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Analysis of Morphometric Features of the Trigeminal Nerve in Healthy People On Magnetic Resonance Images: An Institutional Based Study

Rajeev Choudhary[1], Ravi Kumar Meena[1*], Rohin Garg[2], Sushila Shekhawat[3], Khushboo Mogra[4]

[1]Assistant Professor, Department of Anatomy,
Ananta Institute of Medical Sciences and Research Center, Rajsamand, Rajasthan, India.
[2]Associate Professor, Department of Anatomy,
Teerthanker Mahaveer Medical College & Research Centre, Moradabad, U.P., India.
[3]Assistant Professor, Department of Anatomy, JLN Medical College, Ajmer, Rajasthan, India.
[4]Senior Demonstrator, Department of Anatomy, Government Medical College, Kota, Rajasthan, India.

ABSTRACT

Background: Trigeminal nerve has an extensive anatomic course. Comprehensive knowledge of trigeminal nerve anatomy facilitates understanding of the relationship between the brainstem, skull base and facial nerve. The knowledge of normal morphometric properties of the trigeminal nerve help in evaluating patients having trigeminal neuralgia. The present study was conducted to investigate morphometric features of the trigeminal nerve in healthy people on magnetic resonance images.

Materials and Methods: This study was conducted to investigate morphometric features of the trigeminal nerve in healthy people on magnetic resonance images. In this study, MR images of 180 individuals were included. All MR examinations were performed on a whole-body 3T unit using an 8-channel sensitivity-encoding head coil. The following anatomical parameters of the trigeminal nerve were measured on both sides: The length of the long axis of the trigeminal nerve in the cisternal region, The length of the short axis of the trigeminal nerve in the cisternal region, The length of the long axis of the Meckel cave, The length of the short axis of the Meckel cave, Trigeminal-pons angle (pons angle) was measured on axial images. Statistical analyses were performed using the SPSS 22.0 for Windows statistical software (SPSS Inc., Chicago, IL, USA). For statistical significance, $P < 0.05$ was accepted.

Results: In the present study MR images of 180 (95 male, 85 female) individuals were studied. The result showed that trigeminal long axis was higher in left side of males, the trigeminal short axis was higher in left side of females. Meckal long axis and meckal short axis was higher in left side of females, pons angle was greater in right side of females.

Conclusion: The study concluded that trigeminal long axis was higher in left side of males, the trigeminal short axis was higher in left side of females. Meckal long axis and meckal short axis was higher in left side of females, pons angle was greater in right side of females.

Keywords: Trigeminal Long Axis, The Trigeminal Short Axis, Meckal Long Axis and Meckal Short Axis.

***Correspondence to:**

Dr. Ravi Kumar Meena,
Assistant Professor,
Department of Anatomy,
Ananta Institute of Medical Sciences and Research Center,
Rajsamand, Rajasthan, India.

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INTRODUCTION

The trigeminal nerve (TGN) is the largest cranial nerve in the brain. It includes five segments (brainstem, cisternal, Meckel's cave (MC), cavernous sinus and peripheral divisions) and contains both sensory and motor components.[1,2] It is the thickest cranial nerve which provides sensitive innervation of the head and face region, as well as the motor innervation of the masticatory muscles besides some other small muscles.[3] The trigeminal nerve emerges from the anterolateral surface of the pons with two roots: the smaller being one is the motor and the bigger one is the sensory root. These two roots penetrate the pontocerebellar cistern (prepontine cistern), a large cavity containing cerebrospinal fluid, and extend to the apex of the petrous part of the temporal bone. At the apex of the petrous part, it enters the Meckel cave which is a sac formed by dura mater. In this sac, there is the trigeminal ganglion, where the cell bodies of the sensory axons in the trigeminal nerve are located. Distal to the ganglion, the three

main branches of the trigeminal nerve arise: ophthalmic nerve, maxillary nerve, and mandibular nerve. Spreading to the head and face, these branches carry pain-temperature, pressure-touch, and vibration senses to the central nervous system. Motor root also enters the Meckel cave and joins the mandibular branch as it passes through the oval foramen.[4,5] Due to the complexity of this small space and its proximity to many important neural and vascular structures, an understanding of its anatomy is of clinical importance in the evaluation of patients with symptoms referable to the TG and TN or with abnormalities in this region.[6] The present study was conducted to investigate morphometric features of the trigeminal nerve in healthy people on magnetic resonance images.

