Modified Genioglossal Advancement for Isolated Treatment of Obstructive Sleep Apnea

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Introduction: Genioglossal advancement is a surgical procedure for obstructive sleep apnea (OSA) that has lost favor as a primary treatment strategy. The authors describe utilization of a modified genioglossal advancement (MGA), combining a geniotubercle advancement via sliding genioplasty and a glossopexy.

Methods: A retrospective review was performed. Preoperative and postoperative apnea–hypopnea indices (AHIs) were compared to determine OSA treatment success.

Results: Five patients underwent MGA. Three subjects had preoperative and postoperative AHI scores which improved from 61, 28, and 19 (mean = 36) to 4.5, 2, and 6.3 (mean = 4.3), respectively. Two subjects had incomplete data for comparison. All subjects had an acceptable esthetic outcome.

Discussion: In properly selected subjects, MGA can alleviate OSA and provide improved esthetic outcomes.

Key Words: Genioglossal advancement, glossopexy, microgenia, obstructive sleep apnea

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Obstructive sleep apnea (OSA) is a common health problem in the United States.[1] Obstructive sleep apnea is caused by soft tissue collapse, most commonly in the oropharynx.[2–4] The gold standard diagnostic tool for OSA is polysomnography (PSG). Based upon PSG, an apnea–hypopnea index (AHI) score is calculated to assess OSA severity (normal < 5, mild 5–14, moderate 15–30, severe > 30).[5] Surgical treatment of OSA targets the pharynx and aims to increase its diameter through various surgical procedures. To date, no procedure has been universally successful with many demonstrating only modest benefits.[6,7] Procedures that involve advancing the maxillofacial skeleton are typically more successful; however, these procedures often involve changes in occlusion which require additional surgical skill sets.

Genioglossal advancement (GA) was first described in 1984.[8] It involves repositioning the oropharyngeal tongue base by advancing the tongue's attachment at the geniotubercle without changing the occlusal relationship (Fig. 1, left box). Genioglossal advancement use has lost favor secondary to esthetic concerns regarding the postoperative chin and jawline. In addition, there is minimal support in the medical literature (1 open access article) acknowledging its success as an isolated procedure.[9] We hypothesize that modifications to this operation will make it a successful surgical option in select OSA patients with microgenia. The aim of this study is to assess the OSA treatment results and the associated esthetic outcomes of a modified genioglossal advancement (MGA) procedure.

METHODS

Institutional review board approval was obtained (HSC 13239) and a retrospective chart review was performed. All subjects treated with MGA from January 2012 to December 2014 were included. Subject charts were reviewed for demographic information, relevant medical and surgical history, and preoperative and postoperative AHI. When possible, postoperative PSG was performed at minimum 6 months following surgery. Surgical success was defined as an AHI ≤ 5 (normal). Polysomnography was not performed when prohibited by limited healthcare coverage. For these subjects, success was defined as resolution of symptoms.

Operative Procedure

A standard genioplasty is performed via an intraoral gingival buccal incision. Inferior mandible dissection is limited (4–5 mm below mental foramen) and care is taken to preserve the inferior/anterior mandibular soft tissue attachments. A genioplasty osteotomy is performed and the gnathion/geniotubercle is advanced

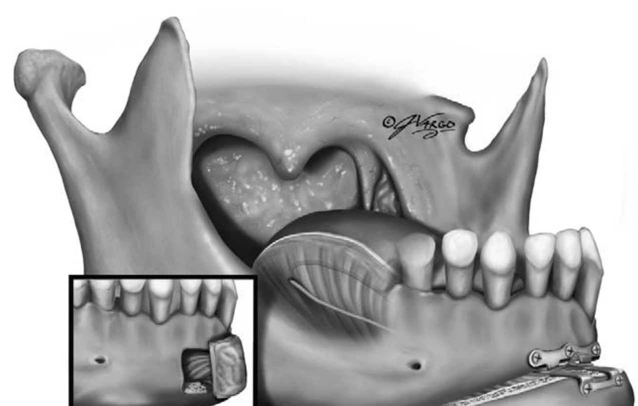

FIGURE 1. Modified genioglossal advancement. Gnathion/geniotubercle is advanced 8 to 12 mm via a standard genioplasty. The occlusal surface of lateral mandible has not been drawn allowing the tongue base and a concomitant glossopexy to be demonstrated (blue suture). Left box insert demonstrates traditionally described "window" osteotomy described for traditional genioglossal advancement (Reproduced with permission from James D. Vargo, M.D., James Vargo M.D.).

