle." Hand search was done in the *British Journal of Oral and Maxillofacial Surgery*, *International Journal of Oral and Maxillofacial Surgery*, *Journal of Oral and Maxillofacial Surgery*, *Journal of Cranio Maxillofacial Surgery,* and *Quintessence International Journal*. Reference list of the identified randomized trials was also checked for possible additional studies.

Quality assessment

Quality assessment was done using Higgins and Green's *Cochrane Reviewer's Handbook*, 2009. The four main quality criteria examined were randomization, allocation concealment, blinding, and completeness to follow-up. Each criterion was assessed with YES, NO, or UNCLEAR. The study was assessed to have a "high risk" of bias if it did not record a "yes" in three or more of the four main categories, "moderate risk "if two out of four categories did not record a "yes," and "low risk" if all the four categories recorded a "yes". In the case of nonrandomized and clinical trials without a control group, it is recorded as not applicable.

Table 1: Sequences of distraction osteogenesis in temporomandibular joint ankylosis

	Stage 1 surgery	Stage 2 surgery
PAD	Ankylosis correction	Dentofacial deformity correction
SAD	Ankylosis + dentofacial deformity correction	
PrAD	Dentofacial deformity correction	Ankylosis correction

DO: Distraction osteogenesis, PAD: Postarthroplastic DO, SAD: Simultaneous arthroplastic DO, PrAD: Prearthroplastic DO

Results

The study selection process was done according to the PRISMA GUIDELINE. From a total of 72 identified research articles, only 10 articles were included for quality assessment after screening and exclusion. The details of the selection process is elaborated in Flow Chart 1. The characteristics of the studies included are given in Table 2. Of the ten included studies, one was a case series, seven were prospective studies, one was a retrospective study, and one was a randomized clinical trial. The follow-up periods in these studies varied from 6 months to 12 years. The quality assessment of all the included studies showed high risk of bias in all the studies [Table 3]. The total sample size in all the studies was 150. Four studies included paediatric population and six studies included both paediatric and adult population. Prearthroplastic DO alone or in combination was evaluated in three studies, postarthroplastic DO alone or in combination was evaluated in three studies, and simultaneous arthroplastic DO alone or in combination was evaluated in five studies. Of the primary outcome, MIO was measured in all studies, polysomnography variables were assessed in five studies, PAS was measured in three studies, and reankylosis was assessed in eight studies.

Maximum mouth opening

All the included studies measured maximum interincisal opening (MIO). The studies showed a significant increase in MIO after ankylosis release. Hence, in PrAD, though mouth opening increases after Stage I, MIO shows a drastic increase only after Stage II ankylosis release. This, however, does not significantly impact the function [Table 4].

Posterior airway space

PAS was measured only in three studies, of which two involved PrAD and one involved SAD. All the three studies showed a significant increase in PAS after DO [Table 4].

Reankylosis

Reankylosis was reported in eight studies, of which two involved PAD, one involved PrAD, three involved SAD, one

Table 2: Characteristic of the included studies

Author	Study design	Duration of follow up	Sample size	Age	Technique used
Andrade *et al*., 2009	Case series	1 year	*n*=5	6-25 years with TMJ ankylosis and OSAS	PrAD
Andrade *et al*., 2012	Prospective study	5 years	*n*=15	6-18 years patients with TMJ ankylosis and OSAS	PrAD versus PAD
Andrade *et al*., 2018	Prospective study	1 year	*n*=25; Adult group-11, Paediatric group-14	6-27 year old patients with TMJ ankylosis and OSAS divided into two groups: paediatric (<18 years) and adult (>18 years) groups	PrAD
Chellappa *et al*., 2015	Prospective randomized experimental study	6 months	*n*=20 with 10 in each group	5-25 years	PrAD and SAD
Feiyun *et al*., 2010	Prospective study	29 months	*n*=16	18-43 year old patients with bilateral TMJ ankylosis and mandibular retrognathia	SAD
Hassan *et al*., 2019	Retrospective study	7-12-year follow-up	*n*=20	Mean age - 20.5 years	PAD
Ma *et al*., 2018	Prospective study	16-45 months	*n*=17	7-12 years	SAD with interpositional arthroplasty and DO
Qiao *et al*., 2018	Prospective study	3-4-year follow-up	*n*=6	21-31 year old patients with unilateral TMJ ankylosis and mandibular dysplasia	PAD with interpositional arthroplasty in Stage 1 and DO at Stage 2
Rao *et al*., 2004	Prospective study	6 months	*n*=6	7-10 year old patients with TMJ ankylosis and mandibular deformity	SAD with gap arthroplasty and DO
Zanaty *et al*., 2016	Prospective observational study	6 months	*n*=30	8-17 year old TMJ ankylosis patients with micrognathia and OSAS	SAD with interpositional arthroplasty and DO

