Establishing surface projection of Temporo-Mandibular Joint using tragus of ear as landmark

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ABSTRACT

Introduction: The temporo-mandibular joint (TMJ) is a synovial joint between the articular fossa of the temporal bone and the mandibular condyle. It is condylar variety of joint. The most important functions of the TMJ are mastication and speech and are of great interest to anatomists, dentists, orthodontists and oro-maxillo-facial surgeons. The study was conducted with objective to establish the surface projection of Temporo-mandibular joint (TMJ) using tragus of ear as land mark. **Materials and methods:** Twenty five cadavers dissected in pre auricular area on both right and left side were studied. Out of 25 cadavers, 18 were male and seven were females. The temporo-mandibular joints were exposed on both sides, keeping the tragus of the ear intact. Altogether fifty temporo-mandibular joints were studied. On living persons, condylar head of TMJ were palpated while the subjects were carrying out side to side movement of lower jaw. The distance between the summit of the tragus and the marking on condylar head was measured with the help of divider and scale. **Result:** The mean distance in millimeter (mm) from midpoint of condylar head to the summit of tragus in all living subjects and cadavers (n=150) was 12.5 ± 3.5 mm and the mean length of distal phalanx of fore finger in all living subjects and cadavers (n=150) was 22 ± 4 mm. **Conclusion:** The mandibular condyle can be palpated at 12.5 ± 3.5 mm distance from summit of tragus of ear (i.e. Half-length of distal phalanx of fore finger which is 22 ± 4 mm) just below the inferior border of zygomatic arch.

Key words: Surface projection, Temporo-mandibular joint, Tragus of ear.

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Submitted: March 10, 2020

Accepted: May 25, 2020

To cite: Baral P, Awasthi J, Shrestha R, Sapkota S, Chaudhari B, Koju S. Establishing surface projection of Temporo-Mandibular Joint using tragus of ear as landmark. JGMC Nepal. 2020;13(1):39-44. **DOI:** 10.3126/jgmcn.v13i1.29315

INTRODUCTION

The temporo-mandibular joint (TMJ) is a synovial joint between the articular fossa of the temporal bone above and the mandibular condyle below.[1-6] It is a ginglymo-arthrodial joint, a term that is derived from ginglymus, meaning a hinge joint, allowing motion only backward and forward in one plane, and arthrodia, meaning a joint which permits a gliding motion of the surfaces.[1,2] Its joint cavity is divided into two by an articular disc.[1-6] The articular eminence, a transversely elliptical region sinuously curved in the sagittal plane and tilted downwards anteriorly at approximately 25 degree to the occlusal plane, forms most of the articular surface of the mandibular fossa. The articular surface of the mandibular condyle is slightly curved and tilted forward at approximately 25 degree to the occlusal plane.[1] The right and left TMJ form a bicondylar articulation and ellipsoid variety of the synovial joints similar to knee articulation.[1-3]

The common features of the synovial joints exhibited by this joint include a disk, bone, fibrous capsule, fluid, synovial membrane, and ligaments. However, the features that

differentiate and make this joint unique are its articular surface covered by fibrocartilage instead of hyaline cartilage. Movement is not only guided by the shape of the bones, muscles, and ligaments but also by the occlusion of the teeth, since both joints are joined by a single mandible bone and cannot move independently of each other.[1-6] The most important functions of the TMJ are mastication and speech and are of great interest to dentists, orthodontists and oro-maxillo-facial surgeons. This research is aimed to find the surface marking of TMJ using the tragus of ear as the landmark.

Rationale for the study: This type of study had not been conducted so far. The outcome of the study will be very informative for anatomist and oro maxillo facial surgeons, thus, this study was undertaken.

Importance of this study: This study will be highly useful for oral and maxillo- facial surgeon while operating the temporomandibular joint and during arthoscopic surgery and ortho centers of TMJ. As this study is establishing new easy method of surface marking of TMJ, it will be significant for anatomist also.

AIM & OBJECTIVES

Aim (General objective) of study

To establish the surface projection of Temporo-mandibular joints (TMJ) using tragus of ear as land mark.

Specific Objectives

1. To find the mean distance in mm from midpoint of condylar head to summit of tragus in living male and female
2. To find the mean distance in mm from midpoint of condylar head from summit of tragus in cadaveric male and female
3. To find the mean length of distal phalanx of fore finger in living male and female.
4. To find the mean length of distal phalanx of fore finger in cadaveric male and female
5. To compare the mean distance in mm from midpoint of condylar head to summit of tragus between living and cadaveric male and female and test the significant difference between them.
6. To compare the mean length of distal phalanx of fore finger between living and cadaveric male and female and test the significant difference between them.

