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MORPHOMETRIC ANALYSIS OF THE TENTORIAL NOTCH

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Abstract : Tentorial notch is a gap in the tentorium cerebelli connecting the posterior cranial fossa with the supra tentorial compartments of the cranial cavity and transmits the mid-brain, the posterior cerebral arteries, and cerebrospinal fluid in the subarachnoid space. The dimensions of tentorial notch determine the prognosis of trans-tentorial herniation, concussion, acceleration-deceleration injuries. It also explains the differences in the clinical outcome in patients with similar intracranial pathologies. The extent of brain tissue herniation through the tentorial opening and the brainstem damage depends on the variations in dimensions of tentorial notch and the relationship of brain stem to the free tentorial margin. In this study of 10 specimens from the Institute of Anatomy, Madras Medical College, specific parameters were measured and tabulated. This study may modify the criteria for intervention procedures in neurosurgery and may provide data for interpreting the radiological imaging of the tentorial opening and its relation to brain stem.

Keyword : Tentorial notch, Tentorium cerebelli, Trans-tentorial herniation

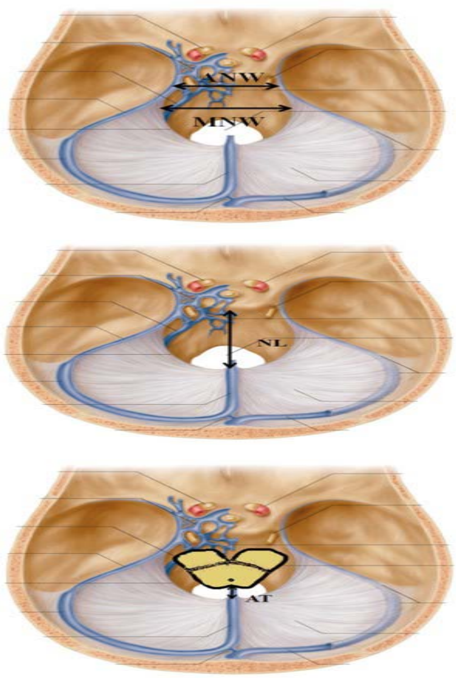
INTRODUCTION

The tentorial notch is defined by the free margin of tentorium cerebelli. The midbrain and cerebral peduncles pass through the tentorial notch. It is a preformed defect through which brain tissue can herniate in cases of raised intracranial tension. This transtentorial herniation if left untreated progresses rapidly to death. There are individual variations with respect to its dimensions and the structures within it. These variations can alter the pattern of transtentorial herniation and hence its sequelae. In this study, we concentrate on the variations in its dimensions and the position of brainstem within the notch. This anatomical study can be correlated with MR and CT imaging methods. This can enhance the neuroimaging definition of the tentorial aperture and the structures within it.

MATERIALS AND METHODS

This study was done in 10 embalmed human adult cadavers obtained from the Institute of Anatomy, Madras Medical College. The cadaveric dissection began with a saw cut that extended circumferentially from 2 cm superior to the glabella to 3 cm superior to the inion. The skull cap was removed with the head placed at an angle of 45 to 60 degree above the horizontal plane. The dura mater over the vertex and the posterior falx were kept intact. The frontal lobes were lifted and the anterior falx was cut. The optic nerves were cut rostral to the sella turcica. The optic chiasm was lifted and the mesencephalon was cut at the level of the interpeduncular fossa in the axial plane, extending posteriorly. The cerebral hemispheres were removed along with diencephalon. The brainstem cut followed the contour of the tentorial edge to the point of the notch apex. The following distances were measured using vernier calipers. Anterior Notch Width (ANW) : Width of tentorial notch in axial plane through posterior aspect of dorsum sellae (Fig.1). Maximum Notch Width (MNW) : Maximum width of notch in axial plane (Fig.1). Notch Length (NL) : Distance between superoposterior edge of dorsum sellae in median plane and apex of notch (Fig.2). Apico Tectal distance (AT) : Distance from tectum in median plane to notch apex (Fig.3).

PARAMETERS MEASURED IN THE STUDY (Fig.1,2,3)



OBSERVATIONS

Quartile distribution technique was applied to all measurements. By following Adler et al tentorial notch was categorised into six groups. By combining these groups a matrix was formed and the notch was classified into eight types. (Table 4).

Table 1 : Summary Data for morphometric measurements of the anatomy of the tentorial notch.

