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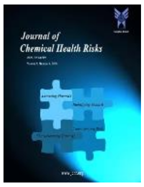

Assessment of Oropharyngeal Airway Before and After Distraction Osteogenesis in Patients with Obstructive Sleep Apnoea Syndrome – A Clinical Study

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KEYWORDS

Treacher Collins syndrome, distraction osteogenesis, obstructive sleep apnea syndrome, cephalometry.

ABSTRACT:

Background: This study was conducted for the assessment of oropharyngeal airway before and after distraction osteogenesis in patients with obstructive sleep apnoea syndrome.

Materials and methods: Ten patients with mandibular hypoplasia of obstructive sleep apnoea syndrome were included in the study. A detailed case history was recorded. Pre operatively Clinical examination, General systemic examination, physical examination, routine hematological investigations, HbsAG (hepatitis B antigen) testing, ECG (electro cardio gram) evaluation, HIV (human Immunodeficiency Virus) a chest x-ray evaluation were done for all the patients in the study. Preoperatively before starting distraction, photographs and relevant radiographs like OPG, Lateral Cephalogram, Cephalometric Analysis, Overnight Polysomnogram, snoring, Heart Rate, Oxygen saturation, Linear Oropharyngeal airway space, Apnoea and Hypopnoea Index values were calculated. Patient Mock Surgery i.e, preoperative study models – articulation, osteotomy cuts were made. Then Pre-anaesthetic evaluation done. Presurgical antibiotic therapy was done before one day of the surgery, followed by surgery under general anaesthesia. Patients' guardians were asked to sign in a written informed consent form explaining the procedure and also any complications that may arise as a result of the surgery. Any additional investigations, if required, as per the systemic condition of patient were carried out. Anaesthetist consent and physician consent were taken. Surgery was performed under general anaesthesia in a standardized manner by same group of surgeons. Bilaterally submandibular incision was made to access the posterior body, angle, lateral and medial rami of the mandible, Once the surgery was done the distractors are placed bilaterally extra-orally and suturing done patient given antibiotics and analgesics for a week post operatively patient is advised to take soft and liquid diet for a month. Then the patient was advised to come for follow up in 1,3,6,9,12 months. For all the ten patients in this study a standard 2.5 cm intraoral mandibular distractors were placed, after latency period of 5 days and activation of 1 mm per day for a maximum period of 25 days (length of the distractor is fixed). Thus, 2.5 cm or 25 mm of maximal distraction was achieved. Post operatively clinical, radiographical, polysomnographic, Heart rate, Apnoea and Hypopnoea Index, Oxygen saturation values were evaluated for all the patients in the study. Patients in the present study were recalled in

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1 ,3, 6, 9,12 months after distraction osteogenesis to assess and evaluate the clinical, radiographical, polysomnograhic and functional changes post operatively. Preoperative photographs and Pre operative relevant radiographs like, Lateral cephalogram, sleep study was taken for all the patients in the present study. Patients were systematically followed up postoperatively at an interval of 1,3,6,9,12 months for the evaluation of oropharyngeal airway space and airway obstruction, oxygen saturation, apnoea and hypopnoea index, heart rate. As a part of record a printed report including patient data, details of surgery, and pre and post operative photographs were maintained.

Results: In the present study all the 10 patients are with Obstructive Sleep Apnea Syndrome with mandible hypoplasia, all ten patients in the study undergone distraction osteogenesis of the mandible. Clinically and radiographically follow up has done after distraction of the mandible. Clinically and radiographically, there is an increase in the mandible length, air way space which is measured cephalometrically on lateral cephalogram after distraction osteogenesis of the mandible. The results showed an increase in the mandibular length, increase in airway space, increase in oxygen saturation, decrease in snoring events and decrease in the Apnea Hypopnea Index (AHI) statistically.

Conclusion: The study concludes that the Mandibular distraction osteogenesis is an effective treatment in treating the patients with mandibular deformities associated with unilateral or bilateral TMJ ankylosis and also in treating the patients with obstructive sleep apnea syndrome. The results concluded that the Mandibular Distraction Osteogenesis is a successful treatment in treating the upper Airway Management and stated that Mandibular retrognathia may cause upper airway obstruction in the paediatric patient due to tongue collapse and physical obstruction in the hypopharyngeal region. Most commonly, the aetiology of upper airway obstruction is associated with a craniofacial malformation or other anomaly such as Pierre Robin sequence, Treacher Collins syndrome, hemifacial (craniofacial) microsomia, Nager syndrome that include mandibular anteroposterior hypoplasia, or developmental failure of growth of the mandible in utero, these disorders in the individual patient is responsible for the wide range of respiratory compromise that is observed clinically in terms of disordered breathing and inability to maintain appropriate levels of arterial oxygen saturation and concluded that Mandibular distraction osteogenesis (MDO) is a viable option for the paediatric patient with upper airway obstruction due to mandibular deficiency to avoid a tracheostomy or other surgical intervention.

Introduction

Temporomandibular joint ankylosis is a serious condition which refers to adhesion of mandibular condyle to the glenoid fossa and the surrounding structures leading to the succedent loss of function. Due to the condyles special function as the mandibular growth centre, if TMJ ankylosis occurs at childhood, it may predispose patients to growth deformities, which can result in either mandibular asymmetry deformity in unilateral TMJ ankylosis or maxillo-mandibular disharmony in bilateral ankylosis. Trauma, local or systemic infection, iatrogenic factors including previous TMJ surgery and irradiation, burn, genetic factor may all contribute to this disease.[1] Temporomandibular joint (TMJ) ankylosis in a growing child leads to micrognathia, which can produce airway obstruction. The obstructive sleep apnea and hypopnea syndrome (OSAHS) resulting from TMJ ankylosis accompanied by mandibular micrognathia can severely influence the patient’s life. The presence of micrognathia in these patients creates a narrowing of the oro-pharyngeal space with mechanical obstruction to respiration. This process forms a complex syndrome of apneic episodes with

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significant reduction in the mean oxygen saturation levels during sleep and secondary cardiac and respiratory problems.[2]

Ankylosis of the TMJ is a common pathology affecting the facial skeleton, which often gets overlooked during younger age, thereby creating a more complex situation making it difficult to manage during the later years of life. The treatment of the sequelae of bilateral temporomandibular ankylosis is difficult, because these patients present with significant micrognathia, and it is impossible to use the conventional techniques for mandibular augmentation. The latest technique for combating the same is “Distraction Osteogenesis”. Distraction techniques have been used in the facial bone area for the past 10 years. Distraction osteogenesis (DO) is a biologic process of new bone formation by gradual traction of a fracture callus formed between osteotomised bone segments. Bone lengthening by osteotomy and distraction osteogenesis of long bones was first described by Codivilla and later popularized by Ilizarov.DO has been applied to the craniofacial region since McCarthy et al reported the first clinical application of the technique in the treatment of four children with either unilateral or bilateral mandibular hypoplasia[3] Distraction osteogenesis was originally reported by Codivilla in 1902 and further refined by the soviet surgeon Ilizarov in 1950s to correct various extremity deformities. McCarthy et al in 1992 developed the technique for Mandibular elongation with extra oral distractors.