DO: Distraction osteogenesis, PAD: Postarthroplastic DO, SAD: Simultaneous arthroplastic DO, PrAD: Prearthroplastic DO, TMJ: Temporo-mandibular joint, OSAS: Obstructive sleep apnoea syndrome

Table 3: Risk of bias

Study	Randomization	Allocation concealment	Assessor Blinded	Dropouts described	Risk of bias
Andrade *et al*., 2009	No	No	No	None	High
Andrade *et al*., 2012	No	No	No	Yes	High
Andrade *et al*., 2018	No	No	No	None	High
Chellappa *et al*., 2015	Yes	No	No	None	High
Feiyun *et al*., 2010	No	No	No	None	High
Hassan *et al*., 2019	No	No	No	Yes	High
Ma *et al*., 2018	No	No	No	None	High
Qiao *et al*., 2018	No	No	No	None	High
Rao *et al*., 2004	No	No	No	None	High
Zanaty *et al*., 2016	No	No	No	None	High

involved PrAD versus PAD, and one involved PrAD versus SAD. Reankylosis was reported more in PAD followed by SAD with none in PrAD. PAD showed significantly more incidence of reankylosis than PrAD [Table 4].

Polysomnography variables

Polysomnography variables were assessed in five studies, of which two involved PrAD, two involved SAD, and one involved PrAD versus SAD. PAD showed worsening of polysomnography variables as noted by an increased incidence of bradycardia and respiratory distress in patients with concurrent severe micrognathia and OSAS. PrAD showed significant improvement in polysomnography variables with resolution of OSAS symptoms. SAD showed similar results with baseline comparisons [Table 4].

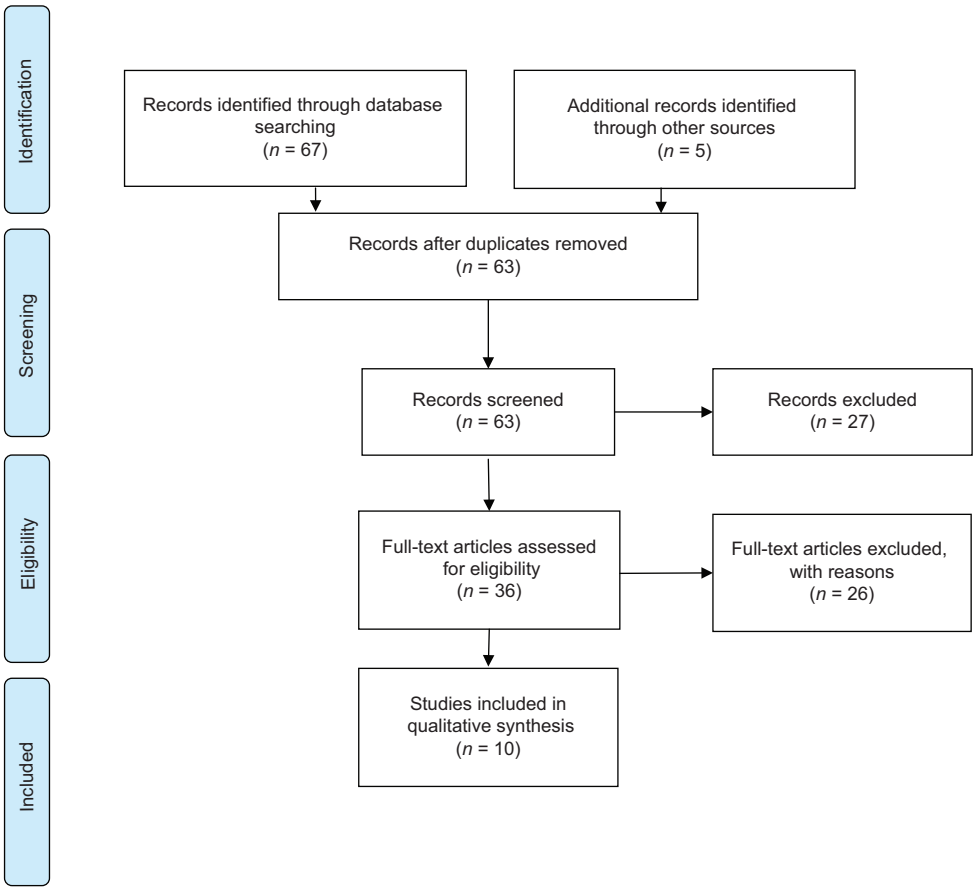
Chin position, mandibular position, and mandibular length

