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Review Article

Efficiency of distraction osteogenesis maxillary expansion in treatment of obstructive sleep apnea: A systematic review and meta-analysis

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Abstract

One type of sleep disturbance known as obstructive sleep apnea syndrome (OSA syndrome) is defined by partial or complete obstruction of the upper airway and the ensuing halt of airflow during sleep, which frequently results in arousals and oxygen desaturation. The genesis of the disease is a heterogeneous collection of symptoms that can range from excessive daytime sleepiness to snoring and co-occur with severe neurological, behavioural, and hemodynamic consequences. The main objective of this systematic review was to assess the efficiency of the Distraction Osteogenesis Maxillary Expansion (DOME) in treatment of obstructive sleep apnea. The title and the abstract of each study were reviewed and critically assessed by two independent reviewers. articles, binding to apply the selection criteria were the integration of the searched outcomes to delete duplicate entries, examination of titles and abstracts to delete clearly irrelevant articles, recovery of the full text of potentially relevant articles ,binding and gathering of multiple articles of the very same study, examination of the articles' full text to verify the degree of compliance that the studies had with the eligibility criteria and deciding about the study's inclusion and proceeding with data gathering.

Four studies were included in this review whose general characteristics are explained in detail. The included studies were conducted in different parts of world with three in USA and one in Japan. Among the included studies, two were prospective clinical studies and two were retrospective studies. A total of 147 participants were included in this review of which 82 were males and 65 were females. All the included participants were diagnosed with OSA on the basis of attended polysomnography. Outcomes such as Epworth Sleepiness scale score, Nasal obstruction symptom evaluation (NOSE) score, airway measurements, apnea-hypopnea index (AHI), etc. were evaluated in these studies.

The conclusions of studies indicated that DOME treatment was effective in improving the outcome parameters and thus reduced the severity of OSA.

Keywords: Obstructive sleep apnea, Distraction osteogenesis maxillary expansion, Maxillary expansion, Airway.

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1. Introduction

One type of sleep disturbance known as obstructive sleep apnea syndrome (OSA syndrome) is defined by partial or complete obstruction of the upper airway and the ensuing halt of airflow during sleep, which frequently results in arousals and oxygen desaturation.[1] The genesis of the disease is a heterogeneous collection of symptoms that can range from excessive daytime sleepiness to snoring and co-occur with severe neurological, behavioural, and hemodynamic consequences. The recommended treatments for OSAS in children have included adenotonsillectomy and, in some cases, continuous positive airway pressure (CPAP); however, neither procedure is able to completely improve the condition. Recently, speech therapy and intraoral devices have been proposed as minimally invasive treatments.[2,3] Rapid maxillary expansion, or RME, is one of the intra-oral devices that has been utilized to treat OSAS in children. However, the effectiveness of this procedure in reducing OSAS symptoms has only been assessed in a small number of investigations. Rapid palatal expansion (RPE) is frequently performed in patients to expand the maxilla and is acknowledged as a legitimate supplementary treatment in children with OSA.[4,5] DOME was created to meet the requirement for quick adult maxillary expansion using less invasive osteotomy and a mini-implant-assisted expander. DOME improves perceived nasal breathing and increases intraoral volume for the tongue by changing the palatal

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vault's morphology from a narrow, high-arched shape to a dome. Due to the advent of mini-implants for the facial bones, the adult maxilla can be expanded using the Distraction Osteogenesis Maxillary Expansion (DOME) procedure, which is comparable to paediatric RME.[6]