Distraction osteogenesis has recently become a mainstay for reconstruction of temporomandibular joint ankylosis with mandibular hypoplasia. Advancement of the mandible greater than 7 mm becomes increasingly more unstable with traditional osteotomies. Large advancements of the mandible are a relative indication, but when technical difficulties with a thin ramus or relapse after a previous sagittal split are accompanied with a large movement, then distraction is a reasonable alternative. Hence to overcome these drawbacks of conventional procedures distraction osteogenesis has become modified surgical procedure for temporomandibular joint ankylosis.[4]

The underlying pathophysiology of obstructive sleep apnea is beginning to be better in recent years. Mandibular hypoplasia is now considered to be a significant reason for this disorder. Mandibular hypoplasia can result from a variety of causes including congenital like, mandibulofacial dysostosis, and acquired conditions like TMJ ankylosis. The use of distraction osteogenesis for the maxillofacial skeleton is a relatively new concept. Obstructive apnea is the absence of airflow despite respiratory effort. Retrognathism or retropositioning of the jaw is beginning to be appreciated as a significant risk factor in the development of OSA. Large advancements of the jaws through traditional orthognathic surgery were accompanied with a high rate of relapse. Distraction osteogenesis is a technique that offsets these problems. Distraction osteogenesis was first developed by the Russian surgeon Ilizarov for correction of various extremity deformities. It was adapted to the maxillofacial region in the early 1990’s to treat congenital and developmental hypoplasias of the maxilla and mandible. It involves gradual separation of the osteotomised bone edges resulting in the formation of new bone.[5] Obstructive sleep apnea syndrome (OSAS) is a complex disorder that not only affects the quality of life but can also have undesirable cardiorespiratory sequelae Anatomically the pharynx is formed by the soft tissues suspended from the cranial base. The mandible indirectly acts as a major anchorage point for the hyoid, the laryngeal cartilages, pharynx and the tongue musculature which help maintaining the airway patency. Thus, the mandible is the key skeletal unit in preserving airway patency. More than 52 % of the upper pharyngeal airway obstructions occur at the base of the tongue.[6]

Obstructive sleep apnea syndrome (OSAS) is characterized by recurrent obstruction of the upper airway during sleep. It is a major health problem that affects 2% to 4% of children and adults, and ultimately influences multiple organ systems. It is typically diagnosed using lateral cephalometry, computed tomography and polysomnography. Partial or complete obstruction of the upper airway during sleep decreases oxygen saturation, causes sleep disruption, and adversely affects patients’ physical and psychological health. OSAS is common among patients with craniofacial deformities. In children, it can lead to growth retardation, aggression, hyperactivity, attention- deficit disorder, cognitive function disorders and poor socialization. Furthermore, OSAS can suppress memory, learning and problem-solving abilities in children.[7]

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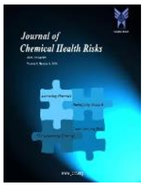


This study was conducted for the assessment of oropharyngeal airway before and after distraction osteogenesis in patients with obstructive sleep apnoea syndrome.

Materials and methods

Patients reporting to the department of oral and maxillofacial surgery, CKS Teja Dental College and Hospital were included in the study after obtaining the informed consent. This study consists of a sample of 10 patients, reported to the department of oral and maxillofacial surgery, CKS Theja Institute of Dental Sciences and Research, Tirupathi, Andhra Pradesh with obstructive sleep apnea syndrome in hypoplastic mandible patients. Patients with TMJ ankylosis (unilateral or bilateral) having severe hypoplastic mandible were selected for this study and treated in our centre during year January 2017– April 2018.

Determination of Pre- surgical and Post- surgical evaluation:

1. Clinical evaluation

2. General systemic evaluation

3. Radiographic Evaluation- Lateral Cephalogram, Cephalometric analysis

4. Linear dimensions of (OPA) Oro Pharyngeal Airway space on Lateral Cephalogram

5. Polysomnography (sleep study test)- Apnoea and Hypopnoea Index calculation

6. Hypopnea index

7. Values of average and lowest oxygen saturation

8. Amount of mandibular advancement measured on Lateral Cephalogram

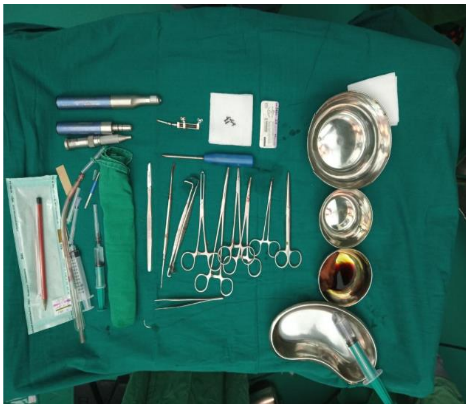
Exclusion Criteria

Un co - operative patients, Mentally Retarded patients, severely ill patients.

Investigations

Surgical profile include, haematological investigations, viral screening, serum creatinine, blood urea levels, random blood sugar levels and preoperative orthopantomogram., lateral cephalogram, sleep study.

Armamentarium



Drape, Marking pencil, Betadine solution(5%w/v), Bard & parker handle and blade, Kidney tray and bowl, Howarths periosteal elevator, Adson's tissue holding forceps, Allis tissue holding forceps, Needle holder, Normal saline, Mosquito forceps: curved and straight and Towel clip. Suture cutting scissor, Sterile syringes 3ml, Local anaesthesia /topical spray, Sterile swabs, Suction tip, Cat spaw, Distractor devi

ce and screws, Cutting saw, Screw holder and screw driver, Suturing material :3-0 vicryl and silk.

Procedure: Ten patients with mandibular hypoplasia of obstructive sleep apnoea syndrome were included in the study. A detailed case history was recorded. Pre operatively Clinical examination, General systemic examination, physical examination, routine haematological investigations, HBsAG (hepatitis B antigen) testing, ECG (electro cardio gram) evaluation, HIV (human immunodeficiency virus) a chest x-ray evaluation were done for all the patients in the study. Preoperatively before starting distraction, photographs and relevant radiographs like OPG, Lateral Cephalogram, Cephalometric Analysis, Overnight Polysomnogram, snoring, Heart Rate, Oxygen saturation, Linear Oropharyngeal airway space, Apnoea and Hypopnoea Index values were calculated. Patient Mock Surgery i.e, preoperative study models – articulation, osteotomy cuts were made. Then Pre-anaesthetic evaluation done. Presurgical antibiotic therapy was done before one day of the surgery, followed by surgery under general anaesthesia. Patients' guardians were asked to sign in a written informed consent form explaining the procedure and also any complications that may arise as a result of the surgery. Any additional

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investigations, if required, as per the systemic condition of patient were carried out. Anaesthetist consent and physician consent were taken. Surgery was performed under general anaesthesia in a standardized manner by same group of surgeons. Bilaterally submandibular incision was made to access the posterior body, angle, lateral and medial rami of the mandible, Once the surgery was done the distractors are placed bilaterally extra-orally and suturing done patient given antibiotics and analgesics for a week post operatively patient is advised to take soft and liquid diet for a month. Then the patient was advised to come for follow up in 1,3,6,9,12 months. For all the ten patients in this study a standard 2.5 cm intraoral mandibular distractors were placed, after latency period of 5 days and activation of 1 mm per day for a maximum period of 25 days (length of the distractor is fixed). Thus, 2.5 cm or 25 mm of maximal distraction was achieved. Post operatively clinical, radiographical, polysomnographic, Heart rate, Apnoea and Hypopnoea Index, Oxygen saturation values were evaluated for all the patients in the study. Patients in the present study were recalled in 1 ,3, 6, 9,12 months after distraction osteogenesis to assess and evaluate the clinical, radiographical, polysomnograhic and functional changes post operatively. Preoperative photographs and Pre operative relevant radiographs like, Lateral cephalogram, sleep study was taken for all the patients in the present study. Patients were systematically followed up postoperatively at an interval of 1,3,6,9,12 months for the evaluation of oropharyngeal airway space and airway obstruction, oxygen saturation, apnoea and hypopnoea index, heart rate. As a part of record a printed report including patient data, details of surgery, and pre and post operative photographs were maintained.