These outcomes improved faster in PrAD and SAD when compared to PAD due to delay in DO after ankylosis release [Table 4].

Discussion

Postarthroplastic distraction osteogenesis

Snyder *et al*. in 1973 reported mandibular lengthening in canine species using extraoral distractors following which many similar animal experiments were conducted by eminent researchers that proved DO is not restricted to long bones.[4-6] McCarthy *et al*. in 1992 performed mandibular lengthening of four syndromic patients (hemifacial microsomia, Nager



Flow Chart 1: Prisma flow diagram

syndrome) using DO.[7-9] Though it is McCarthy who is famously credited for performing DO in human mandible, in a letter to the editor of "Plastic and Reconstructive Surgery," August 1993, Mustafa Sengezer stated that mandibular DO was being practiced by his colleague Prof. Cemal Aytemiz since 1978 in Gulhana Military Medical Academy, Ankara, Turkey. Interestingly in the letter, Sengezer states that their mandibular lengthening procedures using DO performed between 1978 and 1991 were done primarily for TMJ ankylosis patients.[10] In the 10th International Confederation for Plastic and Reconstructive Surgery (1992), Aytemiz and Sengezer presented their case series of 11 TMJ ankylosis patients treated by postarthroplastic DO.[11] At the time DO was introduced for correcting dentofacial deformity in TMJ ankylosis, it was popularly believed that addressing the ankylosis should be of primary concern and correction of deformity is to be delayed. This poses greater importance on the restoration of function as the primary goal. Lopez and Dogliotti insist on postarthroplastic DO as they believe the need to first assess the growth potential of mandible which has been released from ankylosis before proceeding with DO.[12] A straightforward drawback of postarthroplastic DO is the instability of proximal segment while placing the osteotomy cut as well as distracting, with the latter contributing to the risk of reankylosis.[1,13-15] Hassan and Mohamed noted reankylosis in two out of twenty patients in whom postarthroplastic DO was performed.[16] Qiao *et al*. performed postarthroplastic DO in six patients with unilateral TMJ ankylosis, maintaining a gap of 6 months between the two surgeries. During distraction, the authors insisted on avoiding active assist forces from any other device or apparatus in order to avoid the instability of the proximal segment and the risk of reankylosis. No complications were noted in a 3–4-year follow-up.[17] Andrade *et al*. elaborated the drawback of using postarthroplastic DO in patients suffering from OSAS secondary to TMJ ankylosis and stated the following two problems: noncompliance to physiotherapy due to compromised airway and activation of trigemino cardiac reflex pathway while opening the mouth.[1]

Simultaneous arthroplastic distraction osteogenesis

Driven by the proposition of Munro *et al*. that TMJ ankylosis and dentofacial deformity correction should be performed together as a single-stage procedure, Dean and Allamilos in 1999 became the first to document simultaneous arthroplastic DO technique in three unilateral TMJ ankylosis patients.[18] Active physiotherapy was started from the 1st postoperative day and continued for a year while active distraction began from the 5th postoperative day. Though they reported no complications and achieved adequate mouth opening and deformity correction, no particular rationale was stated as to the advantages of this technique over the then popularly