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anteriorly to the maximally favorable esthetic position and secured with a chair-style genioplasty titanium plate (8–12 mm). A glossopexy is then performed via the osteotomy using a 0-polydioxanone suture. A large, deep bite of muscular tongue is purchased as far posteriorly as possible and then secured over the genioplasty plate providing further anterior translocation of the tongue base (Fig. 1).

A modification is made in subjects without microgenia. A 2.0 L-shaped titanium plate is hand bent and fixed so that the vertical gnathion segment is fixated vertically allowing unobstructed access to its buccal surface. A separate submental incision is made and the buccal cortex of the gnathion is reduced and contoured appropriately with a drill to minimize the macrogenia deformity.

RESULTS

Five subjects underwent MGA during the study period. Modified genioglossal advancement was successful in 4 of the 5 (80%) subjects. There were 4 females and 1 male. The average age was 41 years (range 21–62). Three subjects had complete preoperative and postoperative PSG data for outcomes comparison. Subjects 1 (Fig. 2) and 2 (Fig. 3) had significant microgenia and were referred directly for MGA surgery without prior OSA procedures. Subject 3 (Fig. 4) had failed previous oropharyngeal soft tissue surgery and declined maxillary mandibular advancement. Apnea hypopnea index (AHI) scores improved from 61, 28, and 19 (mean = 36) to 4.5, 2, and 6.3 (mean = 4.3), respectively. Modified genioglossal advancement anterior displacement of the geniotubercle was 9, 9, and 8 mm, respectively (Table 1). Statistical comparison was not performed as a result of the small study population. No surgical complications were observed and all subjects had an acceptable esthetic outcome (Fig. 2). There have been no recurrences of OSA symptoms to date (mean follow-up 24.2 months).

Apnea hypopnea index outcomes comparison for subjects 4 and 5 was not possible as limited healthcare coverage did not allow complete PSG testing. Subject 4 achieved significant subjective improvement of OSA symptoms. Subject 5 demonstrated minimal AHI improvement following MGA, but did report subjective esthetic improvement of her chin and facial profile.

FIGURE 3. Patient 2. (A-C) Preoperative photographs showing microgenia (preoperative AHI = 28). (D-F) Postoperative photographs with acceptable esthetic outcomes (postoperative AHI = 2). AHI, apnea–hypopnea index.

FIGURE 2. Patient 1. (A-C) Preoperative photographs showing microgenia (preoperative AHI = 61). (D-F) Postoperative photographs with acceptable esthetic outcomes (postoperative AHI = 4.5). AHI, apnea–hypopnea index.

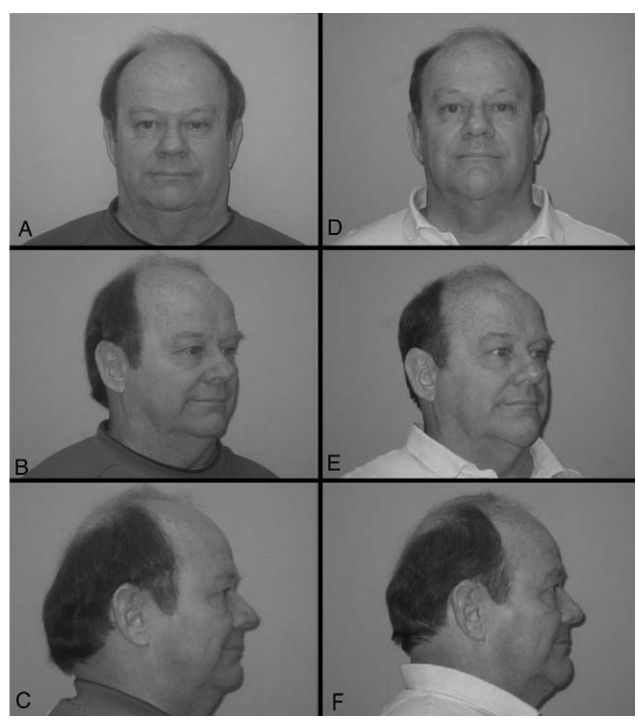

FIGURE 4. Patient 3. (A-C) Preoperative photographs without microgenia (preoperative AHI = 19). (D-F) Postoperative photographs demonstrate maintenance of acceptable geniotubercle projection (postoperative AHI = 6.3). AHI, apnea–hypopnea index.

TABLE 1. Patient Demographics and Data for Study Patients

Subject	Age, y	Sex	Body Mass Index	Preoperative Microgenia	Prior OSA Surgery	Genial Advancement, mm	Preoperative AHI	Postoperative AHI
1	37	F	21	Y	N	9	61	4.5
2	52	F	21	Y	N	9	28	2
3	62	M	37	N	Y	8	19	6.3
4	21	F	20	Y	N	10	N/A	N/A
5	31	F	24	Y	N	11	21	N/A

AHI, apnea–hypopnea index; OSA, obstructive sleep apnea.

