

Henle's Spine - A Surgical landmark for skull base surgeries

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Abstract

Introduction: Henle's spine is a small spicule anterior to the supramastoid pit at the postero-superior margin of bony external acoustic meatus which is of surgical importance in localizing foramen ovale, carotid canal and jugular foramen.

Objective: To compare the distances from henle's spine to foramen ovale, carotid canal and jugular foramen of both sides of skulls and to look for possible sexual dimorphism.

Materials and Method: 51 (102 sides) adult skulls (n=24 males and n=27 females) with prominent Henle's spine were noted. The distances from Henle's spine to foramen ovale, jugular foramen and carotid canal of both sides in male and female skulls were measured by using Digital Vernier Calliper.

Results: Mean±SD of Henles spine to posterior medial and posterior lateral jugular foramen (HS-PMJF, HS-PLJF) distance were statistically significant between right and left sides in male skulls. The mean distance of Henle's spine to anterior margin of foramen ovale (HS-AMFO) was significant on right side, while HS-PMJF & HS-PLJF distance were significant on left side when compared between male & female skulls.

Conclusion: Henle's spine can serve as an important landmark for localizing foramina of skull base during skull base surgeries.

Key Words: Supramastoid pit, otological surgeries, lateral skull base surgeries.

Introduction

The temporal bone is a critical component of the basicranium. It is surrounded by the posterior and middle cranial fossae superiorly, and the infratemporal fossa and the upper cervical region inferiorly^[1]. Temporal bone gives passage for the internal carotid artery, jugular bulb and facial nerve. Today is the era of skull base surgeries; even a minimal variation can lead to major catastrophe. The surgical exposure of the middle cranial fossa, trans-petrosal and trans-mastoid approaches for skull base surgeries would require the identification of the surface anatomical landmarks like Henle's spine or suprameatal spine^[2].

Henle's spine (HS) is a small bony prominence or spicule anterior to the supramastoid pit at the postero-superior margin of bony external acoustic meatus^[3] (Fig no 1). The HS, when present, because of its superficial and key position^[2], this point is reliable and multipurpose surgical landmark in localizing foramen ovale, carotid canal and jugular foramen in various skull base and otological surgeries^[3] (Fig no 2).

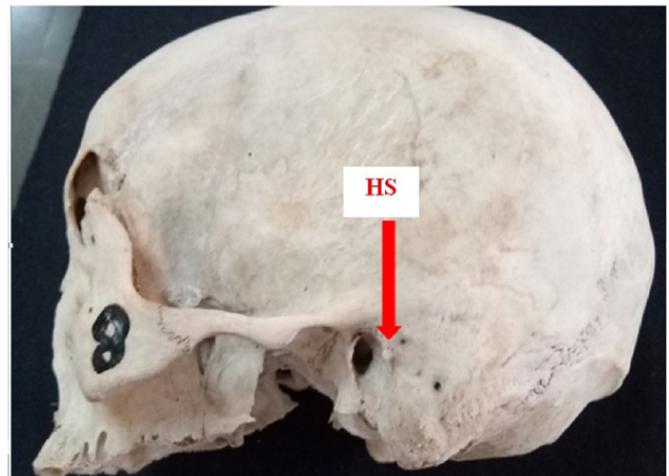


Figure 1: Showing Henle's spine (HS) in postero-superior margin of bony external acoustic meatus

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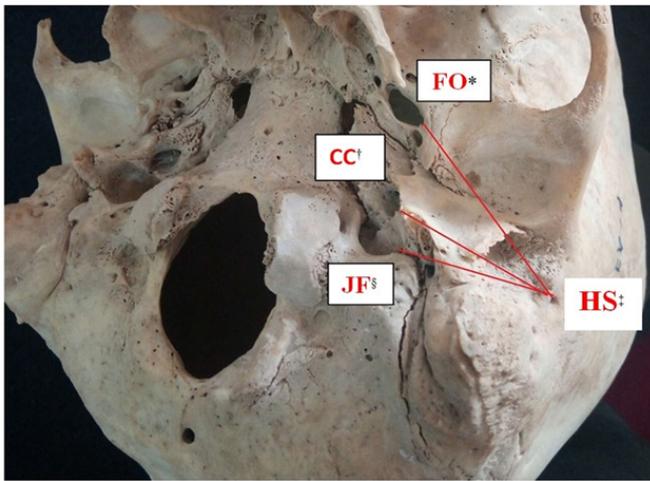


Figure 2: Henle's spine to foramen ovale, carotid canal and jugular foramen

Foramen ovale is of great importance in procedures like percutaneous trigeminal rhizotomy in trigeminal neuralgia and in trans-facial fine needle aspiration technique^[4].

