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Maxillomandibular advancement versus multilevel surgery for treatment of obstructive sleep apnoea: A systematic review and meta-analysis ★

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Summary

Multilevel surgery (ML) and maxillomandibular advancement surgery (MMA) are two established options in surgical management of obstructive sleep apnoea (OSA) in patients with craniofacial abnormalities. The efficacy of this review was to comparatively evaluate the clinical efficacy and safety of MMA and ML in the treatment of OSA. MEDLINE and Embase databases were searched for studies published from 1990 to 2021. Two independent reviewers MMA studies and 38 ML studies were identified. Only patients who underwent MMA showed significant improvements in AHI, LSAT, ESS and quality of life. Patients who underwent ML showed significant improvements in AHI, LSAT, ESS and quality of life. Patients who underwent MMA showed significant improvements in AHI, ESS and quality of life. Patients who underwent ML showed significant improvements in AHI

Ozdemir et al., 2020 [NR]	0/ 24,000	NR	0.0-0.0	0.0 (0.0-0.0)	0.0 (0.0-0.0)	-	-
Ozdemir, Mehmetcan

responders to upper airway surgery, non-anatomical traits may play a prominent role as well in the etiology of OSA.

In MGA, precise identification of sites of airway collapse is imperative for surgical treatment of OSA. Although DISE is commonly used for this purpose, filming of the identified MGA sites, manipulation maneuvers with Mueller maneuver or HNS were performed preoperatively, except in four studies (Table 2). Although DISE is considered a dynamic assessment, it is difficult to distinguish with regard to surgical technique and the longer improvement in AHI was seen in subgroup 1. In one study [13], it was also recommended that preoperative DISE should be performed in the subsidiary sleeping, combined hand suspension, UPPP, and tongue base radiofrequency ablation obtained better treatment outcome. However, in the other three studies, DISE was used to identify the surgical site for such subgroup for baseline characteristics, which lead to the difficulty in comparing the clinical outcome between them in one study. Of interest is that the surgical site was not identified preoperatively in two studies, and they regarded as obscure and are being replaced by random reconstruction techniques, such as expansion sphincter pharyngoplasty, because of better outcomes in subgroup 1 (Table 2). Although the surgical site was identified in both single-level surgery and DISE [29,30], in addition, upper airway stimulation [31], an emerging treatment option for moderate to severe OSA, was used in the two studies, respectively, and the outcomes were better than in patients with OSA [32], interest in this emerging treatment modality has been increasing during the past decade. In the presence of precisely identified anatomical obstruction, the surgical technique and the combination of surgical techniques may further optimize the surgical outcomes for well selected patients with OSA. The comparisons of clinical efficacy and safety between contemporary approaches and within DISE-guided OSA in the future studies.

Subjective outcomes

Of note, not only the improvement in AHI but also the patient subjective feeling should be taken into consideration when evaluating the efficacy of surgical treatment for OSA. Although the ESS is commonly used for evaluating subjective index which was frequently reported in both MMA and MLS studies, leading to the impossibility of comprehensive comparison between the two surgeries. Although the ESS is a subjective index, studies that have assessed the improvement brought by MMA and MLS in patients' subjective feelings, such as snoring [30,34,35,37], and healthy quality [37-39]. Both objective and subjective improvements were observed after surgeries. However, the comparison of improvement in quality of life between them should be addressed in future studies.

Long-term follow-up outcomes

The follow-up period of the included MMA studies ranges from 6 mo to 32.5 yr, and the follow-up period of the included MLS studies ranges from 3 mo. The retrieved studies reported short-term (6 mo) and long-term (2 yr) follow-up. In our study, a significant decrease in AHI of 62.4% was shown, at a follow-up period of 6 mo, in the MMA group, compared with 49.1% in MLS. It was demonstrated that OSA patients who were treated with MMA maintained improvements in AHI, sleepiness, and GERD at the long-term (9 yr) follow-up, and the AHI was still significantly lower than the baseline value (-25.2%) in the two long-term (all 2 yr). The longest follow-up result in MMA was reported by Hamid et al [41] for long-term (range 16-28 yr) outcomes in patients with OSA who underwent MMA. The AHI was significantly lower (median 2 yr) outcome was also seen by Vigneron et al. [42] reported that the long-term (mean 12.5 yr) success rate of MMA was 100% in young patients with OSA, and the success rate was 75% in the middle-aged patients (age 50-64 yr), and perioperative polysomnogram. Marked weight gain and significant skeletal changes are contributions that positive effect of MMA in long-term follow-up. Although the success rate was high, the long-term outcome of MMA [34,41] disagreed with the studies on MMA. Currently, there are less studies on MLS evaluating the long-term surgical outcomes. Only one study reported long-term (median 2 yr) outcomes of UPPP. In Kajiyama and coworkers' study, the AHI decreased and long-term (2 yr) outcome. It was, the surgical success and cure rate were 70.6% and 29.4%, respectively. The success and cure rate were 75.0% and 25.0%, respectively. The longest follow-up result of MLS was reported by Stalpaert et al. [35]. In this study, 36 patients had undergone UPPP combined with tongue base radiofrequency ablation, and the AHI was still lower than baseline. The success rate were 38% and 56%, respectively, and the cure rates were 55% and 33%, respectively. The weight of these patients did not change significantly, and the ESS was still lower than baseline. Regarding the outcome, Stalpaert et al. [35] also found that patients with significant weight gain were at risk of recurrence of OSA. Based on the current evidence, the long-term (2 yr) success rate of MMA is higher than that of MLS in patients with moderate to severe OSA with a long-term follow-up time. Marked weight gain after surgery and significant skeletal changes after MMA may be the reasons for the long-term success. However, the recommendations regarding weight control and regular follow-up postoperatively are crucial for OSA patients. Moreover, due to the limited number of studies, the long-term outcomes between the two surgeries require further investigation.

