Surgical Landmarks During Mastoidal and Petrosal Operations

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Key Words: Temporal bone, Anatomy, Landmarks, Facial recess, Tympanomastoid suture

Summary: This study was made on twenty-one formalin fixed, adult skull left-half specimens. Each of the measurements was made using callipers accurate to 0.1 mm. The dissection of the temporal bone was begun with simple mastoidectomy and completed when the endosteum of the semicircular canals were opened. During the temporal bone dissection step by step, eleven different measurements have been made with small size callipers, and mean, median, range and standard deviations have been determined. The following set of correlations was found to be significant: I - The correlation between the orbitomeatal length and the distance from the most lateral point of the tympanomastoid suture to the facial canal \( r = 0.69, p < 0.001 \). II - The correlation between the orbitomeatal length and the distance from the tympanic ring to the facial canal \( r = 0.49, p = 0.011 \). III - The correlation between the distance from the most lateral point of the tympanomastoid suture to the facial canal and the distance from the tympanic ring to the facial canal \( r = 0.71, p < 0.001 \).

The majority of the temporal bone operations are applied directly to the mastoid bone or to the mastoid and petrous bones: mastoidotomy, simple mastoidectomy, radical mastoidectomy, posterior tympanotomy, cochlear implantation, labyrinthectomy, endolymphatic sac decompression, translabyrinthine, transotic, transcochlear, retrolabyrinthine, infratemporal fossa approaches. The absence of experience and of knowledge of detailed anatomy of this region may cause several complications or result in inadequate operations.

Anything can replace experience, but exact knowledge of the bone anatomy, of the regional landmarks and of the expected distances between anatomical structures can help to the inexperienced surgeon and also sometimes to the experienced surgeon, when the anatomy is distorted by the pathology.

In this study, the temporal bone was dissected from lateral to medial using classical drilling technique, the landmarks were exposed, the distances between different landmarks were measured and correlations were taken.

Materials and Methods

Twenty-one formalin fixed, adult skull left-half specimens, cut midsagittally, were studied. Each of the measurements was made using small size callipers.

Each specimen was dissected, measured and inspected as follows; the temporal bone was cleaned off excess soft tissue, and the orbitomeatal distance, the distance between the supramastoid crest and the tympanic bone, the distance between the mastoid cortex and the stylomastoid foramen were measured (these distances have been described with details in the results).

Then, a simple mastoidectomy was performed on each bone, extending the dissection to achieve adequate exposure of the sigmoid sinus, sinodural angle and the dural plate of the middle cranial fossa. The horizontal and posterior semicircular canals and facial canal were skeletonized.
posterior wall of the external acoustic meatus was removed till to the tympanomastoid suture. At this stage, the shortest distance between the sigmoid sinus and the mastoid cortex, (at near Citelli angle) and the shortest distance between the most lateral point of the tympanomastoid suture (the most lateral point of the posterior margin of the tympanic bone) and the facial canal were measured.

Afterwards the posterior meatal wall was entirely removed with the exception of tympanic ring (Posterior Butress). At that stage, the shortest distance between the posterior semicircular canal and the sigmoid sinus was measured. Then, the temporal bone was cut at the mandibular fossa anteriorly, and at the Trautmann's triangle posteriorly and the petrous bone, tympanic bone and anterior part of the mastoidal bones were entirely removed. With this operation, deep structures in this region were evaluated better: the distance between the tympanic ring and the facial canal, the distance between the fossa incudis and the posterior semicircular canal, the diameter of the posterior semicircular canal, the distance between the horizontal and posterior semicircular canals, and the distance between the posterior semicircular canal and the facial canal.

Finally, a statistical analysis was made of the measurements using these parameters. The range for each measurement represents the highest and lowest value obtained within the sample. The mean indicates the arithmetic average determined by the sum of all observations divided by the number of observations. The median indicates the value of the sample which is exactly middle of the population. The standard deviation is a measure of the scatter of observations about the mean. The classical correlation test was used for the correlations between observations. And by this way r and p were determined.

Results

Orbitomeatal distance
The distance between the lateral angle of the eye and the anterior border of the tympanic bone. The mean is 75.23 mm.
Standard deviation: 5.94, Median: 73.54, Range: 66.45–87.90.

Supramastoid crest–tympanic bone
The shortest distance between the supramastoid crest and the lowest junction point of the posterior margin of the tympanic bone with the mastoid bone. The mean is 25.31 mm.

Mastoid cortex–stylomastoid foramen
The temporal bone in the anatomic position, the distance between the sagittal line tangential to the most prominent point of the mastoid bone and the stylomastoid foramen. The mean is 19.74 mm.

Mastoid cortex–sigmoid sinus
At the Citelli angle, the shortest distance between the mastoid cortex and the sigmoid sinus. The mean is 6.66 mm.

Tympanomastoid suture–facial canal
The shortest distance between the most lateral point of the tympanomastoid suture (the most lateral point of the posterior margin of the tympanic bone) and the facial canal. The mean is 12.14 mm.

