

# Genial Tubercles – a Morphological Analysis in Dry Mandibles

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## ABSTRACT

**Introduction:** the Genial tubercles are the important anatomical landmark with wide variation in their number and morphological pattern. Analysis of genial tubercle anatomy can be a valuable in evaluation of mandibular asymmetry, estimation of the safe area/zone prior to implant surgeries. Morphological patterns help surgeons in the preparation for genioglossus advancement in the treatment of obstructive sleep apnoea (OSA). Hence these form an important landmark for maxillofacial surgeons, radiologists, prosthodontists, and general dentists.

**Methods:** the study was conducted on 70 mandibles of either sex collected from the department of Anatomy JSS medical college and Mysore Medical College and Research Institute, Mysore. Normal mandibles were included. Damaged mandibles were excluded. The genial tubercles present on the lingual side of the mandible was inspected, its number and pattern were noted.

**Results:** out of 70 mandibles, all had genial tubercles. Regarding the number of genial tubercles, the most prevalent variant was the three-tubercle-variant in 35 mandibles (50%) and four-tubercle- variant were present in 6 mandibles (8.5%), least common. Most common pattern was upper 2 tubercles and lower 1 tubercle.

**Conclusion:** the comprehensive knowledge of the morphological features of genial tubercles should be of great clinical interest to clinicians, surgeons and to be in considered in the differential diagnosis for a painful swelling in the floor of the mouth in the edentulous patients. These are important landmarks for maxillofacial surgeons, radiologists, prosthodontists, and general dentists. Accurate identification of the GTs morphology, pattern is valuable for different applications, such as preparation for genioglossus advancement in the treatment of obstructive sleep apnea, estimation of the safe zone before implant surgery in the interforaminal region of the mandible.

**Keywords:** Genial tubercle; Genial spine; Mandible.

## Introduction

Genial tubercles are small bony projections/prominences located bilaterally around the lingual foramen, on the lingual surface of the mandible, present midway between the superior and inferior borders of the mandible. These are also known as mental spines, genial apophysis, spinae mentalis. Classically they are described as to be four in number, two superior and two inferiors. The superior genial tubercles (SGT) give origin to the genioglossus and inferior genial tubercles (IGT) to geniohyoid muscles<sup>1</sup>.

The action of these muscles is associated with two important functions i.e speech and deglutition. Genioglossus muscles helps in the protrusion of tongue and elevation of its tip which completes the buccal phase of deglutition. This contributes in pharyngeal phase by forming Winslow's geniopharyngeus muscle along with pharyngeoglossus muscle<sup>2</sup>. Both these muscles of tongue help in pushing the food particles towards the pharynx during deglutition. Geniohyoid helps in drawing the hyoid bone up and forward during mastication process and further assisting in the opening/depressing the mandible and laryngeal closure by lowering the epiglottis by its influence on hyoid bone<sup>3</sup>.

The Genial tubercles are the important anatomical landmark with wide variation in their number and morphological pattern. In cases of enlarged genial tubercles due to calcification of tendons, pronounced or prominent tubercles due to excessive resorption of alveolar process these may cause recurrent ulceration of overlying mucosa in the floor of oral cavity, may lead to spontaneous fracture and displacement or impede the use of prosthetic devices. These situations may pose problems in normal speech, mastication, deglutition and failure of rehabilitation with complete denture prosthesis. Enlargement of genial tubercles and mandibular bone resorption are responsible for poor adaptation of the complete prosthesis, leading to painful swelling, ulceration, haematoma in the floor of mouth which in turn causes limited tongue mobility<sup>3,4,5</sup>.

Hence the morphological patterns, number of genial tubercles holds great clinical importance to clinicians, surgeons and differential diagnosis would be incomplete without taking the account of genial tubercles.

## Aims and objectives

This present study was taken to assess the number and morphological pattern of genial tubercles in an adult human dry mandible.

### Methods and Materials

The study was conducted on 70 mandibles of either sex collected from the department of Anatomy JSS medical college and Mysore Medical College and Research Institute, Mysore. Normal mandibles were included. Damaged mandibles were excluded. The genial tubercles present on the lingual side of the mandible was inspected for the presence and absence, if present, its number were noted. Morphological patterns of the genial tubercles were noted and classified.