Internal carotid artery runs inside the temporal bone and restricts surgical procedures for lesions extending not only to the middle skull base but to the infratemporal fossa. So identifying the carotid canal is important in en-bloc resection of the tumour, trans basal approach to lesions in the frontal skull base, and trans-zygomatic approach to those in the middle skull base^[5]. This will help in preventing complications like internal carotid artery transection, thrombosis and embolism^[6].

The jugular foramen has constantly fascinated ENT surgeons, Radiologists and Neurosurgeons because of modern advances in surgical procedures involving skull base and middle ear. Tumours in this area such as schwannoma, meningioma, glomus jugulare and chordoma can produce multiple cranial nerve palsies, i.e, jugular foramen syndrome (Vernet's syndrome). Most of the approaches for resection for these tumours such as retrosigmoid, transjugular craniotomy require partial petrosectomy traversing the jugular fossa^[7]. Ligation of the internal jugular vein is sometimes performed during radical neck dissection with the risk of venous infarction, which some assume to be because of the ligation of the dominant internal jugular vein^[8].

A study done by Biswabina ray revealed that statistical differences between the two genders showed significant difference only in the distance between the HS to the medial margin of the external orifice of carotid canal^[2].

A study done by Tuncay Ulug revealed that the mean distance from HS to the posterior and anterior margins of the foramen ovale was 4 and 4.5 cm and the

distance from Henle's spine to the lateral and medial margins of the jugular foramen was 2.5 and 3.5 cm^[9].

A study done by Yogita R revealed significant difference in mean distance from Henle's spine to posterolateral margin of jugular foramen between right and left sides ($p < 0.05$)^[3].

The purpose of this study was to identify the distances from easily recognizable bony landmark like Henle's spine to foramen ovale, carotid canal and jugular foramen. As there was less data from Bagalkote district of North Karnataka region, this data will help neurosurgeons and otologists to identify the mean distances of various foramina from Henle's spine and preventing complications in various skull base surgeries.

Materials and method

A Cross sectional observational study was done on fifty one (102 sides of 24 male skulls and 27 female skulls) adult skulls in S Nijalingappa Medical College, Bagalkote. Inclusive criteria - Adult skulls with prominent HS were included in the study.

Exclusive criteria - Skulls with pathological changes and destruction at the cranial base and HS were excluded from the study.

Duration of study - Three months

The power of the study was calculated retrospectively following the analysis of the data. At 95% confidence level, Mean \pm SD of HS-PMJF (posterior margins of jugular foramen) distance on right side was 37.7 ± 3.81 and Mean \pm SD of HS-PMJF distance on left side was 35.5 ± 3.36 . After taking the sample size of the present study (51 skulls), the power of the study was 93% (which is more than 80%). Hence the sample size for the present study is adequate.

Male and female skulls were identified and classified by the features of external skull. Male skulls are more robust and less rounded forehead. The male mandible is more robust and larger than that of the female: it generally displays a greater height in the region of the symphysis menti, the chin is more square, the condyles are larger, the muscle attachments are more pronounced and the gonial angle is generally less than 125° . A male skull has thicker and more rounded orbital margins, pronounced supra-orbital ridges, and often a well-defined glabella that occupies the midline above the root of the nose. The temporal lines are more pronounced in male skulls and the supramastoid crest generally extends posterior to the external auditory meatus. Female skulls are more gracile. The female forehead is generally higher, more vertical and more rounded than male skulls, and there is a clear retention of the frontal eminences in female skulls^[10].

The distances from Henle's spine (HS) to anterior & posterior margins of foramen ovale (HS-AMFO & HS-PMFO), Henle's spine (HS) to medial & lateral margin of carotid canal (HS-MCC & HS-LCC) and Henle's spine to anterior & posterior margin of Jugular foramen (HS-AMJF & HS-PMJF) of both sides in male and female skulls (Fig no.3) were measured by using digital Vernier calliper of 0.01 mm accuracy.