So therefore, adults with transverse maxillary atresia are treated with distraction osteogenesis maxillary expansion (DOME) or surgically aided rapid maxillary expansion (SARME). The process known as SARME was initially documented in 1938 and it has since gained widespread recognition as a low-risk, low-complication method for maxillary expansion.[7] In 2016, SARME was administered to adult patients with OSA, and the condition showed good improvement.[8] The Distraction Osteogenesis Maxillary development (DOME) technique was created at Stanford for adult OSA patients with narrow and high arch palates to improve the predictability of maxillary skeletal development in adults DOME combines a procedure which include placement of maxillary expander with mini-implants (by orthodontist), then maxillary osteotomy by (surgeon) expansion followed by re-establishment of occlusion (done by orthodontist).[9] Snoring is always a sign of some level of airway blockage. Despite being first thought to be "benign," it is now understood that snoring may be linked to sleep disturbance when it occurs without obstructive sleep apnea (OSA) or hypoxemia during sleep.[10] Guillemin Ault et al, investigated the connection between the etiology of OSA and maxillary constriction, and they found that family members of OSA patients tend to have narrow, high palates. The standard of care for moderate to severe OSA has been continuous positive nasal airway pressure. Patients with mild to moderate OSA are treated with mandibular advancement splints. Rapid maxillary expansion (RME) has recently been proposed as a therapy option for OSA. RME improves intranasal capacity, decreases nasal resistance, and widens the maxilla. A 45–55% decrease in nasal airway resistance was documented by Hershey et al. and persisted after the appliance was removed.[11]

The anchorage perspective has undergone a paradigm shift with the invention of implants, making it feasible to enhance anchorage during rapid maxillary expansion without the need for dental support. Mini screws have been employed as a method of complete orthodontic support. Instead of causing the maxillary alveolar shelves to flex, bone-anchored palatal expanders were said to transfer the expansion stresses straight to the palatal bone, increasing skeletal movement. This could lead to more efficient mechanics, less detrimental oral consequences, and greater physiologic sutural expansion.[12]

For patients with jaw abnormalities, distraction osteogenesis (DO), which can promote bone growth and soft tissue expansion at the same time, has emerged as a successful surgical approach.[13]

DOME employs limited LeFort I osteotomy, which eliminates the need for pterygoid plate fracture. In an anterior maxillary approach, the left and right maxilla are separated using osteotomes and a piezoelectric saw. A small space between the maxillary central incisors is seen as the suture opens. To ensure that the screw threads are intact and that the maxilla may be separated symmetrically and easily on both sides, the expander screw is turned. While those who present with severe OSA are observed overnight, patients with mild to moderate OSA can be released on the day of surgery. Blood loss is not very high. Concurrent septoplasty may be used, particularly in patients who have a significant posterior septal deviation at the vomer area.[14]

There are many other distraction regimens, such as 1-mm initial activation followed by 0.25 mm twice daily every two weeks, 0.8 mm divided into 4 activation steps per day, and 0.75 mm/d or 3-time activation employing a Hyrax device.[15] McCarthy et al. used distraction osteogenesis on the human jaw for the first time in 1992. In 1998, Liou and Huang used a method known as "Dental distraction" to quickly retract canines in order to use DO to orthodontic treatment for the first time in 2001. Later, Iseri et al. and Kisnisci et al. created a distinct method for quick canine distalization utilizing osteotomies dubbed "dentoalveolar distraction. “Several disorders, such as congenital and acquired deformities of the jaw, midface, zygomatic bones, and calvarium, condylar reconstruction in temporomandibular joint ankylosis, and facial traumas, including non-healing fractures, can be effectively treated using intraoral DO. Orthognathic surgery is not the first option for cases of syndromic (Pierre-Robin, Goldenhar, Treacher Collins, Facial Clefts, Alveolar Clefts, Cranial Microsomia) or calvarial, fronto-orbital complex hypoplasia, and non-syndromic bimaxillary shortening, such as retrognathic mandible in Obstructive Sleep Apnea (OSA), or calvarial situations.[16]

Significant new therapy options for both mild and severe skeletal abnormalities have been made possible by distraction osteogenesis of the craniofacial skeleton. The development of effective and precise mini distraction devices is anticipated to greatly improve the capacity to correct for moderate skeletal growth anomalies. Small transcutaneous screws will be used to adjust these devices, which will be buried beneath the skin. As a result, the surgeon and orthodontist are now partners in a process that progressively modifies the size and course of craniofacial development.[17]

The healing phase is the primary distinction between osteotomy/corticotomy in DO and traumatic fracture. Instead of endochondral ossification, membrane ossification takes place in the distraction-produced gap due to the gradual expansion and regulated microtrauma in DO. Only when the callus has begun to form is distraction force applied to the bone segments. Periodically separating the bones will cause tension in the callus, causing the callus tissue to align parallel

to the force. The distraction force is stopped once the appropriate bone length is reached, and the newly produced bone is allowed to mature and remodel.[18]

Hence, the principal objective of this systematic review to evaluate the efficiency of the Distraction Osteogenesis Maxillary Expansion in the treatment of Obstructive Sleep Apnea.

