

Assessment of Genial Tubercle with CBCT with Clinical Relevance

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Abstract

Introduction: CBCT uses have been expanded in many field of medical sciences. In the same way, it can be used to assess the position and anatomy of the genial tubercle during the management of OSA. The present study was planned to assess the utility and accuracy of the 3 D cone beam CT in locating the exact anatomical position of genial tubercle in the human skull.

Materials and Method: For the present study, 20 adult human cadaver head were randomly selected. All the cadaver underwent radiographic imaging with the cone beam CT. Based on the radiographic measurements, genial tubercle height, genial tubercle width, mandibular height, distance from inferior border of mandible to genial tubercle and lastly mandibular thickness were recorded.

Results: A total of 20 cadavers were obtained from the department of anatomy. We observed that there were difference in the measurements obtained from CBCT to that of calliper but however when the statistics were applied this difference was not found to be significant.

Discussion & Conclusion: No significant difference was seen between the two study group measurements cadaver dissections versus CBCT measurements. This radiographic technique may prove useful in preoperative planning for the mandibular osteotomy in genioglossus advancement procedures. In addition, this technique may allow for preparation of a pre-operative template to guide the surgeon. Future research will focus on the development of a simple surgical template to locate the genial tubercle accurately.

Keywords: Genial Tubercle, CBCT, Calliper, Obstructive Sleep Apnoea

Introduction

On the lingual surface of the mandible there are tiny bony projections, which gives attachment to geniohyoid inferiorly and genioglossus superiorly. These bony projection are known as Genial Tubercle. They surround the lingual foramen and are group of four bony projections, located between the superior and inferior border of mandible.^(1,2)

As the age of person increases, there is resorption of alveolar process, sometimes there is delayed oral rehabilitation and lack of balanced occlusions, thereby leaving genial tubercle as bony projections. Sometimes they are enlarged due to excessive movements of tongue; this may result in elevated bony projections making it vulnerable to site of alveolar fracture.⁽³⁾

Obstructive sleep apnoea syndrome is a condition causing serious physical and psychological consequences. It is defined as cessation of breathing during sleep because of mechanical obstruction such as retro positioning of the tongue in the airway, a large amount of tissue in the upper airway, or even a partially collapsed trachea. It is an respiratory disorder with features of snoring, episodes of breathing cessation and absence of respiratory airflow during sleep. The patient might have other symptoms like depressions, cardiac arrhythmias, pulmonary hypertension and cerebrovascular accidents.^(4,5)

The treatment proposed for OSAS is genioplasty, box osteotomy, mandibular trapezoid osteotomy, circular osteotomy and mortised genioplasty.⁽⁶⁾ During

the procedure of genioglossus advancement; care should be taken to identify the bone segment attached to genioglossus muscle to avoid complications such as devitalisation of the incisor roots, mandibular fracture and incomplete incorporation of genioglossus muscle hence the location of the genial tubercle plays an important role. In the study done by Yin SK et al he correlated the CT measurements and anatomical measurements of the genial tubercle in Chinese population.⁽⁷⁾

To assess and plan the treatment of various maxillofacial deformities, three dimensional imaging have been used for long period. Keeping this as base, such imaging can also be used for accurate identification of the genial tubercle while preparing the patient for genioglossus advancement. So it is very important to know about the exact anatomy and morphology of genial tubercle in relation to the margins of mandible and anterior teeth.

As compared to Computerised tomography, CBCT that is cone beam CT is a new radiological technology that offers significantly less radiation exposure and superior resolution than CT. Its uses have been expanded in many fields of medical sciences. In the same way, it can be used to assess the position and anatomy of the genial tubercle during the management of OSA. Hence keeping all the above point in mind, the present study was planned to assess the utility and accuracy of the 3 D cone beam CT in locating the exact

anatomical position of genial tubercle in the human skull.

Materials and Method

For the present study, 20 adult human cadaver head were randomly selected. All the cadaver underwent radiographic imaging with the cone beam CT. Based on the radiographic measurements, genial tubercle height, genial tubercle width, mandibular height, distance from inferior border of mandible to genial tubercle and lastly mandibular thickness were recorded.

The scans were read and the measurements were carried out by the radiologists who were blinded to the results of the cadaver measurements. Dissection of cadaver was then carried out to expose the genial tubercle. Measurements including genial tubercle height, Mandibular thickness, genial tubercle width and mandibular height were recorded in the cadaver itself. To reduce the margin of error, all the soft tissues was dissected from anterior and posterior aspect of mandible and measurement was done with the help of callipers. Measurements were rounded with the nearest round figure of measurement. The two groups measurements (one with CBCT and other with calliper) were compared with a paired t test to check the statistically significance among the difference between the groups. A 3DX CT machine with latest technology was used in the present study. The institute ethical committee was informed prior to the start of the study and ethical clearance certificate were obtained from it.

Results

The measurements for the genial tubercle height, width, and distance from inferior border of mandible to genial tubercle were calculated in all the 20 cadavers first with CBCT than compared with that of measurements obtained by measuring with calliper. The results obtained with the measurements as followed: the average width of the genial tubercle was found to be 4.9 mm with CBCT and 5.2 mm with calliper, average distance of genial tubercle with inferior border of mandible was found to be 12.9 mm in CBCT and 10.9 mm with calliper, average height of genial tubercle was found to be 4.5 mm in CBCT and 5.0 mm with calliper and lastly the average thickness of mandible was found to be 14.0 mm with CBCT and 14.2 mm with calliper. On comparing the result with paired t test, the difference of measurement between the CBCT and calliper was not found to be statistically significant.

