Craniofacial Profile Assessment in Patients with Obstructive Sleep Apnea

A commentary on Lee et al. Craniofacial Phenotyping in Obstructive Sleep Apnea – A Novel Quantitative Photographic Approach. SLEEP 2008;32:37-45. and Lee et al. Prediction of Obstructive Sleep Apnea with Craniofacial Photographic Analysis. Sleep 2009;32:46-52.

David S Hui, MD, FCCP

Department of Medicine and Therapeutics, The Chinese University of Hong Kong,Prince of Wales Hospital, Shatin, New Territories, Hong Kong

IN THIS ISSUE OF SLEEP, THERE IS AN INTERESTING CASE CONTROL STUDY FROM THE LABORATORY OF CISTULLI AND COLLEAGUES[1] DEMONSTRATING A number of craniofacial differences between subjects with and without obstructive sleep apnea (OSA), based on a quantitative photographic analysis technique involving measurements from digital photographs. A total of 71 craniofacial measurements were computed using this novel photogrammetry technique on 114 OSA patients (defined as having apnea-hypopnea index [AHI] ≥ 10/hr on polysomnography) versus 66 sleep clinic controls with AHI < 10/hr, all of Caucasian ethnicity. Photographic differences were noted across all the craniofacial regions, with larger measurements of face width, mandible width, intercanthal width, and nose width in the OSA subjects than controls in the primary analysis. Following body mass index (BMI) and sex-matched subgroup analysis involving 51 patients with OSA versus 51 controls, the study revealed that subjects with OSA have a shorter and retruded jaw, smaller enclosed area within the mandible, wider and flatter mid and lower face, and more soft tissues or fat deposition on the anterior neck, without the influence of obesity.[1] In a related prospective cohort study of 180 subjects referred for the initial investigation of OSA, the same group of investigators demonstrated that anatomical data useful in the prediction of OSA could be obtained from craniofacial photographic analysis, providing correct subject classification in about 76%.[2]

OSA syndrome is equally common among middle-aged male Caucasian and Asian populations, with prevalence rates of at least 4%.[3-5] Most OSA patients have an anatomically small upper airway with augmented pharyngeal dilator muscle activation maintaining airway patency awake but not asleep.[6] OSA is likely caused by a combination of multiple anatomical and pathophysiological factors. Obesity, sleep-induced loss of muscle tone, craniofacial abnormalities, and upper airway collapsibility probably all contribute to varying degrees in individual cases. Enlargement of the oropharyngeal soft tissue structures, especially the lateral pharyngeal walls (LPW),[7] and a more collapsible velopharynx[8] are some of the other important factors that may contribute to upper airway obstruction.

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Address correspondence to: Dr. David S Hui, Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, New Territories, Hong Kong; Tel: (852) 2632 3128; Fax: (852) 2648 9957; Email: dschui@cuhk.edu.hk

Obesity is the most important risk factor in the pathogenesis of OSA in middle-aged adults.[9] Neck circumference, a surrogate measure of neck fat, seems to be a better predictor of the presence of OSA than overall obesity.[10] However, neck circumference is a gross measurement of a combination of structures including subcutaneous fat, neck muscle, parapharyngeal fat, and parapharyngeal wall muscle. It remains uncertain which structures in the neck are more important in the pathogenesis of OSA. It has been suggested that fat deposits, particularly at the lateral parapharyngeal space, might play a key role in the pathogenesis of OSA, whereas other studies have suggested that increased parapharyngeal wall thickness is a major cause of OSA.[11,12] Enlargement of soft tissue structures, particularly the LPW, is associated with an increased likelihood of OSA among patients presenting to sleep disorders centers.[7] Sonographic measurement of LPW thickness has been reported as a novel and reliable technique and has good correlations with measurement by magnetic resonance imaging (MRI) and the severity of OSA.[13]

Although the studies by Lee et al.[1,2] dealt exclusively with Caucasians, craniofacial abnormality appears to play a particularly important role in OSA in Asian populations. While Asian patients with OSA are generally less obese than the Caucasian counterparts, despite having similar prevalence rates of OSA,[3-5] craniofacial abnormalities such as a low hyoid bone and retroposition of the maxilla or mandible are common predisposing factors for OSA in the Asian populations.[14,15]

Nevertheless, previous studies with lateral cephalometric radiographs and other imaging techniques have revealed rather inconsistent and conflicting findings when comparing the craniofacial structures between Caucasian and Asian subjects with OSA. A study of a mixed group of Asians (consisting of Chinese, Japanese, and Korean) with OSA has shown that they had maxillo-mandibular protrusion, narrower cranial base angle, larger posterior airway space, and a more superiorly positioned hyoid bone as compared with Caucasians.[16] In contrast, Liu et al.[17] found no significant differences between Caucasians and Chinese, matched for age and BMI, with reference to the position of hyoid bone or maxilla. They did note, however, a smaller midface with a smaller and more posteriorly positioned mandible in the Chinese group. A study of OSA patients in Hong Kong and in Vancouver has shown that a crowded posterior oropharynx and a steep thyromental plane predicted OSA across two different ethnic groups and varying degrees of obesity.[18] After removal of prior differences in BMI and neck circumference, Asians differed from Caucasians in Mallampati score (MS), thyromental distance (TMD), and thyromental angle (TMA). In order of importance, Asians had higher MS, smaller TMD, and larger TMA than Caucasian subjects.[18]

Upper airway imaging is a useful research tool that has improved our understanding of the biomechanics, pathophysiology, and treatment of OSA. A number of different imaging modalities have been used to evaluate the upper airway and surrounding structures including acoustic reflection, fluoroscopy, nasopharyngoscopy, cephalometry, computed tomography, MRI, and sonographic measurement of the LPW thickness.[13,19] The novel craniofacial photogrammetry technique described by Cistulli and colleagues[1,2] has several advantages over some of these imaging methods, including being widely available, safe without radiation, inexpensive, portable, and quick image acquisition.

In conclusion, the craniofacial photographic analysis described by Lee et al.[1,2] can detect phenotypic differences in OSA subjects versus sleep clinic controls, and provide detailed anatomical data useful in the prediction of OSA. The novel photographic analysis technique may have great potential as a clinical and research tool in the field of OSA. Further studies are needed with this technique to examine if there are any differences in craniofacial anatomy between different ethnic groups, and between OSA subjects and controls preferably recruited from a non-clinical population, in addition to testing its role in OSA risk stratification and management algorithm.

DISCLOSURE STATEMENT

Dr. Hui has indicated no financial conflicts of interest.

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