### Results

Out of 70 mandibles, all had genial tubercles (Figures 1, 2 and 3). Regarding the number of genial tubercles, the most prevalent variant was the three-tubercle-variant in 35 mandibles (50%) and the four-tubercle-variant was present in 6 mandibles (8.6%), least common as shown in Table 1. The most common pattern was upper 2 tubercles and lower 1 tubercle as shown in Tables 2 and 3.



Figure 3. Mandible with single median tubercle.

Table 1. Distribution based on the number of genial tubercles.

No of tubercle	No of mandibles (n-70)	Percentage
1	09	12.8
2	20	28.6
3	35	50%
4	06	8.6%

Table 2. Distribution of the genial tubercles based on the morphology.

Pattern	No of mandibles (n-70)	Percentage
4 tubercle variant Type I	06	8.6
3 tubercle variant – upper 2 & lower 1. Type II	35	50
2 tubercle variant (right and left) Type III	19	27.1
2 tubercle variant (upper and lower) Type III	01	1.4
1 tubercle variant – round Type IV	07	10
1 tubercle variant – linear Type IV	01	1.4
1 tubercle variant – pointed Type IV	01	1.4



Figure 1. Mandible with two tubercles.



Figure 2. Mandible with three tubercles.

Table 3. Comparison with previous studies.

Classification	Description	Oda LS et al .	V Singh et al.	Padmavathi G et al.	Present study
Type I	Two superior and two inferior tubercles	14.21	19.6	23.33	8.6%
Type II	Two superior GTs and a median ridge representing fused inferior GTs	24.72	47.7	35	50%
Type III	Two superior GTs and a rough impression below them	27.27	23.7	26.67	28.5%
Type IV	a single median eminence or projection	24.0	7.2	13.33	12.8%
Type V	Absence of the GTs	9.8	1.8	1.67	-----

## Discussion

Genial tubercles (GTs), also known as mental spines, spinae mentalis and genial apophysis. GTs are small eminences/projections of bone found on the lingual side of the mandible at the midline and are important landmarks for maxillofacial surgeons, radiologists, prosthodontists and general dentists<sup>3,4</sup>.

Classically, genial tubercles are described in various anatomy textbooks/atlas as four mental spines on the lingual surface of the symphysis menti arranged in two pairs placed one above the other but they show different patterns in their positions and shapes<sup>5</sup>.

As the age advances, there shows some morphological changes in the bone architecture of the face and are subjected to remodelling. The microstructural changes are observed in the bone matrix and has got a significant impact on bone mineral density and calcium concentration. Aging of the craniofacial structure is reflected in the form of bone atrophy, which further leads to changes in dynamics<sup>6</sup>.

There are osteological and radiological studies reporting the morphology of the genial tubercles which is valuable for different dental applications in terms of position, number and dimensions. Genial tubercles can be used as a reference in the assessment of mandibular asymmetry<sup>7,8</sup>. Genial tubercle dimensions are important for the complete denture stability in the mandible<sup>9</sup>. It can also be used as a guide to determine a safe zone in the mental foramina region in the mandible before implant surgeries<sup>10</sup>.

Thomson examined 1,670 mandibles from anthropoids and concluded that the genial tubercles may be absent, replaced by pits or fossa and in some cases well-developed<sup>11</sup>.

V. Singh has studied the patterns of the mental spines and mental foramina in 1200 adult human mandibles of Indian origin and has classified the patterns into type I to type V. In his study he found type II pattern of distribution of genial tubercles to be more followed by type III. The mental spines were present in 1178 mandibles (98.2%). The usual textbook description of four spines, arranged in two pairs one above the other was found only in 231 mandibles (19.6%), similar to our study with 8.6%. Mandibles with only two superior mental spines were seen in 842 cases (71.4%) which were associated with either a median vertical ridge below them (47.7%) or with a rough impression in place of the median ridge (23.7%)<sup>12</sup>.

Type I; The classic description of four spines, two superior and two inferior tubercles

Type II; Two superior GTs and a median ridge representing fused inferior GTs below them

Type III; Two superior GTs and a rough impression below them.

Type IV; a single median eminence or projection.

Type V; Absence of the GTs<sup>12</sup>.

Oda *et al* has observed and analysed 275 human adult mandibles of both sexes and ethnic groups and found that the spina mentalis exists in  $90.04 \pm 1.8\%$  of the mandibles of Brazilian Whites and Negroes. The typical form with four tubercles, as classically described by authors, was least found as similar to our study. In most cases it is characterized by the presence of two upper tubercles  $27.27 \pm 7.2\%$ , two superior tubercles and one inferior  $24.72 \pm 6.7\%$ , and one elongated median tubercle  $24.0 \pm 6.6\%$ . The GT was absent in  $9.8 \pm 3.2\%$  of the cases, especially in mandibles of edentulous subjects<sup>13</sup>.