A total of 20 cadavers were obtained from the department of anatomy. We observed that there were difference in the measurements obtained from CBCT to that of calliper but however when the statistics were applied this difference was not found to be significant.

Table 1: CBCT measurements versus calliper measurements (n = 20)

Measurements	CBCT (mm)	Calliper (mm)	T test
GTW	4.9	5.2	P = 0.81
Distacne IBM/GT	12.9	10.9	P = 0.82
GTH	4.5	5.0	P = 0.75
MT	14.0	14.2	P = 0.80
MH	13	14	P = 0.78

CBCT, cone beam CT; GT, genial tubercle; GTW, genial tubercle width; GTH, genial tubercle height; IBM, inferior border mandible; MH, mandibular height; MT, mandibular thickness.

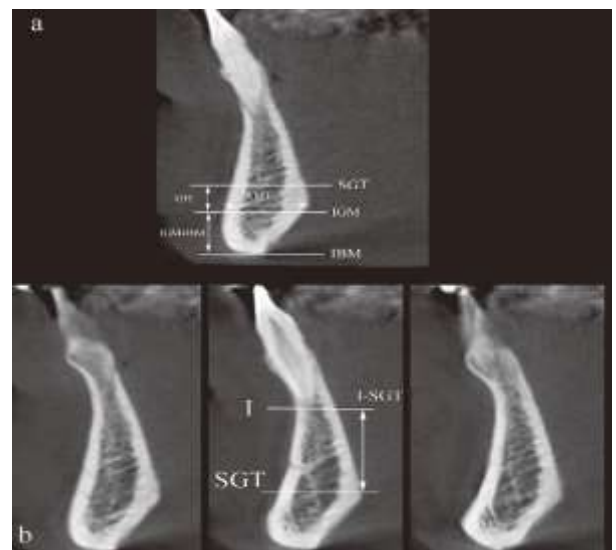


Fig. (a) CBCT scan showing the parameters evaluated: thickness of the anterior mandible (AMT), genial tubercle height (GH; distance from the superior border [SGT] to the inferior border of the genial tubercle [IGM]), and distance from the IGM to the inferior border of the mandible (IBM) (IGM-IBM). (b) Consecutive cross-sectional images help to determine the apices of the incisors, which allow measurement of the I-SGT (distance from the apices of the lower incisor [LI] to the superior border of the genial tubercle [SGT])

Discussion

The major challenge in using the cone beam CT imaging and diagnosis is related to the lack of familiarity experienced by most of the medical professions with the principle of multiplanar imaging.⁽⁸⁾ This principle is offered by this newest technology. Multiplanar imaging is the ability to generate images in different plane, curved or flat. This type of facility is provided only by some of the contemporary imaging modalities such as CBCT. Diagnostic imaging in different planes is a new concept and do require a different view of imaging data.⁽⁹⁾

In the patient with obstructive sleep apnoea; when conservative's treatment are not successful and applicable surgical intervention is indicated. In case of surgical approach, a correct surgical approach is established for the OSA.⁽¹⁰⁾ In the patient with velopharyngeal obstruction, soft tissue surgery like uvulo palatopharyngoplasty is indicated and used. For the surgical management of OSA, in patient with airway resistance and obstruction in base of tongue mandibular advancement surgery is indicated and advocated. In the methodology of surgical advancement of mandible; advancement of genial tubercle to achieve posterior relocation of the tongue sleep. The surgery is done with the aim is to avoid the damage to the roots of anterior teeth, to prevent mandibular fracture, to integrate the fibres of the muscle.⁽¹¹⁾

Precision location, origin of the genioglossus muscle and anatomy of the genial tubercle is necessary for the genioglossus advancement surgery. This is the necessary for the appropriate osteotomy site location. The insertion of the posterior part of the genioglossus muscle is at the base of the tongue.⁽¹²⁾ Thus, the hypopharyngeal and retrolingual level of obstruction in OSA is addressed by advancing the genial tubercle with the attached genioglossus muscle. This provides additional space in the posterior airway and prevents collapse of the base of the tongue.

The genial tubercle is typically identified intraoperatively before osteotomy by finger palpation in the floor of the mouth and with the aid of preoperative imaging studies. Numerous reports in the literature have described genioglossus advancement surgery hyoid suspension uvulopalatopharyngoplasty as effective procedures for OSA depending on the level of obstruction.⁽¹³⁾

The type II error of 0.2 for the power calculations given shows that we would have detected the two methods to be different in eight of 10 cases if it were larger than the difference that could be detected based on these data and their variability.

When comparing the measurement of mandibular height of cone beam CT and calliper, the difference was smaller with value smaller in calliper as compared to CBCT. In the field of medical science cone beam CT technology is now routinely used for various procedures. When compared to conventional CT, cone beam CT is less expensive and provides faster results. CBCT provides superior resolution and less radiation is required than conventional CT. This study shows that the genial tubercle anatomic location is predicted accurately by CBCT. No significant difference was seen between the two study group measurements cadaver dissections versus CBCT measurements. This radiographic technique may prove useful in preoperative planning for the mandibular osteotomy in genioglossus advancement procedures. In addition, this technique may allow for preparation of a pre-operative template to guide the surgeon. Future research will

focus on the development of a simple surgical template to locate the genial tubercle accurately.

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