Table 4: Results of the included studies

Author and technique used	Variables/method of evaluation	Mean values				Results
Andrade *et al*., 2009 PrAD	1. MIO 2. Polysomnography variables - O_2 saturation, AHI, Apnoea-Hypopnoea episodes 3. PAS 4. Mandibular lengthening 5. Position of the mandible (SNB angle)	-				MIO increased drastically only after Stage 2 Improvement of all the polysomnographic variables and drastic increase PAS after Stage 1 and complete resolution of all symptoms of OSAS Increase in mandibular length and increased chin prominence indicated by favorable SNB angle after Stage 1
Andrade *et al*., 2012 PrAD versus PAD	1. MIO 2. O_2 saturation 3. AHI 4. Pulse rate 5. Hyoid-menton distance 6. Position of the mandible (SNB angle) 7. Reankylosis	**Outcomes assessed**	**Baseline value**	**PAD**	**PrAD**	Of the 7 patients with severe OSAS treated by PAD, 6 patients had recurrence and 1 patient was lost to follow-up PAD caused bradycardia and respiratory distress during active physiotherapy PrAD is superior to PAD in patients with severe OSAS
		O_2 saturation	92	78	96	
		MIO	6	22	38	
		Pulse rate	92	78	96	
		AHI	4	Obliterated during jaw stretching	9	
		SNB angle	61	61	74	
		Hyoid-menton distance	3.5	3.5	8	
		Reankylosis	-	6	0	
Andrade *et al*., 2018 PrAD	1. PAS width 2. AHI 3. O_2 saturation 4. MIO 5. Mandibular advancement 6. Reankylosis	**Outcomes assessed Pediatric group**	**Immediate Preoperative**	**Immediate Postoperative**	**Late Postoperative**	PrAD significantly improved OSA by increasing the PAS which was evident by the lower AHI score and higher O_2 saturation No incidence of reankylosis Mouth opening was also significantly improved post ankylosis release and maintained during late postoperative period
		PAS width	3.57	8.69	9	
		AHI	48.04	3.41	3.6	
		O_2 saturation	89.86	96.74	96.88	
		Mandibular advancement	-	10.14	10.07	
		MIO	4.64	-	34.43	
		Reankylosis	-	0	0	
		Adult group	**Immediate Preoperative**	**Immediate Postoperative**	**Late Postoperative**	
		PAS width	5.18	10.09	10.91	
		AHI	31.45	1.37	1.43	
		O_2 saturation	92.01	96.80	96.84	
		Mandibular advancement	-	9.64	9.36	
		MO (mm)	5.18	-	33.91	
		Reankylosis	-	0	0	
Chellappa *et al*., 2015 PrAD and SAD	1. MIO 2. Duration to achieve active functional MO 3. Reankylosis	**Outcomes assessed**	**Preoperative**	**PrAD**	**SAD**	No significant difference in MIO observed between both groups Duration to achieve active functional MO is significantly reduced in SAD Risk of reankylosis and poor segment stability maybe the drawbacks of SAD
		MIO (mm)	5	Intraoperative - 38.5	Intraoperative - 38.9	
				POD3-22.3	POD3-15.3	
				POD30-35.4	POD30-34.5	
				POD180-34.3	POD180-35.9	
		Duration to achieve active functional MO (days)		15.6	84.4	
		Reankylosis	-	0	1	

Contd...

Table 4: Contd...