Submandibular Incision Given

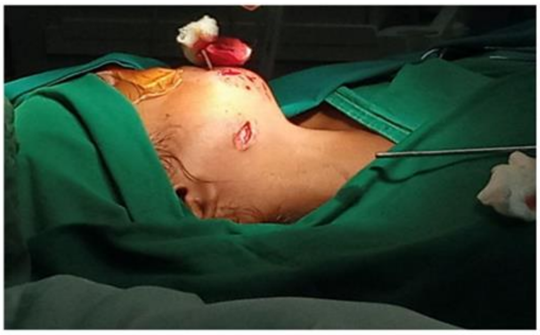

Fig :1

MANDIBULAR DISTRACTOR PLACEMENT DONE EXTRAORALLY AT TH ANGLE OF THE MANDIBLE BILATERALLY:

Fig :2

PATIENT 1

Fig 4: Pre operative pics

Fig 5: Post operative pics

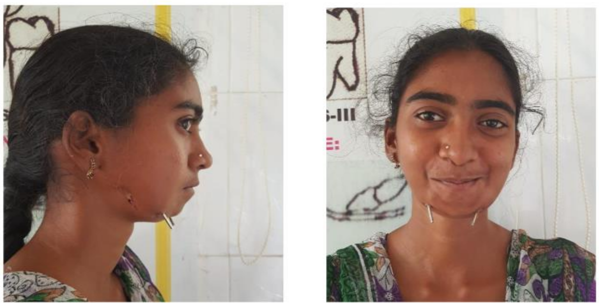

Fig 6: Pre op lateral cephalogram

Fig 7: Post op lateral cephalogram

Post op lateral cephalogram Shows an increase in the oropharyngeal airway space and increase in the mandibular length after distraction osteogenesis of the mandible

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PATIENT 2

Fig 8: Pre operative pics:

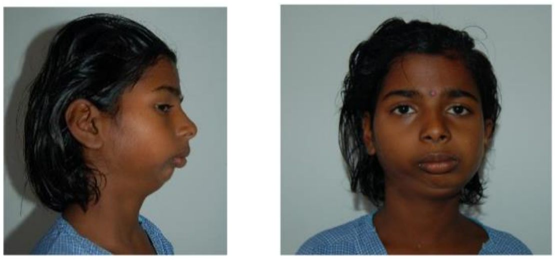


Fig 9: Post operative pics:

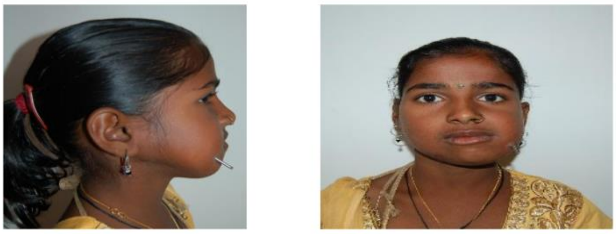


Fig 10: Pre op lateral cephalogram

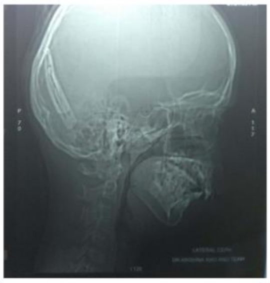


Fig 11: Post op lateral cephalogram

Post operative lateral cephalogram Shows an increase in the oropharyngeal airway space and increase in the mandibular length after distraction osteogenesis of the mandible

PATIENT 3

Fig 12: Pre operative

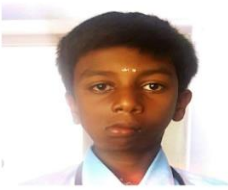


Fig 13: Post operative

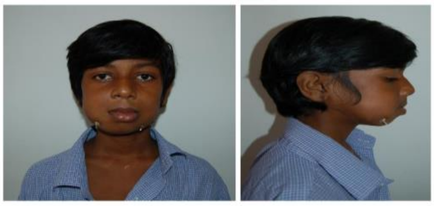


Fig 14: Pre op lateral cephalogram

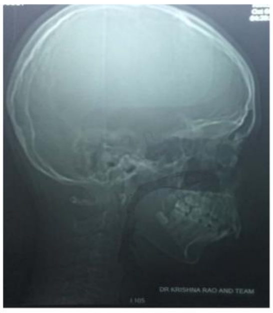
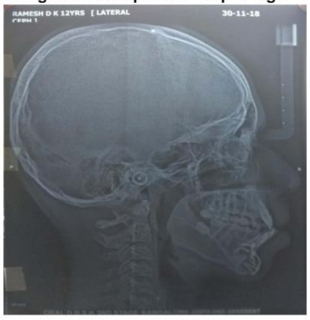


Fig 15: Post op lateral cephalogram



Post operative lateral cephalogram Shows an increase in the oropharyngeal airway space and increase in the mandibular length after distraction osteogenesis of the mandible

PATIENT 4

Fig 16: Pre operative

Fig 17: Post operative

Fig 18: Post operative pics

Fig 19: Pre op lateral cephalogram

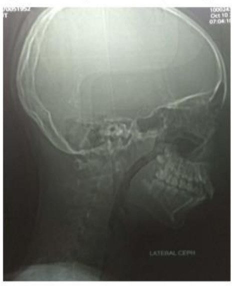
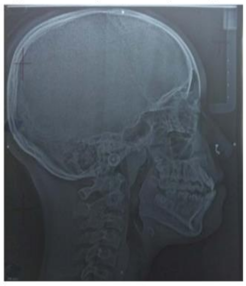


Fig 20: Post op latera cephalogram



Post operative lateral cephalogram Shows an increase in the oropharyngeal airway space and increase in the mandibular length after distraction osteogenesis of the mandible

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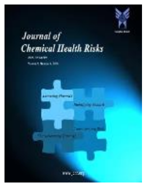

Results

In the present study all the 10 patients are with Obstructive Sleep Apnea Syndrome with mandible hypoplasia, all ten patients in the study undergone distraction osteogenesis of the mandible. Clinically and radiographically follow up has done after distraction of the mandible. Clinically and radiographically, there is an increase in the mandible length, air way space which is measured cephalometrically on lateral cephalogram after distraction osteogenesis of the mandible. The results showed an increase in the mandibular length, increase in airway space, increase in oxygen saturation, decrease in snoring events and decrease in the Apnea Hypopnea Index (AHI) statistically.

Table 1: comparison of mandibular advancement (mandibular length)before and after distraction osteogenesis of the mandible.

Patient name	**Before Distraction Mandibularlength (mm)**	**After distraction Mandabular length(mm)**	**e in Mandibularlength(mm)**
1)patient1-12/F	75 mm	92mm	17mm
2)patient 2-16/F	78mm	99mm	21mm
3)patient3-13/M	81mm	102mm	21mm
4)patient4-12/F	78mm	93mm	15mm
5)patient 5-13/f	79mm	94mm	15mm
6)patient 6-14/F	84mm	100mm	16mm
7)patient 7-10/F	77mm	97mm	20mm
8)patient 8-11/M	83mm	101mm	18mm
9)patient 9-12/F	81mm	96mm	15mm
10)patient 10-15/M	74mm	91mm	17mm

Table 1: Comparison of mandibular advancement i.e MANDIBULAR LENGTH after 4 months on lateral cephalogram: Before Vs After distraction osteogenesis of the mandible

	Mean	**N**	**Std. Deviation**	**Mean Change**	**t- value**	**p value**	**Sig**
Before Distraction Mandibular length	79.00	10	3.27	17.500	22.913	0.000	**
After distraction Mandabular length	96.50	10	3.92				

Note: ** = Significant at 0.01 level

* = Significant at 0.05 levelns = Not Significant

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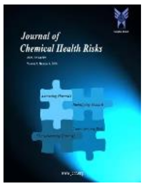

Table 2: comparison of SNA angle before and after distraction osteogenesis of the mandible, normal range 82^0 +/- 2: > 82^0 prognathic maxilla or retrognathic mandible or skeletal class 2

Patient name	**Sl.No**	**Before Distraction SNA angle (indegrees)**	**After distraction SNA Angle (indegrees)**	**Change in SNA angle (indegress)**
1)patient1-12/F	1	77^0	82^0	5^0
2)patient2 16/F-	2	67^0	71^0	4^0
3)patient3-13/M	3	82^0	85^0	3^0
4)patient4-12/F	4	80^0	82^0	2^0
5)patient 5-13/f	5	75^0	77^0	2^0
6)patient 6-14/F	6	83^0	86^0	3^0
7)patient 7-10/F	7	71^0	79^0	8^0
8)patient 8-11/M	8	82^0	89^0	7^0
9)patient 9-12/F	9	79^0	84^0	5^0
10)patient 10-15/M	10	80^0	88^0	8^0

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Table 2: Comparison of cephalometric values before and after distraction ofthe mandible: Before Vs After

	Mean	N	Std. Deviation	Mean Change	t-value	p value	Sig
raction SNAangle	77.60	10	5.21	4.700	6.429	0.000	**
action SNAAngle	82.30	10	5.46				

Note : ** = Significant at 0.01 level

* = Significant at 0.05 levelns = Not Significant

Table 3: Comparison of SNB angle before and after distraction osteogenesis of the mandible, normal range is :80º +/- 2: Retrognathic mandible <80º