2. Materials and Methods

The systematic review conducted in this study followed a rigorous and well-established methodology to ensure the reliability and transparency of the research results. It rigorously complied with the guidelines in the Cochrane Handbook for Systematic Review of Interventions. Furthermore, this systematic review was conducted with great attention to detail. By adhering to PRISMA, every aspect of the research process, including study selection, data extraction, and analysis, was transparently documented, allowing readers to evaluate the quality and validity of the review's findings.

Additionally, the review also followed the PRISMA extension statement that pertains specifically to network meta-analyses of healthcare interventions. Network meta-analyses are advanced statistical methods used to compare multiple interventions simultaneously, and the PRISMA extension for network meta-analyses provides supplementary guidance to ensure that these complex analyses are conducted and reported with precision and clarity.

2.1. Focused question

What is the effectiveness of Distraction osteogenesis maxillary expansion in the treatment of Obstructive sleep apnea?

2.2. Search approach

Studies were selected based on the PEOS inclusion criteria in the review protocol. Two reviewers assessed titles and abstracts to identify potentially eligible studies. Any queries were discussed with a third reviewer. The preferred reporting Items for Systematic Reviews and Meta- Analyses (PRISMA) for conducting a meta-analysis were followed. The electronic data resources consulted for elaborate search were Cochrane, Central Register of Controlled Trials (CENTRAL), MEDLINE, CINAHL EMBASE, PsycINFO, Scopus, ERIC, ScienceDirect with controlled vocabulary and free text terms Articles published until 31/03/2024 were searched, without any restriction concerning the publication's language.(**Figure 1**)(**Table 1, Table 2**)

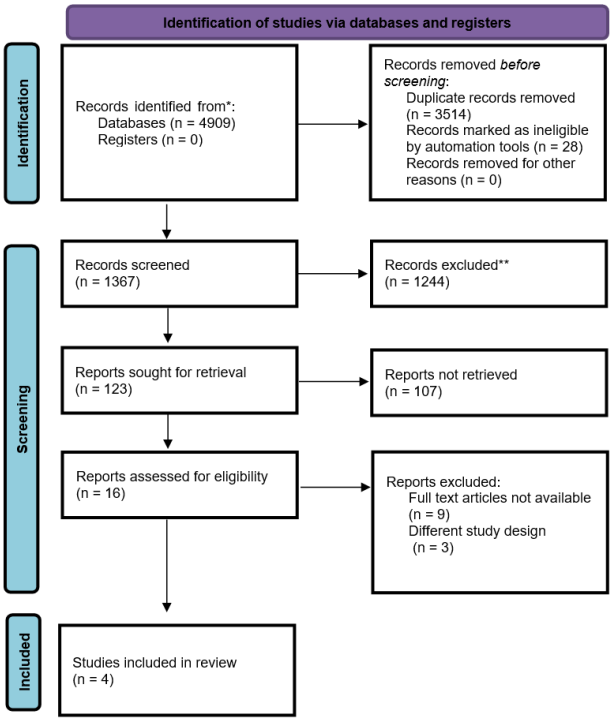


Figure 1: PRISMA check list

Table 1: PICO criteria

Population	Patients diagnosed with obstructive sleep apnea.
Exposure	Participants exposed with DOME as a treatment for obstructive sleep apnea
Comparison	Studies including no comparison group or comparison group without any treatment
Outcome	Studies giving information about success of treatment, patient compliance, patient satisfaction, airway health measured using different parameters like Epworth Sleepiness scale (ESS), nasal obstruction symptom evaluation (NOSE), rhinomanometry, CT measurements, etc.