METHODOLOGY

It is a crosss-sectional study conducted in Gandaki Medical College, Pokhara, Kaski from March 2014 to April 2019

Sample size and Sampling method for cadaveric study: Non-probability convenient sampling technique was adopted for cadaveric study. Whatever cadavers were available during study period in dissection hall, anatomy department were studied. **Cadaveric study procedure:** Twenty -five cadavers dissected in pre auricular area on both right and left side were studied. Out of 25 cadavers, 18 were male and seven were females. The temporo-mandibular joints were exposed on both sides, keeping the tragus of the ear intact. Altogether fifty temporo-mandibular joints were studied.

The distance between the summit of the tragus and the midpoint marking on condylar head was measured with the help of divider and scale. The distal phalanx length of fore finger was measured in a similar way. It is the distance between the crease on junction of distal and middle phalanx (distal interphalangeal joint) and tip of distal phalanx.

Sample size and Sampling method for living subjects study: For the living sample subjects, sample size was calculated by formula, sample size (n) = s^2/e^2 where 's' is standard deviation and 'e' is standard error. From the previous pilot study, value of standard deviation(s) and standard error (e) were determined as two and 0.28 respectively. Thus sample size was calculated as 50. Fifty living person (25 male and 25 female) were studied. Simple random sampling method was adopted to select the research subjects. **Study procedure on living subjects:** On living persons, condylar head which is one of the articular surface located by temporo-mandibular joints were palpated while the subjects were carrying out side to side movement of lower jaw. The TMJ was marked as point after condylar head was being palpated. The distance between the summit of the tragus and the marking on condylar head was measured with the help of divider and scale. The distal phalanx length of fore finger was measured in a similar way. It is the distance between the crease on junction of distal and middle phalanx (distal interphalangeal joint) and tip of distal phalanx. The procedure is shown in figure 1, 2 and 3.

Reliability and validity of research: To ensure the high reliability and validity of research bias was eliminated and measurements were taken by single observer who was principal investigator. **Inclusion and Exclusion criteria:** We included 25 to 35 years male and female with normally developed pinna of ear. Those with abnormally

developed pinna were excluded. **Statistical analysis:** The data collected entered into excel and data were analysed by using statistical software SPSS version 16. Student's 't' test was applied to compare the statistical difference between male and female and living and cadaveric data. For the data quality control during present research study, measures taken were adopting correct method of data collection; screening and verifying the collected data; selecting appropriate computer software; coding and entering the data into computer and rechecking it; processing the data; constructing a data base for data management and appropriate data analysis and review over it. **Ethical consideration:** There was no ethical issue for the cadaveric study. For the study on living subjects, consent was taken from every subject prior to conducting the study. Ethical clearance was obtained from the institutional ethical committee.

RESULTS

The dissection study of twenty-five cadavers on right and left side i.e. fifty temporo-mandibular joints (TMJs) were carried out where as one hundred TMJs on fifty living persons (25 male and 25 female) were studied. The findings are presented in table 1 to 10.

Table 1: The mean distance of midpoint of condylar head from summit of tragus and length of distal phalanx of fore finger of all cadavers (n=50 TMJs):

sn	The mean distance of midpoint of condylar head from summit of tragus and length of distal phalanx of fore finger	measurement
1.	The mean distance in mm from midpoint of condylar head to summit of tragus in all cadavers(n=50)	11.5+_2.5 mm
2.	The mean length of distal phalanx of fore finger in all cadavers(n=50)	21+_3 mm

Table 2: The mean distance of midpoint of condylar head from summit of tragus and length of distal phalanx of fore finger in male and female cadavers:

sn	The mean distance of midpoint of condylar head from summit of tragus and length of distal phalanx of fore finger	measurement
1.	The mean distance in mm from midpoint of condylar head to summit of tragus in male cadavers(n=36)	12+_2 mm
2.	The mean distance in mm from midpoint of condylar head to summit of tragus in female cadavers(n=14)	11+_2 mm
3.	The mean length of distal phalanx of fore finger in male cadavers(n=36)	22+_2 mm
4.	The mean length of distal phalanx of fore finger in female cadavers(n=14)	20+_2 mm

Table 3: Level of significance while comparing male and female cadaver parameters in the study:

S.n	Level of significance while comparing following male and female cadavers parameters	P value
1.	The mean distance in mm from midpoint of condylar head to summit of tragus in male cadavers(n=36)=12±2 mm	0.08
2.	The mean distance in mm from mi point of condylar head to summit of tragus in female cadavers(n=14)=11±2 mm	
3.	The mean length of distal phalanx of fore finger in male cadavers(n=36)=22±2 mm	0.06
4.	The mean length of distal phalanx of fore finger in female cadavers(n=14)=20±2 mm	

Statistical significance ($p<0.05$)

Table 4: The mean distance of midpoint of condylar head from summit of tragus and length of distal phalanx of fore finger of all living subjects (n=100 TMJs):