Author and technique used	Variables/method of evaluation	Mean values					Results
Feiyun *et al*., 2010 SAD	1. MIO 2. Polysomnography-RDI, lowest arterial oxygen saturation 3. SNB angle 4. Reankylosis	**Outcomes assessed** MIO (mm) SNB angle (degree) RDI O_2 saturation (%) Reankylosis		**Preoperative** 4.6 68.7 47.3 75.4 -		**Postoperative** 33.5 77.6 2.1 98.2 0	MIO, SNB angle and polysomnography variables improved with SAD with no incidence of reankylosis SAD can be effectively used correct bilateral TMJ ankylosis with micrognathia and OSAS
Hassan *et al*., 2019 PAD	1.MIO 2. Cephalometric analysis 3. Reankylosis	**Outcomes assessed** MIO (mm) Reankylosis	**Preoperative** 8.2 -	**During activation** 23 -	**1 year after consolidation phase** 39.7 -	**At least 7 years after consolidation phase** 36.5 2	Gained MIO is decreased during activation period at Stage 2. But is regained with subsequent physiotherapy post DO PAD provides a stable short-term improvement in the facial aesthetics, but a significant relapse occurs during the long-term follow-up
Ma *et al*., 2018 SAD with interpositional arthroplasty and DO	1. MIO 2. PAS 3. Reankylosis	**Outcomes assessed** MIO PAS Reankylosis		**Preoperative** 1.4 61.4		**Postoperative** 35.7 96.4 0	SAD significantly improved MIO and PAS with no incidence of reankylosis
Qiao *et al*., 2018 PAD with interpositional arthroplasty in Stage 1 and DO at Stage 2	1. MIO 2. MBL 3. Reankylosis	**Outcomes assessed** MIO (mm) MBL (mm) Reankylosis		**Preoperative** 4.83 51	**After Stage 1** 28.17 51	**After Stage 2** 35.67 67.17 0	PAD with interpositional arthroplasty shows significant improvement in MIO and MBL with no incidence of reankylosis
Rao *et al*., 2004 SAD with gap arthroplasty and DO	1. MIO 2. SNB angle 3. ML-PG, ML-PM 4. Reankylosis	**Outcomes assessed** MIO (mm) SNB angle ML-PG (mm) ML-PM (mm) Reankylosis		**Preoperative** 1.6 67.8 51 49.5 -		**Postoperative** 28 76.5 61.8 60.3 0	SAD shows significant improvement in MIO, ML and chin position with no incidence of reankylosis
Zanaty *et al*., 2016 SAD with interpositional arthroplasty and DO	1. Cormack-Lehane score 2. AHI 3. MIO 4. ODI 5. A/h 6. H/h	**Outcomes assessed** Cormack-Lehane score AHI MIO (mm) ODI A/h H/h		**Preoperative** 4 52.2 18.3 35.6 49.6 3.2		**Postoperative** 1 12.6 38.8 7.3 8 4.3	SAD significantly improves MIO and resolution of airway obstruction. Incidence of reankylosis is unspecified

DO: Distraction osteogenesis, PrAD: Prearthroplastic DO, PAD: Postarthroplastic DO, SAD: Simultaneous arthroplastic DO, MIO: Maximum interincisal opening, PAS: Posterior airway space, AHI: Apnoea-Hypopnoea Index, SNB: Sella-nasion-point B, RDI: Respiratory disturbance index, MBL: Mandibular body length, ODI: Oxygen desaturation index, ML: Mandibular length, ML-PG: ML-Pogonion-gonion, ML-PM: ML-Pogonion-menton, MO: Mouth opening, A/h: Apnoea/hour, H/h: Hypopnoea/hour, TMJ: Temporo-mandibular joint, OSAS: Obstructive sleep apnoea syndrome

practiced postarthroplastic DO except for the avoidance of a second surgery.[19] Subsequently, Papageorge and Apostolidis in 1999 reported a case of unilateral TMJ ankylosis in which they had used the simultaneous technique. Although they noted unstable occlusion postdistraction, it was corrected with orthodontics. They achieved adequate mouth opening with no complications after 15-month follow-up.[20] Yonehara *et al*., Douglas *et al*., Yoon and Kim, and Rao *et al*. reported similar cases treated with simultaneous arthroplastic DO with no specific mention to the pros, cons, or rationale of the technique *per se*.[21-24]