Patient name	Sl.No	Before Distraction SNB Angle(indegrees)	After distraction SNB Angle(indegrees)	Change inSNB Angle(indegrees)
1)patient1-12/F	1	68^0	74^0	6^0
2)patient2 16/F-	2	62^0	69^0	7^0
3)patient3-13/M	3	68^0	77^0	9^0
4)patient4-12/F	4	73^0	79^0	6^0
5)patient 5-13/f	5	70^0	76^0	6^0
6)patient 6-14/F	6	71^0	78^0	7^0
7)patient 7-10/F	7	65^0	78^0	13^0
8)patient 8-11/M	8	74^0	86^0	12^0
9)patient 9-12/F	9	73^0	82^0	9^0
tient 10-15/M	10	67^0	82^0	15^0

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Table 3: Comparison of cephalometric values (SNB angle) Before and Afterdistraction of mandible: Before Vs After

	Mean	N	Std. Deviation	Mean Change	t-value	p value	sig
Before Distraction SNBAngle	69.10	10	3.843	9.000	8.714	0.000	**
After distraction SNBAngle	78.10	10	4.701				

Note: ** = Significant at 0.01 level

* = Significant at 0.05 levelns = Not Significant

Table 4: Comparison of ANB angle before and after distraction osteogenesis of the mandible, normal range = 2º +/- 2. >2^0 – class II skeletal or retrognathic mandible or prognathic maxilla <2^0 – class III skeletal tendency or prognathic mandible

Patient name	Sl.No	Before Distraction ANB Angle (indegrees)	After distraction ANB Angle (indegrees)	Change inANB Angle (indegrees)
1)patient1-12/F	1	9^0	6^0	3^0
2)patient2 16/F-	2	5^0	2^0	3^0
3)patient3-13/M	3	14^0	8^0	6^0
4)patient4-12/F	4	7^0	3^0	4^0
5)patient 5-13/f	5	5^0	1^0	4^0
6)patient 6-14/F	6	12^0	8^0	4^0
7)patient 7-10/F	7	6^0	1^0	5^0
8)patient 8-11/M	8	8^0	4^0	4^0

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9)patient 9-12/F	9	6^0	2^0	4^0
tient 10-15/M	10	13^0	6^0	7^0

Table 4: Comparison of cephalometric values (ANB angle) Before and afterdistraction of Mandible: Before Vs After

	Mean	N	Std. Deviation	Mean Change	t- value	p value	Sig
raction ANBAngle	8.50	10	3.375	4.100	11.000	0.000	**
action ANBAngle	4.10	10	2.726				

Note: ** = Significant at 0.01 level

* = Significant at 0.05 levelns = Not Significant

TABLE 5: Comparison of Apnea Hypopnea Index before and after distractionosteogenesis of the mandible.

Patient name	Sl.No	Before Distraction osteogenesis	ter distraction osteogenesis	Change inosteogenis
1)patient1-12/F	1	7 events /hr	3 events/hr	4events/hr
2)patient2 16/F	2	6 events/hr	4 events/hr	2events/hr
3)patient3-13/M	3	6 events/hr	0 events/hr	6events/hr
4)patient4-12/F	4	5 events/hr	4 events/hr	1events/hr
5)patient 5-13/f	5	10events/hr	3 events/hr	7events/hr
6)patient 6-14/F	6	9events/hr	5 events/hr	4events/hr

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7)patient 7-10/F	7	8events/hr	4 events/hr	4events/hr
8)patient 8-11/M	8	5events/hr	2 events/hr	3events/hr
9)patient 9-12/F	9	7events/hr	1 events/hr	6events/hr
10)patient 10-5/M	10	11events/hr	3 events/hr	8events/hr

Table 5: Apnea Hypopnea Index (AHI index - Normal <5 events / hour): Before Vs After

	Mean	N	Std. Deviation	Mean Change	t-value	p value	Sig
Before Distractionosteogenesis	7.40	10	2.07	4.500	6.400	0.000	**
After distractionosteogenesis	2.90	10	1.52				

Note: ** = Significant at 0.01 level

* = Significant at 0.05 levelns = Not Significant

TABLE. 6: Comparison of average oxygen saturation before and afterdistraction osteogenesis of the mandible :normal range – 94% to 98%

Patient name	Sl.No	Before Distraction osteogenesis Average Oxygen Saturation(%)	After distraction osteogenesis Average Oxygen Saturation(%)	Change in Average Oxygen Saturation(%)
1)patient1-2/F	1	91%	94%	3%
2)patient2-16/F	2	90%	95%	5%
3)patient3-13/M	3	89%	97%	85

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4)patient4-12/F	4	85%	95%	10%
5)patient 5-13/f	5	92%	96%	4%
6)patient 6-14/F	6	93%	97%	4%
7)patient 7-10/F	7	94%	98%	4%
8)patient 8-11/M	8	89%	94%	5%
9)patient 9-12/F	9	90%	96%	6%
tient 10-15/M	10	91%	97%	6%

S	Sl.No	Before Distraction FL %	Before Distraction FS %	After distraction FL %	After distraction FS%	Change in FL %	Change in FS%
1)patient1-2/F	1	30%	22%	22%	10%	8%	12%
2)patient 2-16/F	2	30%	20%	15%	11%	15%	9%%
3)patient3-13/M	3	32%	34%	18%	15%	14%	19%
4)patient4-12/F	4	25%	25%	12%	18%	13%	7%
5)patient 5-13/f	5	40%	25%	30%	20%	10%	5%
6)patient 6-14/F	6	36%	32%	22%	21%	14%	11%
7)patient 7-10/F	7	46%	25%	25%	12%	21%	13%
8)patient 8-11/M	8	38%	24%	30%	18%	8%	6%
9)patient 9-12/F	9	33%	26%	21%	18%	12%	8%
10)patient 10- 15/M	10	28%	20%	11%	10%	17%	10%

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Table 6 : Comparison of Average Oxygen Saturation (AOS) : Before Vs After

	Mean	N	Std. Deviation	Mean Change	t-value	p value	Sig
Before Distraction osteogenesis AOS	90.40	10	2.50	5.500	8.199	0.000	**
After distraction osteogenesis AOS	95.90	10	1.37				

Note : ** = Significant at 0.01 level

* = Significant at 0.05 levelns = Not Significant

TABLE 7:

Hypopnea Index:

1) **% flow limit breathing without snoring (FL) < 60% (normal value)**

2) **% flow limit breathing with snoring (FS)< 40 %(normal value)**

Table 7 a: Comparison of % of flow limit Breathing without snoring (FL) :Before Vs After

	Mean	N	Std. Deviation	Mean Change	t-value	p value	sig
Before Distraction FL	33.80	10	6.27	13.200	10.378	0.000	**
After distraction FL	20.60	10	6.70				

Table 7b: Comparison of % flow limit breathing with snoring (FS) : Before Vs After

	Mean	N	Std. Deviation	Mean Change	t-value	p value	Sig
Before Distraction FS	25.30	10	4.60				

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After distraction FS	15.30	10	4.24	10.000	7.746	0.000	**

Note : ** = Significant at 0.01 level

* = Significant at 0.05 levelns = Not Significant

TABLE:8 : Comparison of upper airway space and lower airway airway spacebefore and after distraction osteogenesis of the mandible.