Table 2: Key and concept table words

Population	Exposure	Outcomes	Study design
1. Adults 2. Obstructivesleep apnea 3. Sleep apneasyndrome	1. Distraction osteogenesis maxillary expansion	1. Treatmentsuccess 2. Patient compliance 3. Patient satisfaction 4. Airway health	1. Randomizedclinical trials 2. Non- randomized clinical studies 3. Retrospectivestudies 4. Cross-sectionalstudies 5. Quasi- experimental studies

2.3. Inclusion criteria

1. Randomized clinical trials, non-randomized clinical studies retrospective studies, cross-sectional studies, quasi-experimental studies were included.
2. Studies published in any language where English translation is possible.
3. Studies published till 31/03/2024.
4. Studies with full text articles were included.

2.4. Exclusion criteria

1. Studies not fully available in the database
2. Reviews reports, case reports, case series and animal studies were excluded.
3. Studies providing only abstract and not full text.
4. Studies not mentioning required outcomes were excluded.

2.5. Screening and selection

The search and screening process was a collaborative effort involving two researchers, and their level of agreement was quantified using a κ coefficient of 0.83, indicating a substantial level of consensus. The process followed a structured framework consisting of four stages. In Stage 1, citations that lacked relevance were promptly excluded from further consideration. Moving to Stage 2, one reviewer meticulously assessed the titles and abstracts of all retrieved articles to determine their alignment with the predefined inclusion criteria.

Articles clearly falling outside the scope of inclusion parameters were promptly excluded, while those with unclear relevance underwent a thorough examination of their full content. When uncertainties arose, a second reviewer's input was sought for clarification. Advancing to Stage 3, all articles selected during Stage 1 underwent a rigorous evaluation by two independent reviewers to confirm their alignment with established eligibility criteria. This phase involved the exclusion of articles with inappropriate study designs or deficiencies in baseline and endpoint outcome measurements.

Articles lacking proper referencing were also excluded. Finally, during Stage 4, all articles deemed suitable for inclusion underwent a comprehensive examination, with relevant data extracted from each. The clinical methodologies employed in all scrutinized studies were critically appraised, focusing on the specifics of interventions and outcomes investigated within each individual study.

2.6. Data extraction

Two reviewer's independently extracted data from the included studies Disagreements were again resolved through discussion. Data gathered was carried out using a verification list of items that were considered for data extraction. Details regarding the publication and the study, the participants, settings, the interventions, the comparators, the outcome measures, study design, statistical analysis and results, and all other relevant data (funding; conflict of interest etc.) were carefully and accurately extracted from all included studies. Data extraction was done and accurately recorded in the excel sheets for all the primary outcomes separately.(**Table 3**)

Table 3: Results

S.No.	1
Year	2017
Author name	Stanley Yung-Chuan Liu, Christian Guillemin Ault, Leh-Kiong Huon, and Audrey Yoon
Title	Distraction Osteogenesis Maxillary Expansion (DOME) for Adult ObstructiveSleep Apnea Patients with High Arched Palate
Country	USA
Study design & samplesize	Prospective cohort study & 20
Gender (Male & Female)	16 & 4
Intervention **Outcome assessed** ● Epworth Sleepiness scale (ESS) ● Nasal obstruction symptomevaluation (NOSE) ● Rhinomanometry ● CT measurements	DOME surgical procedure ● **(**ESS) Pre & Post: 12.4 +/- 4.1 & 7.8+/-4.8 ● (Nose) Pre & Post: 11.7 +/-5.3 & 3.85+/- 3.23 ● (AHI index) apneahypoapnea index pre & post: 30.9+/- & 14.2+/-9.3 ● Oxygen desaturation index (ODI) Pre & Post: 23.0+/- 28.4 & 8.7+/- 6.9
Author's Conclusion	DOME is conceived to widen the maxilla of adult patients with OSA with high arched palate and normal occlusion. It requires minimal maxillary