Kwon *et al*. in 2006 were the first to pose the following questions with regard to simultaneous arthroplastic DO: (1) can active physiotherapy be performed during a distraction period? (2) can occlusal stability be maintained after two concurrent surgeries? They noted the void in addressing these issues in the previous literature. The authors went on to conclude that these

unaddressed questions are a major setback to the simultaneous technique.[25] The potential disadvantages of postarthroplastic DO such as instability of proximal segment and noncompliance to active physiotherapy still persisted in simultaneous technique.[1] Ideally, during distraction, it is desirable to reduce the unwarranted mobility of the jaw to prevent pseudoarthrosis between the segments. Paradoxically, the need for active physiotherapy after ankylosis release, is a compulsive one and cannot be overlooked. This poses a variety of problems starting from interference of the distractor to physiotherapy, instability of proximal segment, difficulty in controlling occlusion, and risk of pseudo-arthrosis. In addition, continuous pressure exerted by the proximal segment over glenoid fossa most often results in reankylosis.[1,13,25,26] With respect to the management of concurrent OSAS associated with TMJ ankylosis, Andrade *et al*. reported that simultaneous technique is not efficient in improving the upper airway space as most often episodes of dyspnea and bradycardia occur whenever patient attempts active physiotherapy, which, in turn, results in noncompliance to physiotherapy and potential risk of reankylosis.[1,13,27]

Chellappa *et al*. in a prospective randomized controlled trial in twenty patients, compared prearthroplastic and simultaneous arthroplastic DO and noted the following advantages of simultaneous technique in comparison to preathroplastic technique: (1) adequate mouth opening is achieved early during the treatment, (2) final position of mandible that achieved is as predicted, and (3) single-stage surgery (more desirable in population who do not voluntarily seek treatment for TMJ ankylosis as is the case in developing/underdeveloped countries).[27]

Prearthroplastic distraction osteogenesis

Introduced by Sadakah *et al*. as a modified technique in 2006, it has since gained wide acceptance because of its obvious advantages. In their research article, they stated that the technique was proposed to overcome the proximal segment instability which is most often encountered in postarthroplastic and simultaneous arthroplastic DO techniques. The unstable proximal condylar segment which displaces antero-superiorly toward the glenoid fossa during distraction is also a major cause for reankylosis. With this modified approach (prearthroplastic DO), Sadakah *et al*. were able to overcome the potential risks which allowed for a more predictable outcome. Stability with respect to intraoperative placement of osteotomy cuts was also improved as the TMJ remained fused during Stage 1 surgery, thereby improving surgical ease.[28] Mehrotra *et al*. in 2016 performed simultaneous maxillomandibular distraction in ten patients who presented with TMJ ankylosis and resulting maxillary cant. They performed prearthroplastic DO in these patients and reported favorable results.[29]

Distraction osteogenesis and obstructive sleep apnoea syndrome

OSAS is often an uninvited accomplice of TMJ ankylosis and needs to be addressed effectively. Zanaty *et al*. evaluated the upper airway changes in thirty TMJ ankylosis patients before and after DO. They demonstrated a significant improvement in Cormack and Lehane score and Apnoea-Hypopnoea Index after DO, indicative of improved oropharyngeal airway space. They noted that as the mandible was lengthened, the tongue base moved forward due to its anterior muscular attachments to the mandible, increasing the airway space, and relieving airway obstruction.[30] Similar results were noted in several other studies which have agreed the positive role of DO in treating OSAS secondary to TMJ ankylosis.[31-35]

The results from our systematic review suggest that there is no significant difference between the three sequences of DO with respect to the MMO that can be achieved at the end of the treatment phase. Though postarthroplastic and simultaneous arthroplastic DO give quicker functional movement of the mandible when compared to prearthroplastic DO, there exists the risk of reankylosis. PAS and polysomnography variables improved drastically with prearthroplastic and simultaneous arthroplastic DO with resolution of OSAS symptoms. The chin position, mandibular length, and mandibular position improved in all the three sequences by the end of the treatment phase, provided there was no reankylosis. The quality of studies included in this review has a high risk of bias and hence, we interpret the results with caution. However, we believe that the evidence supporting the incidence of reankylosis to be lower in prearthroplastic DO is strong, with prearthroplastic DO showing no incidence of reankylosis in this systematic review.

Conclusion

Reankylosis remains a major determining factor in the maintenance of the results obtained from the various sequences of DO. Prearthroplastic DO has nil incidence of reankylosis in all the included studies. Hence, with the available evidence, we conclude that prearthroplastic DO shows more stable results. Well-designed clinical trials comparing various sequences of DO should be done to facilitate high-quality research data for systematic analyses to arrive at a more quantitative consensus.

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Conflicts of interest

There are no conflicts of interest.

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