Normal upper airway space – 15 to 20 mmNormal lower airway space – 11 to 14 mm

Patient name	**Sl.No**	**Before Distraction Upper Airway space(mm)**	**Before Distraction Lower Airway space(mm)**	**After distractionUpper Airway space(mm)**	**After distractionLower Airway space(mm)**	**Change in Upper Airway space in (mm)**	**Change in Lower Airway space in (mm)**
1)patient1-2/F	1	15mm	11mm	19mm	15mm	4mm	4mm
2)patient 2-16/F	2	7mm	5mm	12mm	10mm	5mm	5mm
3)patient3-13/M	3	12mm	11mm	16mm	14mm	4mm	3mm
4)patient4-12/F	4	15mm	8mm	17mm	12mm	2mm	4mm
5)patient 5-13/f	5	16mm	10mm	20mm	14mm	4mm	4mm
6)patient 6-14/F	6	7mm	6mm	11mm	9mm	4mm	3mm
7)patient 7-10/F	7	14mm	9mm	16mm	11mm	2mm	2mm
8)patient 8-11/M	8	11mm	9mm	13mm	11mm	2mm	2mm
9)patient 9-12/F	9	12mm	9mm	15mm	13mm	3mm	4mm
10)patient 10-15/M	10	14mm	10mm	19mm	16mm	5mm	6mm

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Table 8a : Comparison of oropharyngeal airway (OPA) space on lateralcephalogram upper airway space : Before Vs After

	Mean	N	Std. Deviation	Mean Change	t-value	p value	Sig
Before Distraction Upper Airway space	12.3	10	3.2				
After distraction Upper Airway space	15.8	10	3.08	3.5	9.391	0	**

Table 8b: Comparison of oropharyngeal airway (OPA) space on lateralcephalogram Lower airway space : Before Vs After

	Mean	N	Std. Deviation	Mean Change	t-value	p value	Sig
Before Distraction Lower Airway space	8.8	10	1.99				
After distraction Lower Airway space	12.5	10	2.27	3.7	9.348	0	**

Note : ** = Significant at 0.01 level

* = Significant at 0.05 levelns = Not Significant

Table :9: site of distraction and Number of months of distraction done .

lno	ne of thepatient	Amount of Distractiondone	Site of Distraction	No. of months of Distraction done
1	Patient1-F/ 12yrs	17mm	ateral anglemandible	4-5 months
2	Patient2-F/16yrs	18mm	ateral anglemandible	4months

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3	Patient3-M/13yrs	15mm	ıteral anglemandible	3-4months
4	Patient4-F/14yrs	24mm	ıteral anglemandible	5months
5	Patient5-F/13yrs	19mm	ıteral anglemandible	4months
6	Patient6-F/14yrs	22mm	ıteral anglemandible	5months
7	Patient7-F/10yrs	20mm	ateral anglemandible	5months
8	Patient8-M/11yrs	16mm	ıteral anglemandible	4months
9	Patient9-F/12yrs	21mm	ateral anglemandible	4months
10	Patient10-M/15yrs	20mm	ıteral anglemandible	5months

TABLE 10 : Comparison of lowest oxygen saturation before and afterdistraction osteogenesis of the mandible.

Slno	**ne of thepatient**	**lowest oxygen saturation beforeDO**	**Lowest oxygen saturationafter DO**	**Change in lowest oxygensaturation**
1	Patient1-F/ 12yrs	89%	95%	6%
2	Patient2-F/16yrs	83%	92%	9%
3	Patient3-M/13yrs	83%	95%	12%
4	Patient4-F/14yrs	85%	96%	11%

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5	Patient5-F/13yrs	84%	93%	9%
6	Patient6-F/14yrs	86%	93%	7%
7	Patient7-F/10yrs	86%	96%	10%
8	Patient8-M/11yrs	86%	94%	8%
9	Patient9-F/12yrs	88%	97%	9%
10	Patient10-M/15yrs	79%	90%	11%

Discussion

Temporo-Mandibular Joint (TMJ) ankylosis is a very distressing structural condition that denies the victim the benefit of a normal diet and opportunities in careers that require normal speech ability. It also causes severe facial disfigurement that aggravates psychological stress. TMJ ankylosis during early childhood may lead to disturbances in growth, or cause asymmetry and serious difficulties in eating and breathing during sleep. This is caused by various factors including trauma, systemic, and local inflammatory conditions, as well as neoplasm in the TMJ area, and can only be relieved by a direct surgical procedure. Management of TMJ ankylosis is mainly through surgical intervention. It is necessary to use an interpositional material to prevent TMJ re-ankylosis after arthroplasty, and this particular aspect of the treatment has been the subject of numerous discussions. Improvement of the airway dimensions by skeletal advancement remains the most effective surgical therapy for Obstructive Sleep Apnea Syndrome (OSAS). Because the extent of airway improvement is correlated with the amount of skeletal advancement, large skeletal movement with rigid skeletal fixation and autogenous bone grafting are usually performed with improved outcome. Distraction Osteogenesis (DO) offers several advantages over the conventional techniques by eliminating the need of bone grafting and involving less surgical dissection because the lengthening is the result of natural bone healing in a gap created by a simple osteotomy. The incremental skeletal movement allows accommodation of the soft tissues, thus enabling large skeletal movement that cannot be achieved by conventional techniques. Although less surgical dissection is necessary for Distraction Osteogenesis, the procedure is highly technique sensitive, especially in achieving the proper alignment of the distraction devices. Mandibular elongation by progressive distraction is gradual and thus better tolerated by the patient, both functionally and morphologically. The procedure is less time consuming, and placement of the distractors causes no particular problem. Mandibular distraction has been used more frequently in the child and in particular, it has enabled treatment of the malformations responsible for OSAS (Obstructive sleep apnea syndrome).[8]

Micrognathia and retrognathia are common features seen in a number of congenital and acquired craniofacial anomalies including Treacher Collins syndrome, Hemifacial Microsomia, Nager syndrome, Pierre Robbin sequence and TMJ ankylosis. Numerous surgical options have been described for the management of the hypoplastic mandible of which distraction osteogenesis has gained significant acceptance in terms of the predictability of the outcome and lower morbidity post-surgically. Mandibular distraction was proposed by McCarthy in 1992 and has been popularised in the management of the hypoplastic mandible by Carls et al. and Morovic and Monasterio, Carls et al. have discussed the successful use of mandibular distraction in children with a 7-year follow-up. Monasterio reports two groups of patients in the pediatric age group describing the use of distraction in the management of obstructive sleep apnoea in mandibular hypoplasia and shows favourable

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results. Cohen reports a remarkable reduction in the respiratory distress index in his series of patients with the use of distraction osteogenesis. Unlike the other congenital craniofacial anomalies enumerated above, TMJ ankylosis is a acquired condition which produces a severe degree of retrognathia and micrognathia which may lead to Obstructive Sleep Apnea

Syndrome (OSAS). Distraction osteogenesis has become a recent addition in the surgical management of the mandibular micrognathia. The primary problem of sleep disturbance and NDS (Nocturnal Dysfunction Syndrome) in our group of patients shifted the focus to the correction of the mandibular hypoplasia before the release of the joint. In this group of patients, mandibular distraction was performed prior to release of the joint and showed excellent results in the management of the sleep disorder.[9]

Micrognathia and retrognathia are common features seen in a number of congenital and acquired craniofacial anomalies including Treacher's Collins syndrome, Hemifacial Microsomia, Nager syndrome, Pierre Robin sequence and TMJ ankylosis. Abnormalities in the position or morphology of the skeletal tissues have a direct impact on the surrounding envelope of soft tissues of the upper airway, thereby indirectly influencing the airflow through it.

True micrognathia with associated retroglossal airway compromise is a significant cause for airway obstruction, and was the common feature in all our patients. Obstructive Sleep Apnea Syndrome (OSAS) is a condition caused by upper airway obstruction, characterized by aponeic and/or hypopenic episodes during sleep, which in extreme conditions may be accompanied by severe secondary cardiorespiratory problems. These cardiorespiratory issues are secondary to an increase in the negative intra thoracic pressure with an increase in the right ventricular pressure and volume.

The priority in patients suffering from OSAS (Obstructive Sleep Apnea Syndrome) is to relieve them of the causative factor at the earliest. The modality of treatment used is determined by the site of obstruction (upper airway secondary to nasal, nasopharyngeal obstruction or lower pharyngeal airway secondary to retroglossal obstruction) with due consideration to the patient's systemic status. To be successful, the surgical procedure must bypass the obstructive area (tracheostomy) or enlarge the airway (mandibular advancement) or prevent collapse of the soft tissues at the site of obstruction (tongue reduction). Total Mandibular advancement was the first orthognathic surgical procedure used for the treatment of retroglossal airway obstruction. A definitive explanation for an improvement in the airway status after mandibular advancement is still ambiguous. However, greater acceptance has been given to the fact that there is repositioning of the genioglossus along with the advancing segment which pulls the tongue forwards from the posterior pharyngeal wall leading to better airway patency. Recent studies reveal that the genial musculature in these patients show an abnormal neuromuscular activity which improves with mandibular advancement leading to a significant improvement in the airway patency. Numerous surgical options have been described for the management of OSAS secondary to hypoplastic mandible of which distraction osteogenesis has gained significant acceptance. The magnitude of advancement that can be achieved and the predictability of outcome make MDO the treatment of choice over conventional osteotomies in adult cases of OSAS genial advancement with hyoid myotomy and suspension, and genial distraction are the alternate options that have been reported in the literature to improve the retroglossal airway patency.

