Validity of computed tomographic in assessment of genial tubercle and anterior mandible as a reference guide to locate osteotomy in genioglossus advancement

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ABSTRACT

Background: Genioglossus advancement is a surgical procedure to advance the tongue in some patients with obstructive sleep apnea syndrome.The important step in this procedure is that of accurately capturing the bone segment attached to the genioglossus muscle to avoid complications such as mandibular fracture, devitalization of the inferior incisor roots, and incomplete incorporation of the genioglossus

Materials and Method: Computed tomography scans were taken for 53 Iraqi adult patients (28 male and 25 female) range from (18-35) years with skeletal class I classification and intact anterior mandible dentition included in this study using sagittal and axial sections. The measurements were done for genial tubercle and anterior mandibular region.

Results: The mean values of some measurements weresignificantly higher in males than in females. The effect of gender difference was evaluated as a strong effect. The mean value of the other measurements slightly higher among males compared to females, but the difference fail to reach the level of statistical significance. The effect of gender difference on this parameter was evaluated as a moderately strong effect.The results showed that there was no effect of age on all selected measurements in male and female. All selected measurements showed no statistically significant linear correlation with the age.

Conclusions: The variable position and dimensions of this bone segment among patients suggest the need for CT before attempting genioglossus advancement for exact localization, avoiding the expected surgical complication

Keywords: Genioglossus advancement, genial tubercle, computed tomography. (J Bagh Coll Dentistry 2014; 26(3):63-65).

INTRODUCTION

Genial tubercles (GTs) are small bony protuberances on the lingual aspect of the mandible in the area of the symphysis, slightly above the inferior border of the mandible Theyhave the form of spines often distributed as right and left protuberances and superior and inferior tubercles. These structures are a point of attachment for the genioglossus and geniohyoid muscles [(1)].

The genioglossus muscle originates from the superior mental spine or GTs and then fans posteriorly to insert at the tip of the tongue, at the dorsum of the tongue, the superior fibers retract the tip of the tongue, whereas the middle fibers depress the dorsum of the tongue [(2)].

Sleep apnea (OSA) is a syndrome result from complete upper airway obstruction. Multiple levels of the upper airway including retropalatal retrolingual, and hypopharyngeal can obstruct and produce OSA. In the surgical treatment of OSA, multiple sites of obstruction should be addressed to effectively treat the syndrome. The base of tongue or retrolingual region has long been identified as one of the critical sites that can contribute to OSA [(3)].

Mandibular osteotomy with genioglossus advancement (GA) addresses upper airway obstruction at the base of the tongue. The genioglossus muscle is attached to the lingual surface of the mandible at the GT and also to the hyoid complex just above the larynx. Movement forward of either or both of these anatomic structures will stabilize the tongue base along with the associated pharyngeal dilatators. GA enlarges the retrolingual airway specifically by advancing forward the GT of the mandible through a limited parasagittal mandibular osteotomy, thereby forcing an anterior advancement of the tongue base. The procedure achieves a greater hypopharyngeal space. The most serious complications of this procedure are mandibular fracture, which occurs when the osteotomy violates the inferior border of the mandible or induces lesions at the roots of the teeth. Other complications include infection, permanent anesthesia, and seroma [(4)].

The computed tomography (CT) scan is an imaging method that uses X-rays to create cross sectional pictures of the body. Computer crates separate image of body area called slices were can be stored, viewed on monitor or printed on film [(5,6)] .Three dimensional spiral CT has been used in clinics extensively because of its high resolution and the availability of 3-dimensional reconstruction. The maximum resolution of spiral CT, so the images obtained from scanning and reconstruction are sufficiently distinct to allow the examination and measurement of tiny structures, such as the GT [(7)].

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MATERIALS AND METHODS

Prospective study of CT scans were taken for 53 Iraqi adult patients (28 males and 25 females) with (18-35) years ages range. Those patients attending Al- Karkh General Hospital in Baghdad city taking CT scans for different diagnostic the current study included Patients with class I skeletal relationship as the ANB angle range from 2-4 degrees, No congenital craniofacial anomalies, Intact anterior mandibular dentition, No previous fracture or bony surgery on anterior mandible and No obvious facial asymmetry .Spiral CT machine which was used in this study is multi-slice spiral computed tomography scanner(Philips Brilliance CT 64). The selection of the subject sample with class I skeletal relationship made by measuring the ANB angle on sagittal section of CT image, (the ANB angle for CL. I range between (2-4)) [8].

GT located on the lingual surface of the mandible, near the midline, by spiral CT sagittal and axial sections were selected for accurate capturing of mandibular bone segment attached to the genioglossus muscle. All measurements done in millimeter [7] as follow:- Sagittal section: Mandibular thickness (MT): was measured at the level of superior margin of superior genial spine (SGS) and at the level of inferior margin of SGS then averaged to give a single value, Superior genial spine height (SGSH) ; by measuring the distance from superior margin of SGS to inferior margin of SGS, LI-SGS: by measuring the vertical distance from lower central incisor apices (LI) to superior margin of SGS. IBM/SGS: by measuring the distance from inferior border of mandible (IBM) to inferior margin of SGS. Axial section, Superior genial spine width (SGSW): by measuring the widest dimension of SGS from side to side.

RESULTS

From the measurements done at the examined area on sagittal and axial sections, selected measurements were obtained demonstrated in table (1) for the total study sample.

