Morphometric analysis of swallowing mechanics after surgery for Obstructive Sleep Apnea (OSA)

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ABSTRACT

Outcome Objectives: To apply a new method of analyzing swallowing biomechanics on postoperative OSA patients using parameters of the modified barium swallow (MBS) imaging.

Methods: This novel biometric analysis involved two patients following uvulopalatopharyngoplasty, relocation pharyngoplasty, and base of tongue resection for OSA. Postoperative MBS indicated mild swallowing impairment in both patients. Coordinates mapping 10 anatomical landmarks were collected from every frame of the oropharyngeal swallow using ImageJ software. A canonical variate analysis was performed using MorphoJ software with data pooled by subject (S1, S2) and swallowing phase (OP=oral phase, PP=pharyngeal phase). The Mahalanobis distances (D) of the pooled means from each group were defined. Eigenvectors indicated reduced pharyngeal shortening and reduced tongue base retraction compared to published data of normal subjects. These observations are consistent with the postoperative goal of avoiding collapse. Future controlled studies should be performed to determine whether these changes in swallowing mechanics are specific to surgical interventions or the underlying morphology of OSA patients. This method could be applied to other head and neck procedures, as well as post radiation patients.

RESULTS

Significant differences in shape change were found for all values: OP vs. PP of S1(D=9.2, p<.0001) and S2 (D=10.7, p<.0001); OP of S1 vs. S2 (D=45.4, p<.0001); PP of S1 vs. S2 (D=39.2, p<.0001). The OSA patients had normal hyolaryngeal excursion, but reduced pharyngeal shortening and reduced tongue base retraction compared to published data of normal subjects. Penetration aspiration scores were 2, which indicated that the bolus penetrated the larynx but was ejected.

METHODS

This novel biometric analysis involved two patients following uvulopalatopharyngoplasty, relocation pharyngoplasty and base of tongue resection for OSA. Postoperative modified barium swallow study was performed. Coordinates mapping 10 anatomical landmarks were collected from every frame of the oropharyngeal swallow using ImageJ software. The first five coordinates track the relative position of three skeletal levers: the vertebrae, mandible and cranial base. The next four coordinates mark features of the hyolaryngeal complex including the hyoid, anterior larynx, posterior larynx and upper esophageal sphincter. These coordinates approximate muscle attachments of the proposed two-sling mechanism (suprahyoid and long pharyngeal muscles). The final coordinate is the base of tongue.

A canonical variate analysis was performed using MorphoJ software with data pooled by subject (S1, S2) and swallowing phase (OP=oral phase, PP=pharyngeal phase). The Mahalanobis distances (D) of the pooled means from each group were defined. Eigenvectors of shape change in these patients were compared to previously published subjects (non-surgical) to document changes in swallowing mechanics.

CONCLUSIONS

Tongue base retraction and reduced pharyngeal shortening was noted in this small cohort of patients. These observations are consistent with the postoperative goal of necessary tightening in these areas to avoid collapse. Future controlled studies should be performed to determine whether these changes in swallowing mechanics are specific to surgical interventions or the underlying morphology of OSA patients. This method could potentially be utilized to quantify the effectiveness of sleep surgical techniques.

REFERENCES