Successful treatment of OSA (Obstructive Sleep Apnea) can be achieved by a variety of medical and surgical modalities. The high success rate of MMA (Maxillo Mandibular Advancement) has been established and oral and maxillofacial surgeons are now involved more frequently and at an earlier stage in the treatment of OSA. Because of the magnitude, morbidity, and potential instability of standard surgical techniques for large expansions of the facial skeleton, the use of Distraction Osteogenesis (DO) as a minimally invasive alternative has become common place. Distraction Osteogenesis (DO) is an alternative for acute bone lengthening in situations requiring large movements not attainable by standard osteotomies, acute lengthening, and bone grafting. Advancements of 20 mm or more without a bone graft and the associated donor site morbidity, scarring, and potential for infection can be achieved. Soft tissue seems to grow linearly along lines of tension, and skin, muscles, nerves, and vascular tissue are generated, not stretched. Resistance to advancement by the soft tissue envelope is decreased by this process of distraction

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histogenesis. The advantage is obvious, especially for severe midface hypoplasia and micrognathia the stretched soft tissue envelope contributes to relapse after traditional osteotomies, acute lengthening, and bone grafts. Patients and families should be informed that the length of treatment and the number of postoperative visits is significantly increased after DO (Distraction Osteogenesis) when compared with standard osteotomies. Because patients play an important role in the execution of DO (Distraction Osteogenesis), there is a greater requirement for patient understanding and cooperation. Failure to follow the prescribed activation can result in inappropriate vector of distraction, inadequate regenerate formation and even dismantling of the distractor.[10]

Ankylosis is most commonly associated with trauma (31-98%), local or systemic infection (19%), or systemic diseases. Unilateral TMJ ankylosis usually presented with limitation of mouth opening, facial asymmetry and upper airway obstruction (night snoring). Ankylosis will occur, as a result of destruction of the growth centre and limited mobility of the mandible, gross changes in mandibular shape and size, as well as the surrounding functional matrix (muscles, ligaments, and airway). The traditional way to treat such patients has always been to deal first with the ankylosed joint and allow the patient to open the mouth, then to treat any facial deformity later on. This case report highlighted the management of left TMJ (Temporo-Mandibular Joint) ankylosis in a paediatric patient with 2 stage surgery by performing mandibular distraction osteogenesis followed with releasing the TMJ ankylosis later. This was decided based on previous experience of the authors in distracting non-ankylotic mandible where when distracting in anterior- posterior direction, both the proximal and distal segment were pushed away. When the proximal segment (containing condyle) was distracted posteriorly, TMJ posterior dislocation and external auditory meatus compression could happen. Thus, in an ankylotic TMJ, taking the advantage of an immobile condyle would allow only anterior direction distraction of the distal segment, while the proximal segment remain firm in place. Mandibular distraction osteogenesis was reported in unilateral asymmetry cases would improve facial asymmetry and retrognathia and correct the slanted lip commissure (24.7%), and improve or level the mandibular occlusal plane. For bilateral mandibular distraction, its effective preventing tracheostomies of neonates or infants with respiratory distress (91.3%), relieving symptoms of OSA in adults and children.[11]

Obstructive sleep apnea syndrome is a potentially serious disorder affecting millions of people around the world. Many of these individuals are undiagnosed whereas those who are diagnosed often exhibit poor compliance with nightly use of continuous positive airway pressure (CPAP), a very effective nonsurgical treatment. Various surgical procedures have been proposed to manage and, in some cases, treat OSA. Effective surgical management of OSA depends upon developing a complete database and determining different levels of obstruction, which may include nasal, nasopharyngeal, oropharyngeal, and hypopharyngeal/retrolingual, or a combination of these sites. Surgical treatment may involve various procedures that are performed in different stages depending on the patient's sites of obstruction. The most commonly performed procedures include nasal reconstruction, uvulopalatopharyngoplasty (UPPP), advancement genioplasty, mandibular osteotomy with genioglossus advancement, and hyoid myotomy and suspension. In more severe cases, maxillomandibular advancement (MMA) with advancement genioplasty may be indicated. Surgeries in these cases are aimed at reducing the bulk of the tongue base or providing more space for the tongue in the oropharynx so as to limit posterior collapse during sleep. Most surgeries are done in combination and in a multistep manner, with maxillomandibular advancement, typically being reserved for refractory or severe OSA, or for those with obvious and significant maxillomandibular deficiency. Various authors have proposed distraction osteogenesis for maxillomandibular advancement, as a reliable surgical method to alleviate the narrow upper airway in growing OSA patients, especially those with severe cranio-maxillomandibular deformities, the etiology of respiratory obstruction was retrognathic and hypoplastic mandible, advancement was planned and achieved through distraction osteogenesis. The positive outcomes were evidenced by patient's subjective response and duly confirmed by the decrease in respiratory distress index in the polysomnograph as well as, an increase in the pharyngeal airway shadow in the lateral cephalometric radiographs.[12]

OSA (Obstructive Sleep Apnea) is a serious medical problem producing both physical and behavioural derangement. It is essential to provide a thorough workup and evaluation of all patients seeking care for snoring or OSA. Polysomnography is the standard for evaluation and assessment of the severity of OSA in every patient. It is now recognized that an important cause of obstructive apnoea in children is micrognathia. The size of the oropharynx is markedly reduced due to the under developed position of the mandible and corresponding retrusion of the tongue. The resulting airway obstruction may necessitate the creation of a long-term tracheostomy which is associated with a number of complications; in children, the mortality rate following tracheostomy itself (as opposed to associated condition) is around 5%. Lengthening of the mandible to correct retrognathia and the associated airway distress in patients with Pierre Robin sequence is not a new concept. The first reported surgical intervention, published by Callister (1937), consisted of a paediatric neurosurgical back-brace with a halo, with the infant imprisoned in this device. However, in addition to treating OSA and micrognathia successfully in 4 weeks, TMJ ankylosis followed this treatment procedure. This procedure applied traction directly to the mandible without osteotomy. As a result, the traction forces are transmitted directly to TMJ which is further immobilized by the traction appliances and accordingly this procedure was rapidly abandoned. More recently, because of utilization of DO principles and devices which allow control of mandibular lengthening, The role of mandibular distraction focuses on improving the position of the tongue in the posterior pharynx; by lengthening the mandible and bringing its muscular insertions forward, the antero-posterior dimension of the airway is thus increased (Monasterio et al., 2002). In this study, we successfully achieved this improvement in tongue position and the soft tissue responsible for narrowing of the posterior airway space in all patients following distraction. The improvement of airway space is evident from computerized measurements of the scanned tracings and analysis of lateral cephalograms as the mean effective airway space increased, when compared with the effective airway space pre-distraction and post distraction. This shows that soft tissue movement follows the skeletal advancement of the mandible through its muscular insertion, leading to relief and disappearance of all symptoms of OSA (as indicated clinically and by polysomnographic examinations during the follow-up period) and improvement in patients feeding and development.[13]

OSAS (Obstructive Sleep Apnea Syndrome) can cause growth retardation, attention deficits, or cognitive function disorders in children. Children with OSAS also experience reduced learning and problem-solving abilities compared to those of children without OSAS. OSAS increases the risk of cardiovascular and metabolic complications for both children and adults. Therefore, the diagnosis and treatment of OSAS are very important.

Severe cases of obstructive sleep apnea in children are treated with a permanent tracheostomy. There are many morbidities of long-term tracheostomies, including tracheomalacia, chronic bronchitis, throat tightness and dislocation of the tracheostomy. Therefore, it can be difficult to care for patients with tracheostomy. Distraction osteogenesis is the preferred treatment method in patients with obstructive sleep apnea due to mandibular shortness, other procedures, including orthognathic surgery, rib grafts, sternoclavicular grafts, and total joint prostheses have also been used to reconstruct the major facial and TMJ deformities associated with Treacher Collin Syndrome. In this case study, the patient was performed successfully by distraction osteogenesis. Mandibular advancement for the treatment of OSAS was initially performed using bilateral external distracters. External devices are advantageous because of their ease of use, manipulation and versatility. In this study, we performed distraction osteogenesis using internal devices in the treatment of obstructive sleep apnea. We considered an extraoral multi-vector distractor. Long term follow-up examinations are indicated in these patients in order to evaluate the effects of mandibular growth, airway relapse, and the need for additional surgical intervention. In this study, distraction osteogenesis was effective in advancing the mandible, increasing the upper airway space and eliminating OSAS.