Tympanic ring–facial canal
The shortest distance between the tympanic ring (anulus tympanicus) and the facial canal. The mean is 2.83 mm.
Standard deviation: 0.55, Median: 2.80, Range: 2.04–4.45.

Fossa incudis–posterior semicircular canal
The distance between the fossa incudis and the posterior margin of the posterior semicircular canal along the horizontal semicircular canal. The mean is 9.84 mm.
Standard deviation: 1.73, Median: 8.7, Range: 6.04–12.34.

Posterior semicircular canal–sigmoid sinus
The shortest distance between the posterior semicircular canal and the sigmoid sinus. The mean is 8.69 mm.
Standard deviation: 1.73, Median: 8.7, Range: 6.04–12.34.

Posterior semicircular canal–facial canal
The shortest distance between the posterior semicircular canal and the facial canal. The mean is 3.23 mm.
Standard deviation: 0.59, Median: 3.28, Range: 2.10–4.81.

Fossa incudis–posterior semicircular canal
The distance between the fossa incudis and the posterior margin of the posterior semicircular canal along the horizontal semicircular canal. The mean is 9.84 mm.
Standard deviation: 0.51, Median: 10.00, Range: 9.03–10.54.

Posterior semicircular canal
The diameter of the posterior semicircular canal. The mean is 7.41 mm.
Standard deviation: 0.45, Median: 7.50, Range:
Discussion

The mastoidal and petrosal operations, like any other surgical intervention are based on experience and anatomical knowledge. Experience is earned year by year, but anatomical knowledge may be increased by several comparisons obtained between landmarks. For this reason every measurement on the temporal bone is worthy surgically.

There are many surgical landmarks which are useful during mastoidal and petrosal operations. Some of them serve only as landmarks, that means they shouldn't need protection during surgery. These are the tympanomastoid suture, tympanic ring (anulus tympanicus), supramastoid crest, several regions of the mastoid cortex etc.

And some of them are not only landmarks, at the same time functional important structures. These are the facial canal, horizontal semicircular canal, posterior semicircular canal, sigmoid sinus, the short process of the incus at an angle of 30 degrees from the tegmen, and 12 mm from the fossa incudis at an angle of 45 degrees from the tegmen. This area described above identifies and isolates the hard angle.

The shortest distance between the posterior semicircular canal and the sigmoid sinus varied from 6.04-12.34 mm. It indicates a high standard deviation. According to Maniglia's measurements this distance ranged from 4 to 14.5 mm. However, the standard deviation was comparable to the one found in this study. The measurements reported here indicate that the correlation between the posterior semicircular canal and the sigmoid sinus shouldn't be taken as a guide for the identification of Trautmann triangle, respectively. Instead, the fossa incudis and hard angle should be taken as surgical landmarks for this triangle.

The shortest distance between the posterior semicircular canal and the facial canal ranges between 2.10-4.81 mm. Maniglio measured the distance between second genu and the posterior semicircular canal and found the range to be 2.5-7 mm (Mean is 3.95). One of the aims of this study was to compare the development of the temporal bone with the development of the other bones. We got a simple measure called the orbitomeatal distance for this...
reason. This distance ranged from 66.45 to 87.90 mm. No correlation have been found between the orbitomeatal distance and the supramastoid crest and the inferior border of the tympanic bone. However, a high correlation was found between the orbitomeatal distance and the distance from the most lateral point of the tympanomastoid suture to the facial canal \( r = 0.69, p < 0.001 \) (very significant). A correlation also was found between the orbitomeatal distance and the shortest distance from the tympanic ring to the facial canal \( r = 0.49, p = 0.11 \) (significant). As a result, the greater the orbitomeatal distance is the deeper and further away from the tympanic ring is the facial canal \( (p < 0.05) \).

Another interesting correlation was found between the two different measurements of the facial canal. The correlation \( (r = 0.71, p < 0.001) \), again very significant one, indicate that farther the distance between the facial canal and the tympanic ring, farther is the distance between the mastoidal segment of the facial canal and the most lateral point of the tympanomastoid suture. The investigators of this study have not come across with reports of similar correlations related to the facial canal in literature.

**Conclusion**

The mastoidal and petrosal operations are based on experience and a good knowledge of anatomy.

The anatomy of this region is very complex and many important structures are contained in a small bony area.

In this study the ranges of the distances between landmarks are measured. Not only giving the knowledge of the expected distances between landmarks, this study showed us also three important correlation: I – The correlation between orbitomeatal length and the distance from the most lateral point of the tympanomastoid suture to the facial canal \( r = 0.69, p < 0.001 \). II – The correlation between the orbitomeatal length and the distance from tympanic ring to the facial canal \( r = 0.49, p = 0.011 \). III – The correlation between the distances from the most lateral point of the tympanomastoid suture to the facial canal and the distance from the tympanic ring to the facial canal \( r = 0.71, p < 0.001 \).

In conclusion, this study shows that, the greater the orbitomeatal distance is the deeper and further away from the tympanic ring is the facial canal. That means also the deeper the facial canal, the greater the facial recess.

**References**