	osteotomies to reliably expand the adult maxilla.
S.No	2
Year	2019
Author name	Mohamed Abdelwahab, Audrey Yoon, Tyler Okland, Sasikarn Poomkonsarn, Chris Gouveia, and Stanley Yung- Chuan Liu
Title	Impact of Distraction Osteogenesis Maxillary Expansion on the Internal Nasal Valve in Obstructive Sleep Apnea
Country	USA
Study design & Sample size	Clinical Study & 32
Gender (Male & Female)	7 & 25
Intervention **Outcome assessed** • Epworth Sleepiness scale, (ESS) • Nasal obstruction symptom evaluation, (NOSE) • CT measurements	DOME surgical procedure **(ESS) Pre & Post**: 10.30+/-5.44 & 6.53+/-5.17 **(Nose) Pre & Post**: 10.87+/-4.7 & 3.27+/-2.03
Author's conclusion	DOME was effective in improving ESS and NOSE scores. The improvement is correlated with widening of the INV angle and SA. (Internasal valve and Surface area)
S.No	3
Year	2019
Author name	Tomonori Iwasaki & Audrey Yoon & Christian Guillemin Ault & Youichi Yamasaki1 & Stanley Yung Liu
Title	How does distraction osteogenesis maxillary expansion (DOME) reduce severity of obstructive sleep apnea?
Country	Japan
Study design & sample size	Retrospective study & 20
Gender (Male & Female)	5 & 15
Intervention **Outcome assessed** • **AHI** • **ODI** • **Airway size**	DOME surgical procedure • (Ahi index) Apneahypoapnea index Pre & Post: 17.81+/-17.56 & 7.82+-7.11 • Oxygen desaturation index (ODI) PRE & POST: 9.67+/-15.84 & 4.92+/-5.88 • Pharyngeal airway volume: 16.00+/-5.57 & 18.20+/-6.19 • Intraoral airway volume: 2.41+/-4.54 & 1.08+-3.08
Author's conclusion	Anatomic expansion of the nasal floor with widening of the hard palatal vault from DOME is associated with reduction of nasal airflow velocity and downstream reduction of negative pressure in the pharyngeal airway. This dynamic interaction correlates with a reduction in the apnea-hypopnea index (AHI) and Oxygen Desaturation Index (ODI)
S.No	4
Year	2019
Author name	Audrey Yoon, Christian Guillemin Ault , Soroush Zaghi , Stanley Yung-Chuan Liu
Title	Distraction Osteogenesis Maxillary Expansion (DOME) for adult obstructive sleep apnea patients with narrow maxilla and nasal floor
Country	USA
Study design & sample size	Retrospective study & 75
Gender (Male & Female)	57 & 18
Intervention **Outcome assessed** • **Epworth Sleepiness scale, (ESS)** • **Nasal obstruction symptom evaluation**	DOME surgical procedure • (ESS) Pre & Post: 10.48+/-5.4 & 6.69+/-4.75 • (NOSE) PRE & POST: 10.94+/-5.51 & 3.28+/-2.89 • (AHI index) Apneahypoapnea index Pre & Post: 17.65+/-19.30 & 8.17+/-

(NOSE)	8.47 • Oxygen desaturation index (ODI) Pre & Post: 13.06+/-18.46 & 5.14+/-5.9
Author's conclusion	DOME treatment reduced the severity of OSA, refractory nasal obstruction, daytime somnolence, and increased the percentage of REM sleep in this selected cohort of adults OSA patients with narrow maxilla and nasal floor.

Table 4: Risk of bias for clinical studies

Study ID	**Liu 2017**	**Abdelwahab 2019**
Confounding Bias	Low	Low
Selection Bias	Low	Low
Misclassification Bias	Low	Unclear
Bias due to deviation from intended interventions	Low	Low
Bias due to missing data	Low	Low
Bias in measurement of outcomes	Low	Low
Bias due to selective reporting of results	Low	Low
Overall risk of bias	Low	Moderate

Table 5: Risk of bias for retrospective studies

Study Id	**Selection**				**Comparability**		**Outcome**		**Total score**	**Risk of bias**
	Represent-ativeness of sample	**Sample size**	**Non-responders**	**Ascertainment of exposure**	**Main factor**	**Additional factor**	**Assessment of outcome**	**Statistical test**		
Iwasaki 2019[6]	*	-	-	*	*	-	*	*	5	Low
Yoon 2019[7]	*	-	*	*	*	-	*	*	6	Low

2.7. Search and selection

The results of the study selection process showed that a total of 4 studies were included in the review. These studies were conducted in different parts of the world, with three in the USA and one in Japan. Two of the studies were prospective clinical studies, while the other two were retrospective studies. The total number of participants included in the review was 147, with 82 males and 65 females. All participants were diagnosed with obstructive sleep apnea OSA) based on attended polysomnography The outcomes evaluated in these studies included the Epworth Sleepiness scale score, Nasal obstruction symptom evaluation (NOSE) score, airway measurements, apnea-hypopnea index (AHI), and oxygen desaturation index (ODI). The conclusions of the studies indicated that DOME treatment was effective in improving these outcome parameters and reducing the severity of OSA.