For a long time, patients with obstructive apnea whose condition could not be managed with prone positioning were tracheotomized is an effective method of treatment in cases of severe obstructive apnea, but longstanding tracheotomies are associated with high morbidity, such as tracheomalacia, chronic bronchitis, and laryngeal stenosis, and risk of death due to a mucus plug or dislodgment of the tracheotomy tube. Patients who undergo tracheostomy require complex nursing care, and their parents require extensive education.[14]

Others procedures, such as glossopexy (in which the tongue is moved anteriorly and attached to either the mandible or the lip), have been used to provide an adequate airway. Many children with micrognathia have restricted air flow but not enough to prevent them from having a relatively “normal life.” However, when they are faced with any disturbance, such as an upper respiratory tract infection or palatal surgery, an obstructive respiratory condition may develop, requiring placement of an endotracheal tube. These patients usually have failure to thrive with a history of feeding problems, insufficient weight gain associated with malnutrition, higher pulmonary morbidity, and long-term hospitalizations, and their parents have much frustration. Distraction osteogenesis is a new technique to achieve mandibular lengthening in patients with mandibular hypoplasia. This technique is a good alternative to tracheostomy in young patients.

Several modalities of treatment for OSA (Obstructive Sleep Apnea) have evolved over the years. Non-surgical management includes weight loss, oral devices, Continuous Positive Airway Pressure [CPAP]. Since the etiology of respiratory obstruction was retrognathic and hypoplastic mandible, advancement was planned and achieved through distraction osteogenesis. The results were evidenced by the decrease in respiratory distress index in the polysomnograph, as well as an increase in the pharyngeal airway shadow in the lateral cephalometric radiographs. Distraction osteogenesis is an emerging treatment modality used for correction of severe hypoplasia of the jaws. It carries with it the advantages of minimal relapse and added stability. In this study the mandible had to be advanced by 20 mm.

Conventional osteotomies cannot achieve this magnitude of movement without bone grafting which has additional donor site morbidity. Though distraction osteogenesis of the jaws has been used to treat congenital hypoplasia in children, very few reports in the literature describe this as a definite modality in compromised airway following ankylosis of the temporomandibular joint. Distraction Osteogenesis (DO) has become accepted as an efficient treatment for severe mandibular hypoplasia and OSAS. The tongue base is carried anteriorly via its muscular attachments to the distracted mandible, thus pulling the tongue out of the hypopharynx and relieving the airway obstruction. This case demonstrates that DO had improved this patient’s airway restriction.

Various treatment options have been suggested for OSAS, including use of nasal continuous positive airway pressure, or an oral appliance to keep the mandible forward during sleep. Surgeries including uvulopalatopharyngoplasty, laser-assisted uvulopalatoplasty, maxillomandibular osteotomy, distraction osteogenesis, and hyoid suspension are other therapeutic alternatives for OSAS (Obstructive Sleep Apnea Syndrome). Distraction osteogenesis (DO) has become an effective surgical technique for correction of deformities in craniofacial region. It is a process in which osteotomised bone segments are mechanically moved by externally or internally placed devices to form new bone at the osteotomy site. DO has several advantages over conventional orthognathic surgery as it reduces surgical stress, requires no bone grafting, induces soft- tissue regeneration, and enables extensive bone lengthening. Because of these advantages, distraction is widely used for treatment of hypoplastic mandible and OSAS in a wide range of acquired and congenital disorders. In a recent prospective study, it has been shown that distraction osteogenesis results in considerable improvement of facial esthetics in case of severe mandibular deficiency.[15]

DISTRACTION PROTOCOL :

Distraction protocols[16]:- The protocol for distraction varies among different studies within a small range. The latency period ranged from 1 to 7 days. Children or infants were usually allowed for a shorter latency period of 1 to 5 days, while adult patients were allowed for 5 to 7 days. The protocol of distraction also varied among studies, ranging from 0.8 to 2mm per day in 1 to 4 rhythms. The consolidation period varied from 4 to 28.9 weeks, while the majority was in the range of 2 to 4 months. Some studies reported removal of distractors under local anesthesia or sedation, while others were all performed under general anesthesia, after the consolidation period was completed.

In another study, Zanaty O and colleagues have concluded that DO of mandible results in marked improved in apnea-hypopnea index in patients of obstructive sleep apnea. It has been shown that DO can also result in avoidance of need of tracheostomy in infants and young patients with severe airway obstruction due to mandibular micrognathia.

Ilizarov[4] popularised distraction osteogenesis. Mandibular lengthening by distraction osteogenesis was originally successful in experimental studies and then was adapted to the Conventional surgical procedures are extensive and are not advocated in early childhood due to their associated high risk.

The other disadvantages of conventional osteotomy procedures are: Surgical neurosensory complication, Condylar resorption, post-operative relapse, Bone graft failure, Bone graft donor site morbidity, Bone formation by secondary healing. To overcome these problems distraction osteogenesis is the treatment of choice for the reconstruction of temporomandibular joint ankylosis and Mandibular hypoplasia. The two major strengths of distraction osteogenesis in the Mandibular reconstruction are the ability to provide strong bone with excellent blood supply and the ability to provide effective expansion of the soft tissue envelope called distraction histogenesis and mandible by McCarthy et al. All these investigators used extraoral devices.

Distraction osteogenesis is a biological process of new bone formation between the surfaces of iatrogenically fractured bone segments that are gradually separated by incremental traction. A callus forms between the separated bony segments and as long as the traction proceeds, callus tissues are stretched inducing the bone formation. Distraction osteogenesis was first introduced by Codvilla in 1905 that used the technique to elongate femur. During 1950's the studies of Ilzarov made a contribution in development of the technique by elucidating the biological and mechanical principles in the formation of new bone. DO applied to craniofacial region since McCarthy et al in 1992 reported the first clinical application of technique in the treatment of four children with either unilateral or bilateral mandibular hypoplasia. Early in the history of this procedure, distraction osteogenesis of the mandible involved using bulky external distractors. Although these distractors still have a place in certain applications, a wide variety of intraoral distractors are now available; these are small and compact, with increased patient comfort and acceptance.[17]

However, during distraction osteogenesis, active histogenesis occurs in different tissues including gingiva, blood vessels, ligaments, cartilage, muscles and nerves. These adaptive changes in the soft tissues decrease the relapse risk and allow the treatment of severe facial deformities. Severe mandibular hypoplasia can lead to reduction of oropharyngeal capacity and glossoptosis because of the post location of the suprahyoid muscles into the mandible and thus airway obstruction, feeding difficulties, speech problem and sleep apnoea.

Hence, Distraction Osteogenesis is used to expand the mandibular size and soft tissue matrix. This creates a static open bite, facilitates mid-facial growth, and avoids compromise of the airway, speech, nutrition, and oral hygiene. To maintain these objectives, mandibular Distraction Osteogenesis may be repeated as the child matures. Once skeletal maturity is reached, Distraction Osteogenesis used to normalize occlusion and further expand the soft tissue envelope.

Because the tongue is held forward by its anterior muscular attachments to the mandible and hyoid bone, a lack of mandibular projection in patients with micrognathia may allow the tongue base to compress the epiglottis, leading to supraglottic obstruction. The primary objective of Mandibular Distraction is to advance the tongue base anteriorly via its muscular attachments to the distracted mandible, thus pulling the tongue out of the hypopharynx and relieving upper airway obstruction.

In the present study, 10 patients were included with TMJ ankylosis with unilateral or bilateral hypoplastic mandible, with obstructive sleep apnea syndrome leading to decreased oropharyngeal air way space, distraction osteogenesis was preferred in these patients, the predictable mandibular advancement is 20 mm approximately. Severe mandibular hypoplasia can lead to reduction of oropharyngeal capacity and glossoptosis because of the post location of the suprahyoid muscles into the mandible and thus airway obstruction, feeding difficulties, speech problem and sleep apnoea. In this study sleep apnoea is resolved and oropharyngeal airway space is improved after active distraction of about 4 to 5 months.