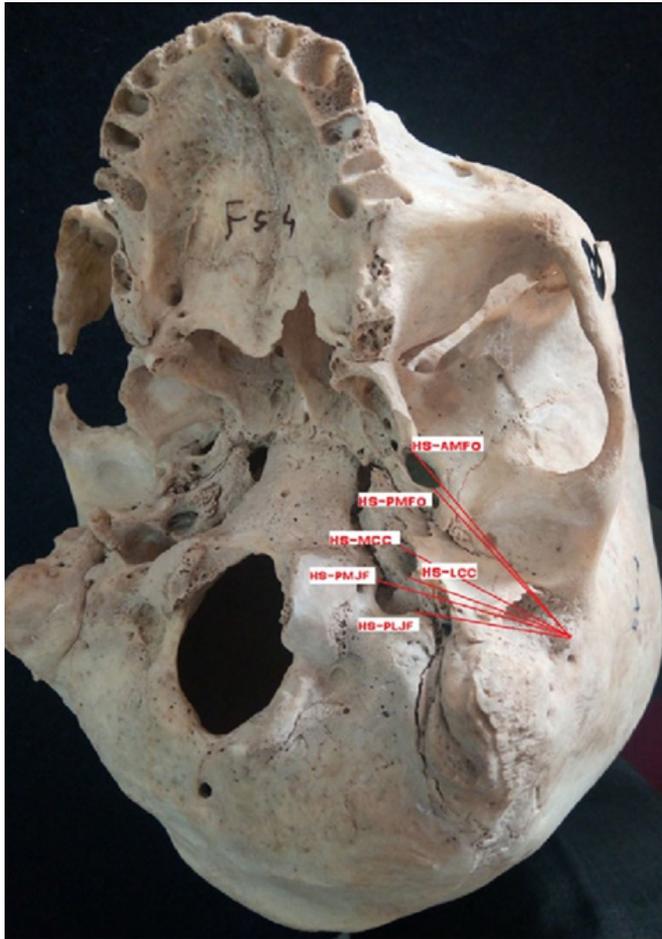


Figure 3: Showing the distance from Henle's spine to anterior & posterior margins of Foramen ovale (HS-AMFO, HS-PMFO), Henle's spine to medial & lateral margin of carotid canal (HS-MCC, HS-LCC) & Henle's spine to anterior & posterior margin of Jugular foramen (HS-AMJF, HS-PMJF)

Results

The mean and Standard Deviation of distances from the HS to foramen ovale, carotid canal and jugular foramen were calculated. The values are given in mm and as Mean ± Standard Deviation (SD). 'p' value was considered statistically significant if it was ≤ 0.05.

Table 1: Comparison of mean distances of both the sides in male skulls

Mean distance In mm	Right side Mean ±SD*	Left side Mean ±SD*	P† value
HS-AMFO	44.97±2.94	45.79±3.27	0.362
HS-PMFO	37.15±2.95	37.64±2.84	0.567
HS-MCC	34.26±3.0	34.36±2.05	0.890
HS-LCC	28.24±2.73	29.05±2.42	0.284
HS-PMJF	37.7±3.81	35.53±3.36	0.041
HS-PLJF	24.03±3.09	25.42±2.95	0.0002

*- SD-standard deviation, †P-significance.

In male skulls, Mean±SD of HS-PMJF distance was 37.70±3.81mm on right and 35.53±3.36mm on left side (p=0.041) and HS-PLJF was 24.03±3.09mm on right and 25.42±2.95mm on left side (p=0.0002). Results were significant when compared to right and left side (Table 1)

Table 2: Comparison of mean distances of both the sides in female skulls

Mean distance In mm	Right side Mean ±SD*	Left side Mean ±SD*	P† value
HS-AMFO	42.80±2.71	42.54±2.35	0.712
HS-PMFO	35.48±2.77	35.24±2.05	0.723
HS-MCC	33.47±2.27	33.24±2.18	0.705
HS-LCC	27.38±2.02	27.49±1.99	0.837
HS-PMJF	35.45±3.43	34.89±2.36	0.000001
HS-PLJF	23.51±2.00	23.99±2.32	0.415

*- SD-standard deviation, †P-significance.

Among female skulls, Mean±SD of HS-PMJF distance was 35.45±3.43mm on right and 34.89±2.36 mm on left side and on comparison results were highly significant (p=0.000001) (Table 2).

Table 3: Comparison of mean distances of right side between male and female skulls

Mean distance In mm	Males	Females	P† value
HS-AMFO	44.97±2.94	42.80±2.71	0.0087
HS-PMFO	37.15±2.95	35.48±2.77	0.0420
HS-MCC	34.26±3.00	33.47±2.27	0.2923
HS-LCC	28.24±2.73	27.38±2.02	0.2052
HS-PMJF	37.70 ± 3.81	35.45±3.43	0.0313
HS-PLJF	24.03±3.09	23.5±2.00	0.4704

*- SD-standard deviation, †P-significance.