S.n	The mean distance of midpoint of condylar head from summit of tragus and length of distal phalanx of fore finger	measurement
1.	The mean distance in mm from midpoint of condylar head to summit of tragus in all living subjects(n=100)	13.5±2.5 mm
2.	The mean length of distal phalanx of fore finger in all living subjects(n=100)	23±3 mm

Table 5: The mean distance of midpoint of condylar head from summit of tragus and length of distal phalanx in living male and female:

S.n	The mean distance of midpoint of condylar head from summit of tragus and length of distal phalanx	measurement
1.	The mean distance in mm from midpoint of condylar head to summit of tragus in living male (n=50)	14±2 mm
2.	The mean distance in mm from midpoint of condylar head to summit of tragus in living female (n=50)	13±2 mm
3.	The mean length of distal phalanx of fore finger in living male (n=50)	24+_2 mm
4.	The mean length of distal phalanx of fore finger in living female (n=50)	22+_2 mm

Table 6: Level of significance while comparing living male and female parameters in the study:

S.n	Level of significance while comparing living male and female parameters in the study	P value
1.	The mean distance in mm from midpoint of condylar head to summit of tragus in living male(n=50)= 14±2 mm	0.07
2.	The mean distance in mm from midpoint of condylar head to summit of tragus in living female(n=50)=13±2 mm	
3.	The mean length of distal phalanx in living male(n=50)=24±2 mm	0.06
4.	The mean length of distal phalanx in living female(n=50)=22±2 mm	

Statistical significance **($p<0.05$)**

Table 7: Level of significance while comparing the mean distance in mm from midpoint of condylar head to summit of tragus between living and cadaveric male and female.

S.n	Level of significance while comparing the mean distance in mm from midpoint of condylar head to summit of tragus between living male and female	P value
1.	The mean distance in mm from midpoint of condylar head to summit of tragus in living male (n=50)= 14±2 mm	0.07
2.	The mean distance in mm from midpoint of condylar head to summit of tragus in cadaveric male(n=36)= 12±2 mm	
3.	The mean distance in mm from midpoint of condylar head to summit of tragus in living female(n=50) =13±2 mm	0.06
4.	The mean distance in mm from midpoint of condylar head to summit of tragus in cadaveric female(n=14)= 11±2 mm	

Statistical significance **(p<0.05)**

Table 8: Level of significance while comparing the mean length of distal phalanx between living and cadaveric male and female:

Sn	Level of significance while comparing living male and female parameters in the study	P value
1.	The mean length of distal phalanx in living male(n=50)= 24±2 mm	0.07
2.	The mean length of distal phalanx in cadaveric male (n=36)= 22±2 mm	
3.	The mean length of distal phalanx in living female(n=50) =22±2 mm	0.06
4.	The mean length of distal phalanx in cadaveric female (n=14)= 20±2 mm	

Statistically significance **(p<0.05)**

Table 9: Level of significance while comparing the mean distance in mm from midpoint of condylar head to summit of tragus and the mean length of distal phalanx between overall living subjects and cadaveric bodies:

Sn	Level of significance while comparing overall living subjects and cadaveric parameters in the study	P value
1.	The mean distance in mm from midpoint of condylar head to summit of tragus in all cadavers(n=50)= 11.5±2.5 mm	0.07
2.	The mean distance in mm from midpoint of condylar head to summit of tragus in all living subjects(n=100)= 13.5±2.5 mm	
3.	The mean length of distal phalanx of fore finger in all cadavers(n=50)= 21±3 mm	0.06
4.	The mean length of distal phalanx of fore finger in all living subjects(n=100)= 23±3 mm	

Statistically significance **(p<0.05)**

Table10: The mean distance in mm from midpoint of condylar head to summit of tragus and the mean length of distal phalanx in all living subjects and cadavers:

sn	The mean distance of midpoint of condylar head from summit of tragus and length of distal phalanx	Measurement
1.	The mean distance in mm from midpoint of condylar head to summit of tragus in all living subjects and cadavers (n=150)	12.5±3.5 mm
2.	The mean length of distal phalanx of fore finger in all living subjects and cadavers (n=150)	22±4 mm

DISCUSSION

The temporo-mandibular joint (TMJ), which is synovial joint of condylar variety is very important joint because it involves in chewing food. As this joint has function of mastication and during mastication there is wear and tear in structure of the joint which results several types of joint disorders. In TMJ disorders, from the examination i.e. palpation of condylar head to clinical operative procedures like TMJ arthroscopy and others, it is quite necessary to locate condylar head by surface marking. So far there was no established method to locate it by surface marking thus this study was undertaken.

The present study was designed to carry out both on living subjects and dead bodies (cadavers) so that the result obtained from cadaveric study would be compared with the results obtained from study on living subjects. The statistical tests were used to compare the data obtained from living subjects and cadaveric studies for statistical significance. While doing so data would be validated for living subject studies.