DISCUSSION

Obstructive sleep apnea management is challenging and often requires surgical intervention as medical therapies such as weight loss and continuous positive airway pressure (CPAP) are often unsuccessful.[10–12] Unfortunately, success rates of surgical procedures are generally poor as well. A meta-analysis of 1978 patients demonstrated 56.5% success for mild/moderate OSA and 69.3% for severe OSA, with "success" defined as a modest AHI reduction of a 50% and an AHI < 20.[13] This definition suggests that subjects with severe OSA may have surgical "success," yet still have moderate OSA on postoperative PSG (eg, preoperative AHI $= 40$, postoperative AHI $= 20$).

The MGA procedure described in this paper combines and modifies several previously described surgical concepts. First, a traditional sliding genioplasty is used instead of the "window pogonion/genial turbercle osteotomy" described in traditional GA procedures.[14] This modification improves both the oropharyngeal airway diameter as well as the esthetics of microgenia as opposed to traditional GA surgery. In addition, the osteotomy provides access for a glossopexy suture which can be secured over the fixation plate for further tongue base suspension. Furthermore, there is no change in occlusion with this procedure and the operative technique falls within the skill set of any surgeon who routinely performs maxillofacial surgery.

Four of the 5 subjects (80%) demonstrated a significant improvement in OSA symptoms and 3 had near normal AHI scores postoperatively. In all patients, the MGA procedure was performed in isolation. One subject (Subject 3) previously underwent unsuccessful soft tissue phase 1 OSA surgery uvulopalatopharyngoplasty (UPPP) and tonsillectomy prior to MGA. This subject's postoperative PSG was dramatically improved following MGA (AHI $= 19$–6.3); however, his score is the only AHI that fell short of a strict definition of surgical cure (AHI < 5).

Two subjects (subjects 4 and 5) warrant further discussion. Subject 4 presented with a large hemi-facial lymphovenous malformation that has been anatomically stable for 7 years following many debulking and sclerotherapy procedures. At presentation, she demonstrated severe OSA symptoms and described using her finger for manual anterior mandibular translocation during sleep. A planned tracheostomy was necessary at the time of her MGA procedure to secure a safe surgical airway. Although the tracheostomy effectively cured her OSA disease, she desired not to be tracheostomy dependent for life if possible. Following MGA, she achieved dramatic symptomatic improvement during sleep with tracheostomy capping and was ultimately decannulated successfully 4 months after MGA with no evidence of recurrence.

Subject 5 presented with Treacher Collins syndrome. She had previously undergone mandibular ramus length and has a mild Angle class II occlusion. Due to her postsurgical mandibular anatomy and limited access to orthodontics, she was not a candidate for orthognathic OSA procedures and as such, MGA was performed. Postoperatively, she demonstrated minimal subjective OSA improvement, although she did have esthetic improvement of her chin and facial profile. She has since undergone further soft tissue OSA procedures including UPPP, tonsillectomy, turbinate reduction, spreader grafts, and septoplasty with limited additional success and now requires CPAP during sleep.

This study demonstrates the utility of using MGA as an isolated procedure in properly selected patients. Although not intended to be a primary treatment modality for OSA, MGA may be considered in isolation in the rare OSA patient with microgenia or glossoptosis and minimal other upper airway obstruction. The ideal surgical candidate for this procedure has microgenia with Angle class I or mild class II occlusion, as the occlusal relationship is not altered by this procedure.

Although not done in this study, MGA could be performed simultaneously with other procedures for patients with multifactorial disease. In addition, in our experience with 1 subject, it can be used successfully as a "salvage" procedure for patients who have previously failed other soft tissue procedures and have refused or are not candidates for orthognathic surgery. Although feasible, use of MGA should be considered carefully in subjects with complex head and neck comorbidities; however, it can be used as an adjunct when manipulation of occlusion is contraindicated.

This study demonstrates that the MGA used in isolation can "cure" OSA in select patients even if OSA is severe. Modifications can be used to allow its utilization in subjects without OSA; however, our experience demonstrated results that were not as dramatic. Two syndromic subjects also underwent this procedure with 1 having a marked subjective improvement and the other having only modest benefits requiring additional surgery. This further supports proper patient selection and the multifactorial etiology of OSA.

CONCLUSION

The MGA procedure is a useful adjunct within the algorithm of OSA treatment. For select patients with OSA and microgenia, MGA can dramatically improve AHI and cure OSA. Its utility in multifactorial OSA and patients with syndromic craniofacial anomalies remains unclear and its use in such patients should be considered selectively.

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