When compared between the genders, the mean distance of HS-AMFO (p=0.0087) and HS-PMJF (0.0313) were significant on right side (Table 3)

Table 4: Comparison of distances of left side between male and female skulls

Distance (in mm)	Males	Females	Pt value
HS-AMFO	45.79±3.27	42.54±2.35	0.0001
HS-PMFO	37.64±2.84	35.24±2.05	0.00108
HS-MCC	34.36±2.05	33.24±2.18	0.06
HS-LCC	29.05±2.42	27.49±1.99	0.01
HS-PMJF	35.53±3.36	34.89±2.36	0.043
HS-PLJF	25.42±2.95	23.99±2.32	0.0059

*- SD-standard deviation, +P-significance.

When compared between the genders, the mean distance of HS-AMFO (p=0.043) and HS-PMJF (p=0.0059) were significant on left side (Table 4).

Statistical analysis was done by using Open Epi Software version 2.3.1. Mean and standard deviation were calculated. The side differences were compared by using Unpaired 't' test in Open Epi Software version 2.3.1. 'p' value was considered statistically significant if it was ≤ 0.05 .

Discussion

A study done by Biswabina ray in India revealed the significant difference only in the distance from the HS to the medial margin of the external orifice of carotid

canal when compared between two genders^[2]. But, our present study did not show any significant difference in distance between HS & carotid canal.

A study done by Tuncay Ulug in Turkey revealed that the mean distance from HS to the posterior and anterior margins of the foramen ovale was 4 and 4.5 cm and the distance from Henle's spine to the lateral and medial margins of the jugular foramen was 2.5 and 3.5 cm^[9]. In our present study, mean distance from HS- AMFO was 44mm & HS-PMFO was 36mm. Mean±SD of HS-PMJF distance was 37.70±3.81mm on right side and 35.53 ± 3.36mm on left side (p=0.041) and HS-PLJF distance was 24.03 ± 3.09mm on right side and 25.42 ± 2.95mm on left side (p=0.0002) in male skulls. These differences were significant when compared to right and left side in male skulls. There was highly significant difference in HS-PMJF distance in female skulls.

A study done by Yogitha R revealed the significant difference in mean distance from Henle's spine to posterolateral margin of jugular foramen between right and left sides (p<0.05)^[3]. In our study, mean distance of HS-PMJF & HS-PLJF were significant on left side when compared between male & female skulls. The mean distance of HS-PMJF was also significant on right side when compared between male & female skulls. (Table 5).

Table 5: comparison of mean distances in mm between present study and other studies

Anatomic Landmarks	ULUG et al 2005, Turkey n=46	Biswabina Ray et al 2011, India n=39	Yogitha R India 2016 n=29	Present study India 2017 n=51
HS-AM FO	44.71±2.81	45.1±2.7	42.57±2.38	44.02±2.81
HS-PM FO	37.93±1.85	38.2±2.5	35.96±2.05	36.37±2.64
HS-PLJF	23.40±2.37	32.0±5.4	22.82±2.12	28.04±2.28
HS-PMJF	34.35±2.01	-	34.08±2.48	33.81±2.37
HS-MCC	34.50±2.08	35.9±2.9	32.27±2.22	35.14±3.24
HS-LCC	28.70±3.74	27.6±2.6	26.68±1.95	24.21±2.77

Our study also showed the mean HS-AMFO distance was highly significant on right side when compared between male & female skulls.

Limitations

The present study was done on 51 skulls with minimum bias in only one region of Karnataka state of India. There could be geographical variations and gender variations in various regions. Hence studies on various regions with gender differences can influence the mean distances between Henle's spine & foramen ovale, carotid canal, & jugular foramen. It was done by using standard method but it was subjective in nature. Skulls with only prominent Henle's spine were observed but absence of Henle's spine is also not uncommon. In these situations, where there is absence of Henle's spine, the other anatomical surface landmarks should be considered.

Conclusion

There were significant differences in the mean distance from HS to foramen ovale and HS to jugular foramen, but HS to carotid canal was not significant. These differences will be of at most importance in skull base and otological surgeries. These possibilities of side differences and differences in sex should be considered prior to surgeries to prevent complications.

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