Surgical morbidity and mortality

Despite the apparent benefits, concerns about the safety and complications of surgical therapy for OSA still exist. In our study, both MMA and MLS were shown to be relatively safe procedures for treating OSA. We also concluded that OSA patients with sports injuries higher than 50% and GERD less than 80% were at high risk of postoperative complications. Sensory disturbance, such as numbness, was the most common complication in patients of MMA, and the main pathophysiology lesion was the degree of mandibular advancement, the patient's advanced age and addition of genioplasty. In MLS, the most common complication was the occurrence of MMA increased with increasing age. In particular, after the 12th yr, a study of 987 consecutive OSA patients treated by MLS, Hoan et al. [35] concluded that the incidence of complications was 0.3%, and 0.1% was life threatening. Besides, they pointed out that patients with severe OSA (AHI ≥60) and CAST ≥40% might be at high risk of perioperative oxygen desaturation. Although the incidence of life threatening complications was low, the recommendation made in MLS for treating OSA were recommended to be closely monitored after surgery [35,36]. According to the available evidence, generally, more attention should be paid to the patients with highly severe OSA, which may be vulnerable to the postoperative complications, no matter after MMA or MLS.

Limitations

The results presented here should be considered in the context of several limitations. Firstly, the majority of the included studies are non-randomized studies, thus the level of evidence is limited substantially by the study design. Secondly, the quality of the included studies is not high, as evidenced by the majority of studies included in the analysis, as evaluated by the Cochrane Collaboration "Risk of bias" tool and MINORS tool. Moreover, the heterogeneity of the surgical techniques, follow-up times, and interventions are difficult to control. Secondly, there was high heterogeneity in most of the parameters pooled in meta-analysis, which may be attributed to the different surgical techniques, follow-up times, and interventions. The surgical techniques, follow-up times, and techniques of DISE varying. Thirdly, only articles in English were included in our study, which may result in the bias of the results. Finally, the sample size of the included studies, which was clarified by separately pooling results from studies on these two types of surgery, it was not possible to quantify the differences in surgical outcomes between MMA and MLS. Therefore, there is a need for more high-quality experimental studies or comparative cohort studies, the lack of comparison studies between MMA and MLS for treating OSA should be addressed in the future.

Conclusions

In this systematic review and meta-analysis demonstrate that both MMA and MLS are effective treatment options for OSA with an acceptable rate of morbidity. Regardless of disease severity, MMA may offer greater improvement in AHI than MLS. Although MMA may offer a greater cure of OSA in higher-class than of MLS. This conclusion is based on separate analysis of MMA and MLS studies.

Practice points

1. Both MMA and MLS are effective treatment options for OSA with an acceptable rate of morbidity.
2. Regardless of disease severity, MMA may be a more effective treatment compared to MLS in improving OSA.
3. The discrepancy of surgical outcomes between MMA and MLS may be attributed to the different surgical techniques. The cure benefits of MMA were attributed to surgery for the success rate in patients with baseline AHI <40, and for the cure rate in patients with baseline AHI from 40 to 70.
4. The rates of major complication and minor complication of MMA were both higher than those of MLS.
5. Not only the improvement in AHI, but also the patient subjective feeling should be taken into consideration, and morbidity should be taken into consideration when evaluating the efficacy of surgical treatment for OSA.
6. Evidence-based decision making in patients with OSA can be achieved only when having information regarding clinical outcomes, side effects, complications, treatment cost, and predictors of non-response for all the treatment options.

Research agenda

1. Future research should entail comparative studies between MMA and MLS with long-term follow-up and long-term follow-up, in which the surgical techniques, patient selection, patient characteristics, adjunctive outcomes, quality of life, morbidity and mortality, and surgical cost is performed.
2. Large-scale studies are needed to identify predictive factors for surgical treatment outcomes, including MMA and MLS, and should be taken into consideration when evaluating the biomedical, clinical, and surgical characteristics.
3. Upper airway stimulation, a novel treatment modality for moderate-severe OSA, has been found to be highly effective for OSA patients who failed to tolerate CPAP treatment. Its efficacy among MMA, MLS, and upper airway stimulation is called for in future studies.
4. Better studies on the pathogenesis of OSA are essential to facilitate personalized medicine approach for OSA.

Sources of support/grants

No funding was received for this study.

Conflicts of interest

The authors declare that they have no conflict of interest.

Appendix A. Supplementary data

The following are the Supplementary data to this article:

Fig.A1.

Cohort
Case-control
Cross-sectional
Case-control
Cohort
Cohort
Cohort

Figure 1

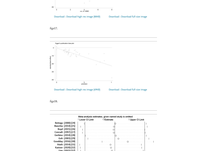

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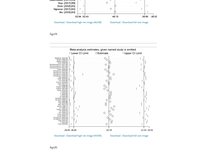
Figure 2


Intervention minutes: per session vs. a year
Bishop, 2009[Bishop2009]
Bishop, 2009[Bishop2009]
Ivanoff, 2001[Ivanoff2001]
Ivanoff, 2001[Ivanoff2001]
Ivanoff, 2001[Ivanoff2001

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☆ This study was presented as an oral presentation at the 2020 Virtual American Association of Oral and Maxillofacial Surgeons (AAOMS) Annual Meeting.

* The most important references are denoted by an asterisk.

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