The mean distance in mm from midpoint of condylar head to summit of tragus in all cadavers (n=50) was 11.5±2.5 mm and the length of distal phalanx of fore finger in all cadavers (n=50) was 21±3 mm. The mean distance in mm from midpoint of condylar head to summit of tragus in male cadavers (n=36) was 12±2 mm and in female cadavers (n=14) was 11±2 mm. The mean length of distal phalanx of fore finger in male cadavers (n=36) was 22±2 mm and in female cadavers (n=14) was 20±2 mm. The level of significance while comparing male and female cadavers parameters in the study was followed: the mean distance in mm from midpoint of condylar head to summit of tragus in male cadavers (n=36) = 12±2 mm and in female cadavers(n=14) =11±2 mm was statistically insignificant **(p<0.05)** likewise length of distal phalanx of fore finger in male cadavers (n=36) = 22±2 mm and in female cadavers (n=14) = 20±2 mm was also statistically insignificant **(p<0.05)**.

The mean distance in mm from midpoint of condylar head to summit of tragus in all living subjects (n=100) was 13.5±2.5 mm and the length of distal phalanx of fore finger (n=100) was 23±3 mm. The mean distance in mm from midpoint of condylar head to summit of tragus in living male (n=50) was 14±2 mm and in living female (n=50) was 13±2 mm. The mean length of distal phalanx of fore finger in living male (n=50) was 24±2 mm and in living female (n=50) was 22±2 mm. The Level of significance while comparing living male and female parameters in

the study was followed: the mean distance in mm from midpoint of condylar head to summit of tragus in living male (n=50) = 14±2 mm and in living female (n=50) = 13±2 mm was statistically insignificant (p value <0.05) likewise the mean length of distal phalanx in living male (n=50) = 24±2 mm and in living female (n=50) = 22±2 mm was also statistically insignificant (p value <0.05).

The level of significance while comparing the mean distance in mm from midpoint of condylar head to summit of tragus between living and cadaveric male and female was followed: the mean distance in mm from midpoint of condylar head to summit of tragus in living male (n=50) was 14±2 mm and in cadaveric male (n=36) = 12±2 mm was statistically insignificant (p value <0.05). Likewise, the mean distance in mm from midpoint of condylar head to summit of tragus in living female (n=50) was 13±2 mm and in cadaveric female (n=14) = 11±2 mm was also statistically insignificant (p value <0.05). The level of significance while comparing the mean length of distal phalanx between living and cadaveric male and female was followed. The mean length of distal phalanx in living male (n=50) was 24±2 mm and in cadaveric male (n=36) was 22±2 mm was statistically insignificant (p value <0.05). Likewise, the mean length of distal phalanx in living female (n=50) was 22±2 mm and in cadaveric female (n=14) was 20±2 mm was also statistically insignificant (p value <0.05).

The level of significance while comparing the mean distance in mm from midpoint of condylar head to summit of tragus and the mean length of distal phalanx between overall living subjects and cadaveric bodies was followed: the mean distance in mm from midpoint of condylar head to summit of tragus in all cadavers (n=50) was 11.5±2.5 mm and in all living subjects (n=100) was 13.5±2.5 mm was statistically insignificant (p value <0.05). Likewise, the mean length of distal phalanx of fore finger in all cadavers (n=50) was 21±3 mm and in all living subjects (n=100) was 23±3 mm was also statistically insignificant (p value <0.05).

The mean distance in mm from midpoint of condylar head to summit of tragus in all living subjects and cadavers (n=150) was 12.5±3.5 mm and the mean length of distal phalanx of fore finger in all living subjects and cadavers (n=150) was 22±4 mm.

From all these observations, the present study proved that the midpoint of mandibular condyle from summit of tragus was found to be 12.5±3.5 mm just below the inferior border of zygomatic arch. The mean length of distal phalanx of fore finger was found to be 22± 4 mm. It means mandibular condyle can be palpated at half length of distal phalanx of fore finger just below the inferior border of zygomatic arch.

There was no previous study of this kind in the world thus comparison of present study result with previous ones could not be done. The outcome of this study is very important for anatomist as it is establishing new easy method of surface marking of TMJ. This study will be highly useful for oral and maxillofacial surgeon during arthroscopic surgery and while surgically operating the temporo-mandibular joint by open method.

CONCLUSION

The midpoint of mandibular condyle from summit of tragus was found to be 12.5±3.5 mm just below the inferior border of zygomatic arch. The mean length of distal phalanx of fore finger was found to be 22± 4 mm. It means mandibular condyle can be palpated at half length of distal phalanx of fore finger just below the inferior border of zygomatic arch.

Conflict of interest: None

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