The causes and treatment of TMJ ankylosis have been well documented with trauma and infection identified as the two leading causes.

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In the present study, all the 10 samples are affected with TMJ ankylosis which results in mandibular retrognathism with obstruction of oropharyngeal airway space and functional deficits, devastating effects on the future growth and development of the jaws and teeth. Furthermore, in these patients it has a profoundly negative influence on the psychosocial development of the patient, because of the obvious facial deformity. Out of ten patients in this study 7 are female patients ,3 are male patients, in which all the 10 patients in this study are associated with TMJ ankylosis with asymmetrical mandible with difficulty in airway breathing. All the 10 patients in this study are associated with retrognathic mandible with obstruction in the upper air way space.

Mandibular retrognathia is one of the most common craniofacial deformities: approximately 10% of the population have significant dental overjet. Mandibular retrognathia may be acquired (due to trauma or a previous surgery) or may be associated with some syndrome like hemifacial microsomia, Treacher Collins, Peirre Robin, Goldenhar syndrome. After osteotomy is performed, distraction osteogenesis begins with the formation of a haematoma between the bone segments. The haematoma organizes into a clot, and bone necrosis occurs at the end of the fracture segments. An ingrowth of vaso-formative elements and capillaries occurs for the restoration of blood supply. Bony trabeculae grow into the fibrous area from the periphery, parallel to the line of tension that occurs during the distraction phase. A bridge of immature bone forms across the distraction gap. A poorly mineralised, radiolucent fibrous inter-zone is located in the middle of the distraction gap. During the consolidation phase, bony remodelling begins and fibrous tissue eventually matures into osseous tissue similar to the native bone.

In this present study ,all the 10 patients by analysing the cephalometrically using Mc. NAMARA ANALYSIS on lateral cephalogram, before distraction and after follow up with distraction of 4 to 5months, mandibular length has been increased clinically, radiographically and statistically which the results are from a mean of 79 % before distraction to a mean of 96 % after distraction osteogenesis of the mandible with standard deviation 3.27 % before distraction and 3.92 % after distraction ,with the mean change of 17.50 % of mandibular advancement after distraction with the t- value of 22.913 with p value 0.000 which is significant as shown in table -1 and fig -1.

In this study, the success of the distraction depends on the rate and rhythm of the force applied to site. The optimal rate of distraction is 1 mm per day. A distraction rate of less than 0.5 mm/day may cause premature consolidation of the bone. Distraction of more than 1.5 mm/day may cause delayed ossification or pseudoarthrosis due to local ischemia in the inter-zone.

The traditional latency period is 5–7 days. The consolidation phase is typically 8 weeks, although some adults may require up to 12 weeks of consolidation period.

Activation of distractors can often be performed on an outpatient basis, although some patients may require 1–2 days of hospitalisation for postoperative care. During the distraction phase, the patient is examined every 2–3 days to monitor the mandibular advancement and to detect oropharyngeal airway space, potential occlusal discrepancies.

The patients in this study have been treated as an inpatient, although admitted before operation day and hospitalised only for 2 days post-op. During distraction phase the patient was examined every day.

In this study, all the 10 patients' cephalometric values are measured by Steiner's analysis, which results in increase in the SNA angle and SNB angle after distraction osteogenesis of the mandible, with an increase of SNA angle distraction i.e. from 77.60 0 before distraction to 82.30 0 after distraction with standard deviation of 5.21% and 5.46 % before distraction and after distraction respectively, the paired t test shows 6.429 t –value and 0.000 p value which is significant. As shown in table 2 and fig 2.

In the present study of 10 patients, the overall SNB angle is also increased after the effective distraction of the mandible, the mean of SNB angle is 69.10% before distraction and 78.10% after distraction, with standard deviation of 3.843and4.701 before and after distraction respectively with mean change of 9.000. The t value is 9.000and p value is 0.000 which is significant as shown in table 3 and fig 3.

As the patients in this study are associated with obstructive sleep apnea syndrome due to micrognathia,

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these patients have The Apnea Hypopnea Index (AHI) which is less than normal i.e less than 5 events /hr.so, after the distraction osteogenesis of the mandible, all the 10 patients in this study have showed a decrease in the AHI by polysomnographic test or sleep study test before and after distraction of the mandible. On statistical results all the 10 patents in this study showed the mean AHI of 7.40 and 2.90 before and after distraction osteogenesis of the mandible respectively as shown in table 5, with t value 6.400 and p-value 0.000 which is significant.

On polysomnography, all the 10 patients' Average oxygen saturation was increased after distraction of the mandible with mean of 90.40 % and 95.90 % before and after distraction respectively as shown in table 6, with the mean change of 5.500 %, with t value of 8.199 and p value of 0.000 which is significant.

In this present study, all the 10 patients were under went over night sleep study test, before and after distraction osteogenesis of the mandible, resulting in decrease in the Hypopnea Index after distraction. The Hypopnea Index with correlates two events:

1) % flow limit breathing without snoring normal value (FL) is <60%

2) %flow limit breathing with snoring normal (FS) value is <40 %

After overnight polysomnography all the ten patients Hypopnea Index is decreased after distraction of the mandible which is shown in the table 7,7a,7b, with the mean of 33.80% of FL before DO and 20.60% after DO.

The mean of the FS is 25.30 % before DO and 15.80 % after distraction of the mandible shown in table 7,7a,7b.

The Oropharyngeal Airway (OPA) space is increased after distraction of the mandible, the linear dimensions of the OPA space is measured on lateral cephalogram, by tracing and measuring the linear dimensions of oropharyngeal airway space on lateral cephalogram before and after distraction osteogenesis, the statistical results showed the mean of 12.30% of upper airway space before distraction and 15.80 % after distraction of the mandible shown in table8,8a,8b

The mean of lower airway space is 8.80% before distraction of the mandible and the 12.50 % after distraction of the mandible with t value of 5.351 of upper and lower airway space before distraction ;6.659 t value of upper and lower airway space after distraction osteogenesis of the mandible with p value of 0.000 which is significant as shown in table 8, 8a, 8b.

On overnight polysomnography test, all the 10 patients showed a normal range of lowest oxygen saturation after distraction of the mandible i.e from 90% - 98% shown in table 10.

Conclusion

The results of the study concluded that after distraction osteogenesis of the mandible with Obstructive Sleep Apnea Syndrome associated with hypoplastic mandible there is:

1. An increase in the mandibular length clinically and radiographically

2. Decrease in Apnea Hypopnea Index, Hypopnea Index by polysomnopgraphic test.

3. Increase in Average oxygen saturation and decrease in snoring events

4. Increase in the oropharyngeal air way space measured on lateral cephalogram.

Further, the study concludes that the Mandibular distraction osteogenesis is an effective treatment in treating the patients with mandibular deformities associated with unilateral or bilateral TMJ ankylosis and also in treating the patients with obstructive sleep apnea syndrome. The results concluded that the Mandibular Distraction Osteogenesis is a successful treatment in treating the upper Airway Management and stated that Mandibular retrognathia may cause upper airway obstruction in the paediatric patient due to tongue collapse and physical obstruction in the hypopharyngeal region. Most commonly, the aetiology of upper airway obstruction is associated with a craniofacial malformation or other anomaly such as Pierre Robin sequence, Treacher Collins syndrome, hemifacial (craniofacial) microsomia, Nager syndrome that include mandibular anteroposterior hypoplasia, or developmental failure of growth of the mandible in utero, these disorders in the individual patient is responsible for the wide range of respiratory compromise that is observed clinically in terms of disordered breathing and inability to maintain appropriate levels of arterial oxygen saturation and concluded that Mandibular distraction osteogenesis (MDO) is a viable option for the paediatric patient with upper airway obstruction due to mandibular deficiency to avoid a tracheostomy or other surgical intervention.

Hence Mandibular Distraction Osteogenesis produces the mandibular advancement in patients with mandibular hypoplasia, such that the oropharyngeal airway obstruction is released.

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