MATERIALS AND METHODS

This study was conducted in Department of Anatomy, Ananta Institute of Medical Sciences and Research Center, Rajsamand, Rajasthan (India) to investigate morphometric features of the trigeminal nerve in healthy people on magnetic resonance images. Before the commencement of the study ethical approval was taken from the Ethical Committee of the institute. In this study, MR images of 180 (95 male, 85 female) individuals who were admitted with various complaints but proven to have no intracranial pathology and no history of TN were included. All MR examinations were performed on a whole-body 3T unit using an 8-channel sensitivity-encoding head coil. Three-dimensional balance fast-feld echo sequences were performed in addition to the routine Magnetic Rezonans sequences. All images were transferred to Philips IntelliSpace workstation, sagittal and coronal reconstruction was utilized on the workstation. All the measurements were carried out by a single person. The following anatomical parameters of the trigeminal nerve were measured on both sides: The length of the long axis of the trigeminal nerve in the cisternal region (trigeminal long axis): In axial images, the length of the trigeminal nerve between its origins from the pons to the entrance of the Meckel cavity was measured in the prepontine cistern, The length of the short axis of the trigeminal nerve in the cisternal region (trigeminal short axis): The thickness of the mid-point of the trigeminal long-axis length was measured, The length of the long axis of the Meckel cave (Meckel long axis): The longest distance of the Meckel cave in axial images was measured, The length of the short axis of the Meckel cave (Meckel short axis): The thickness at the mid-point of the Meckel long axis was measured, Trigeminal-pons angle (pons angle): The angle between the medial margin of the trigeminal nerve and the anterior surface of the pons at the root entry zone was measured on axial images. Statistical analyses were performed using the SPSS 22.0 for Windows statistical software (SPSS Inc., Chicago, IL, USA). For statistical significance, $P < 0.05$ was accepted.

Table 1: The mean values and standard deviations of measurements by gender

Measurements	Male		Female	
	Right	Left	Right	Left
Trigeminal long axis	0.75±0.24	0.85±0.25	0.82±0.12	0.72±0.26
Trigeminal short axis	0.34±0.12	0.36±0.05	0.33±0.12	0.44±0.15
Meckal long axis	1.14±0.21	1.16±0.34	1.19±0.13	1.20±0.24
Meckal Short axis	0.43±0.19	0.42±0.11	0.44±0.09	0.45±0.10
Pons angle	38.02±12.24	33.56±13.23	38.28±10.24	35.34±12.37

RESULTS

In the present study MR images of 180 (95 male, 85 female) individuals were studied. The result showed that trigeminal long axis was higher in left side of males, the trigeminal short axis was higher in left side of females. Meckal long axis and meckal short axis was higher in left side of females, pons angle was greater in right side of females.

DISCUSSION

The trigeminal cave (TC) is a special channel of dura mater, which extends from the posterior cranial fossa into the posteromedial portion of the middle cranial fossa at the skull base.[7] It is also called Meckel's cave.[8] The use of high spatial resolution imaging allows the study of each of the portions of the trigeminal nerve seeking anatomical variants and/or pathological elements that could explain the clinical presentation of a relatively frequent syndrome such as the TN.[9,10] This may occur, not only with involvement of the nervous trunk or its distribution branches, but also of its intra-axial portions or those in the region of Meckel´s space, thus, making it necessary to identify them correctly.[11] The primary imaging modality for evaluation of patients with trigeminal neuralgia is MRI.[12]

It has been used as an adjunct for planning the management of trigeminal nerve pathologies.[13] Ha et al. measured the short-axis length of 3.46 mm in 30 healthy individuals. Ha et al. reported that there was no significant difference in the length of the short and long axes of the trigeminal nerve between the right and left sides in healthy individuals and only in TN patients between the affected and unaffected sides.[14]

Park et al. analyzed the relationship between the morphometric characteristics of the trigeminal nerve and pontine cisternal volume on TN patients. On the affected side, they observed the smaller the pontine cisternal volume is, the shorter is the trigeminal nerve becomes. Smaller pontine cistern and shorter trigeminal nerve might be more prone to be compressed by vessels.[15] A recent study reported that trigeminal NVC as detected by MRI is likely to be symptomatic when it is accompanied by anatomical nerve changes including nerve atrophy.[16]

CONCLUSION

The study concluded that trigeminal long axis was higher in left side of males, the trigeminal short axis was higher in left side of females. Meckal long axis and meckal short axis was higher in left side of females, pons angle was greater in right side of females.

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