2.8. Assessment of risk of bias

For non-randomized studies, ROBINS-I checklist[3] was used to perform quality assessment The ROBINS-I tool covers seven domains through which bias might be introduced into a non-RCT: Bias due to confounding, Selection bias, Miss-classification bias, Bias due to deviation from intended interventions, bias due to missing data, bias in measurement of outcomes, Reporting bias. For ROB assessment of retrospective studies, Newcastle Ottawa tool adapted for cross sectional study was used.(**Table 4**)

2.9. Risk of bias across studies

Among the included clinical studies, one study showed low risk of bias, and one showed moderate risk of bias. In study by Abdelwahab 2019, information related to misclassification bias was unclearly mentioned, which led to moderate risk in this study. All the included retrospective cross-sectional studies showed low risk of bias. Sample size calculation was not mentioned in any of the studies. (**Table 5**)

All the included retrospective cross-sectional studies showed low risk of bias. Sample size calculation was not mentioned in any of the studies. The studies showed no risk in comparibility and outcomes domains of the ROB tool

2.10. Meta-analysis

2.10.1. Meta-analysis was conducted on the studies that provided information on similar outcomes assessment of heterogeneity

Clinical heterogeneity refers to differences between studies with regards to the participants, interventions, comparators, settings, and outcomes. Methodological heterogeneity refers to the study design and the methodological quality of the studies (risk of bias).

The (I) square statistic (I^2) represents the percentage of the variability in effect estimates that isdue to heterogeneity. I^2 is the proportion of observed dispersion of results from different studies included in a meta-analysis that is real, rather than spurious.

Heterogeneity was considered statistically significant if $P < 0.05$. A rough guide to the interpretation of I^2 given in the Cochrane handbook is as follows:

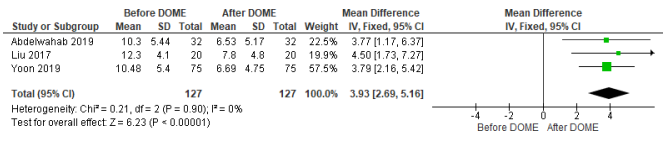
1. From 0 to 30%, the heterogeneity might not be important.
2. From 30% to 60%, it may represent moderate heterogeneity.
3. From 50% to 90%, it may represent substantial heterogeneity.
4. From 75% to 100%, there is considerable heterogeneity.

2.11. Meta-analysis

Quantitative analysis was conducted on studies providing mean and standard deviation values on similar outcomes. Meta-analysis was conducted on 4 parameters - Epworth Sleepiness scale (ESS), Nasal obstruction symptom evaluation (NOSE), apnea-hypopnea index (AHI) and oxygen desaturation index (ODI).

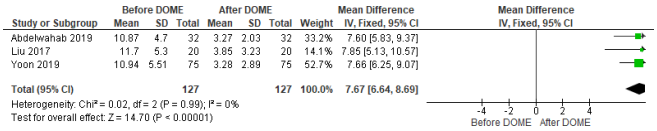
2.11.1. ESS

Three studies were included in the pooled assessment of ESS. A total of 127 participants were evaluated. The pooled mean difference obtained was 3.93[2.69, 5.16] indicating that there was reduction in ESS score after DOME treatment. Overall, the results were statistically significant (p<0.05). A fixed effects model was used for assessment as overall heterogeneity was low (I^2=0%).