Table 1: Mean values of the selected measurements in total study sample

The selected measurements	Mean
Age (years)	26.4
Mandibular thickness at level of superior margin of SGS (mm)	10.5
Mandibular thickness at level of inferior margin of SGS (mm)	12.6
Mean Mandibular thickness at level of SGS (mm)	11.6
SGS height (mm)	6.3
(LI-SGS) Vertical distance from lower central incisor apices to superior margin of SGS (mm)	5.6
(IBM-SGS) Vertical distance from inferior border of mandible to inferior margin of SGS (mm)	10.2
(IBM-LI) Vertical distance from inferior border of mandible to lower central incisor apices (mm)	22.0
Ratio of (LI-SGS) to (IBM-LI)	0.25
Ratio of (IBM-SGS) to (IBM-LI)	0.46
Ratio of (SGS height) to (IBM-LI)	0.28
SGS width (mm)	6.6

As shown in table (2), There were no obvious or statistically significant linear correlation between age and any of the measurements included in the present study as followingAge showed no statistically significant linear correlation with Mandibular thickness at level of superior margin of SGS (r=0.241, P=0.08).Age showed no statistically significant linear correlation with Mandibular thickness at level of inferior margin of SGS (r=-0.189, P=0.17).Age showed no statistically significant linear correlation with Mean Mandibular thickness at level of SGS(r=-0.228 , P=0.1).Age showed no statistically significant linear correlation with SGS height (r=-0.05 , P=0.72). Age showed no statistically significant linear correlation with LI-SGS (r=-0.01, P=0.95)Age showed no statistically significant linear correlation with IBM-SGS (r=0.047, P=0.74).Age showed no statistically significant linear correlation with IBM-LI (r=0.007, P=0.96)Age showed no statistically significant linear correlation with Ratio of (LI-SGS) to (IBM-LI) (r=-0.019, P=0.89).Age showed no statistically significant linear correlation with Ratio of (IBM-SGS) to (IBM-LI) (r=0.085, P=0.54).Age showed no statistically significant linear correlation with Ratio of (SGS height) to (IBM-LI)(r=-0.089, P=0.53).Age showed no statistically significant linear correlation with SGS width (r=-0.171, P=0.22).

Table 2: Liner correlation coefficient between age and selected measurements

Selected measurements	Age (years)
Mandibular thickness at level of superior margin of SGS (mm)	r=-0.241 P=0.08[NS]
Mandibular thickness at level of inferior margin of SGS (mm)	r=-0.189 P=0.17[NS]
Mean Mandibular thickness at level of SGS (mm)	r=-0.228 P=0.1[NS]
SGS height (mm)	r=-0.05 P=0.72[NS]
(LI-SGS) Vertical distance from lower central incisor apices to superior margin of SGS (mm)	r=-0.01 P=0.95[NS]
(IBM-SGS) Vertical distance from inferior border of mandible to inferior margin of SGS (mm)	r=0.047 P=0.74[NS]
Total vertical height of mandibular border (mm)	r=0.007 P=0.96[NS]
Ratio of (LI-SGS) to (IBM-LI)	r=-0.019 P=0.89[NS]
Ratio of (IBM-SGS) to (IBM-LI)	r=0.085 P=0.54[NS]
Ratio of (SGS height) to (IBM-LI)	r=-0.089 P=0.53[NS]
SGS width (mm)	r=-0.171 P=0.22[NS]
Inter-canine distance (mm)	r=0.02 P=0.89[NS]

DISCUSSION

The current study using CT demonstrated that GT varied in position and dimensions among subjects. CT can provide an accurate, non distorted view. This radiographic technique may prove useful in pre-operative planning for the mandibular osteotomy in genioglossus advancement procedures. GA has four major requirements: (1) preventing dental root damage, (2) incorporating most of the genioglossus muscle, (3) avoiding mandible fracture, and (4) maximizing the amount of genioglossus advancement [(9)].

It is critical to accurately identify the GT, lower anterior teeth, and inferior border of the mandible in preparation for GA to manage OSA [(10)]. The advancement is also challenged by the need to avoid mandible fracture and prevent dental root damage. These issues are determined by the anatomic structure of the anterior mandible, including the GT, an anatomic structure with most of the genioglossus muscle attachment, lower anterior teeth and symphysis region. Thus, surgeons need accurate measurements of these structures to aid in preoperative planning Cone-beam computed tomography. Spiral CT is a relatively new radiology technology that offers less radiation exposure than conventional CT.

The mean values of the selected measurements were shown in table (1) for the current study. Yin et al [(7)] found that MT was 12.0 mm and these seem to be close to the finding of this study .Yin et al [(7)] found that the mean value of SGSH was 5.82 mm and this agreed with the results of the present study.. Zhang et al [(11)] and Mintz et al [(12)] measured the distance from the inferior central incisor apex to the superior genial spine LI-SGS as 6.83mm and 6.45 mm respectively and these were in agreement with the current study. Regarding the GTW, Mintz et al [(12)] reported that the mean value of GTW was 6.0 mm in their study, Yin et al [(7)] found the GTW value was 6.98 mm.; these results were close to findings of the present study. Also in this study the measurement of IBM-SGS value was close to that obtained by Yin et al [(7)] Chinese cadaver; they reported the mean value of IBM-SGS was 10.5mm.The important of IBM-SGS distance above the inferior border of the mandible to prevent mandible fracture

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