Padmavathi G *et al* studied genial tubercles in 60 mandibles and reported type - I pattern were seen in 23.33%, type - II in 35%, type - III in 26.67% and type - IV in 13.33% and type - V in 1.67% of the mandibles examined. In majority of the cases, two superior genial tubercles with a median ridge below it was noted (type II) followed by two SGT and a rough area below it (type III)<sup>14</sup>.

Hence considering all the morphological types of genial tubercles, comprehensive knowledge will help the surgeons to look into the cases as spontaneous fractures, displacements, excessive alveolar absorptions which may further pose problems in normal speech, mastication, deglutition and rehabilitation with complete denture prosthesis.

## Conclusion

The genial tubercles are deemed to be prominent as the age advances, care should be taken while constructing complete dentures so has to adjust the denture fitting surface, which gives a relief from pressure effects. Any painful conditions/ swelling or bleeding which may be due to spontaneous fractures, enlarged tubercles, failure of fixation or with potential airway compromise should consider differential diagnosis relating to genial tubercles.

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## Ethics Statement

The authors state that every effort was made to follow all local and international ethical guidelines and laws that pertain to the use of human cadaveric donors in anatomical research.

## References

1. Gray's Anatomy. The anatomical basis of clinical practice. Susan Standring. Elsevier Churchill Livingstone, 41st ed. London: 2016:1243.
2. Shohat I, Shohani Y, Taicher S. Fracture of the genial tubercles associated with mandibular denture: A clinical report. *J Prosthet Dent*. 2003;89(3):232-33
3. Yassutaka Faria Yaedú R, Regina Fisher Rubira-Bullen I, Sant'Ana E. Spontaneous fracture of genial tubercles: case report. *Quintessence Int*. 2006;37(9):737-39
4. Carroll MJ. Spontaneous fracture of the genial tubercles. *Br Dent J*. 1983;154(2):47-48.
5. Hugo V, de Oliveira Rodrigues L. Surgical removal of genial tubercles. Case report. *Int J Dent*. 2011;10(4):274-277.
6. Karadede Unal B, Hanci IH, Aytugan E, Elmalı F, Karadede B, Buyuk O, et al. Comparison of Genial Tubercle Anatomy Based on Age and Gender. *Turk J Orthod* 2021; 34(1): 46-53.
7. Moss ML. Twenty Years of Functional Cranial Analysis. *Am J Orthod Dentofac* 1972; 61: 479-85.
8. Enlow DH. Postnatal craniofacial growth and development. *J Plastic Surgery* 1990; 4: 2496-514.
9. Solomon EG. A critical analysis of complete denture impression procedures: contribution of early prosthodontists in India-part I. *J Indian Prosthodont Soc* 2011; 11: 172-82
10. Voon YS, Patil PG. Safe zone in anterior mandible related to the genial tubercle for implant osteotomy in a Chinese-Malaysian population: A CBCT study. *J Prosthet Dent* 2018; 119: 568-73
11. A.Thomson. On the presence of genial tubercles on the mandible of man and their suggested association with the faculty of speech, *J Anat Physiol* 1915;50: 43-74.
12. V.Singh, M.K.Anand, K.Dinesh. Variations in the pattern of mental spines and spinous mental foramina in dry adult human mandibles. *Surg Radiol Anat* 2000;22: 169-173.
13. Oda LS, Iyomasa MM, Watanabe IS. Morphologic analysis of the "spina mentalis" in adult mandibles of Brazilian whites and negroes. *Rev Bras Pesqui Med Biol* 1977; 10: 357-360.
14. Padmavathi G, Jyothi N Nayak, Sandhya, ShilpaNaik. An Osteological Study to Evaluate the Morphology, Position and Dimensions of the Genial Tubercles with Its Clinical Relevance. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)* 2014;13(4): 81-85.
15. Oda LS, Iyomasa MM, Watanabe IS. Morphologic analysis of the "spina mentalis" in adult mandibles of Brazilian whites and negroes. *Rev Bras Pesqui Med Biol* 1977; 10: 357-360.

## Mini Curriculum and Author's Contribution

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