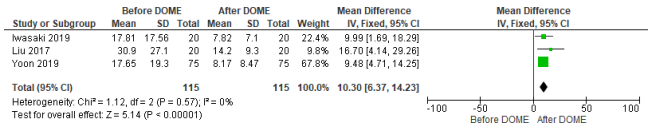
2.11.2. Nose

Three studies were included in the pooled assessment of NOSE. A total of 127 participants were evaluated. The pooled mean difference obtained was 7.67[6.64, 8.69] indicating that there was reduction in NOSE score after DOME treatment. Overall, the results were statistically significant (p<0.05). A fixed effects model was used for assessment as overall heterogeneity was low (I^2=0%).



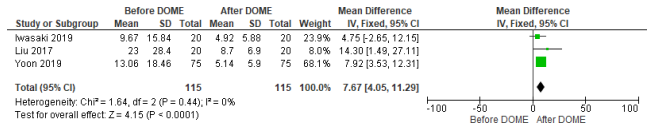
2.11.3. AHI

Three studies were included in the pooled assessment of AHI. A total of 115 participants were evaluated. The pooled mean difference obtained was 10.30[6.37, 14.23] indicating that there was reduction in AHI score after DOME treatment. Overall, the results were statistically significant (p<0.05). Fixed effects model was used for assessment as overall heterogeneity was low (I^2=0%).



2.11.4. ODI

Three studies were included in the pooled assessment of ODI. A total of 115 participants were evaluated. The pooled mean difference obtained was 7.67[4.05, 11.29] indicating that there was reduction in ODI score after DOME treatment. Overall, the results were statistically significant (p<0.05). A fixed effects model was used for assessment as overall heterogeneity was low (I^2=0%).



3. Discussion

The outcomes evaluated in these studies included the Epworth Sleepiness scale score, Nasal obstruction symptom evaluation (NOSE) score, airway measurements, apnea-hypopnea index(AHI), and oxygen desaturation index (ODI). The conclusions of the studies indicated that DOME treatment was effective in improving these outcome parameters and reducing the severity of OSA.

Quantitative analysis was conducted on studies that provided mean and standard deviation values for similar outcomes. Meta-analysis was performed on four parameters: Epworth Sleepiness scale (ESS), NOSE, AHI, and ODI.

For the ESS parameter, three studies were included in the pooled assessment, with a total of 127 participants evaluated. The pooled mean difference obtained was 3.93, indicating a reduction in ESS score after DOME treatment. The results were statistically significant.

For the NOSE parameter, three studies were included in the pooled assessment, with a total of 127 participants evaluated. The pooled mean difference obtained was 7.67, indicating a reduction in NOSE score after DOME treatment. The results were statistically significant.

For the AHI parameter, three studies were included in the pooled assessment, with a total of 115 participants evaluated. The pooled mean difference obtained was 10.30, indicating a reduction in AHI score after DOME treatment. The results were statistically significant.

For the ODI parameter, three studies were included in the pooled assessment, with a total of 115 participants evaluated. The pooled mean difference obtained was 7.67, indicating a reduction in ODI score after DOME treatment. The results were statistically significant.

Overall, the results of the meta-analysis showed that DOME treatment was effective in improving the outcome parameters and reducing the severity of OSA. The results were statistically significant for all four parameters included. These findings suggest that DOME treatment may be a promising approach for managing OSA. However, further research is needed to confirm these results and to explore the long- term effects of DOME treatment on OSA outcomes.

4. Conclusion

The initial search yielded 4909 titles, with 123 relevant titles selected for full-text evaluation.

1. After applying inclusion and exclusion criteria, 4 studies were included in the qualitative synthesis and quantitative assessment.
2. The studies were conducted in different parts of the world, with 3 in the USA and 1 in Japan.
3. The participants were diagnosed with OSA, and various outcome measures were evaluated.
4. The conclusions of the studies indicated that DOME treatment was effective in improving outcome parameters and reducing the severity of OSA.
5. Meta-analysis was conducted on 4 parameters: Epworth Sleepiness scale (ESS), Nasal obstruction symptom evaluation (NOSE), apnea-hypoapnea index (AHI), and oxygen desaturation index (ODI).

The results of the meta-analysis showed statistically significant reductions in ESS, NOSE, AHI, and ODI scores after DOME treatment.

5. Source of Funding

None.

6. Conflict of Interest

None.

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