Value	Minimum (mm)	1st Quartile (mm)	Mean± SD (mm)	Median (mm)	3rd Quartile (mm)	Maximum (mm)
ANW	23.10	25.45	27.35±2.57	26.85	30.21	31.82
MNW	25.30	26.63	30.28±4.42	28.31	33.77	40.20
NL	42.02	45.68	51.18±6.02	49.04	58.94	59.40
AT	12.36	14.33	20.32±6.70	17.20	29.44	30.78

SD=Standard Deviation

Table 2

Notch Length (NL)	Range	Frequency
Long	58.94mm - 59.4mm	2
Midrange	45.69mm - 58.93mm	6
Short	42.02mm - 45.68mm	2

MAXIMUM NOTCH WIDTH (MNW): The mean MNW was 30.28mm. based on MNW the notch was categorised into 3 groups. It was classified as wide when MNW was between 33.77mm and 40.20mm, midrange when MNW was between 26.64mm and 33.76mm and narrow when MNW was between 25.30mm and 26.63mm. Among 10 specimens 2 were wide (20%), 2 were narrow (20%) and 6 were midrange (60%).

Table 3 :

Maximum Notch Width(MNW)	Range	Frequency
Wide	33.77mm - 40.2mm	2
Midrange	26.64mm - 33.76mm	6
Narrow	25.3mm - 26.63mm	2

CLASSIFICATION OF TENTORIAL NOTCH BY MATRIX FORMATION : The notches that were both wide and long were classified as large (Fig.4) and those that were narrow and short were classified as small (Fig.5). The notches that were long with MNW midrange were classified as long (Fig.6) and those that were short with MNW midrange were classified as short (Fig.7). The notches that were wide and NL midrange were classified as wide (Fig.8). The notches that were narrow and NL midrange were classified as narrow (Fig.9). The notches that were midrange in both MNW and NL were classified as typical (Fig.10). The notches that were either wide and short or narrow and long were classified as mixed. Among 10 specimens one was long (10%), one was short (10%), one was wide (10%), one was narrow (10%), one was large (10%), one was small (10%) and four were typical (40%) (Table5).

Table 4: Tentorial notch classification – matrix formation

Notch length / Maximum notch width	Long	Midrange	Short
Wide	Large	Wide	Mixed
Midrange	Long	Typical	Short
Narrow	Mixed	Narrow	Small

Table 5 :

Notch type	Long	Short	Wide	Narrow	Large	Small	Typical
Frequency	1	1	1	1	1	1	4

Fig.4 : LARGE TENTORIAL NOTCH

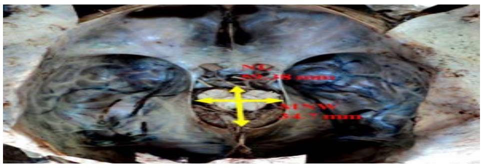


Fig.5 : SMALL TENTORIAL NOTCH

Fig.6 : LONG TENTORIAL NOTCH

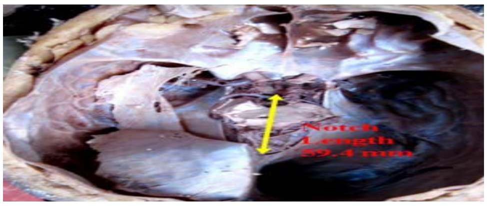
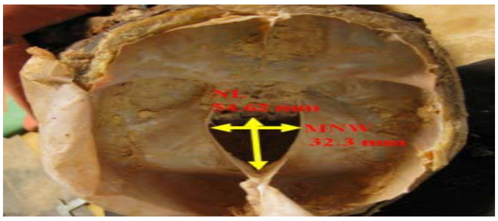


Fig.7 : SHORT TENTORIAL NOTCH

Fig.8 :WIDE TENTORIAL NOTCH

Fig.9 :NARROW TENTORIAL NOTCH

Fig.10 :TYPICAL TENTORIAL NOTCH



DISCUSSION

In 1958 Sunderland3 classified notches and Corsellis1 suggested that notch size and shape affect patterns of herniation. A well defined classification system and hypothesis to explain patterns of transtentorial herniation and its variable clinical sequelae was developed by Adler et al2 in 2002.The study also speculated that the sharp free tentorial edge may play a direct role in the transmission of kinetic energy to the immediately adjacent mid brain. Adler also concurred with Sunderland3 and Corsellis1 that the morphometry of tentorial notch with the supratentorial pressure and the rapidity with which they change plays a key role in determining herniation patterns. Observations obtained from this study may help to explain the pattern of transtentorial herniation, mechanism of brain concussion and inertial injury. Determination of notch type by MR and CT images may influence the treatment of patients with intracranial pathologies.

CONCLUSION

The dimensions of tentorial notch and the position of brainstem within it were measured On the basis of this study morphometric variations in the tentorial notch and its regional anatomy may be implicated in different clinical presentations related to transtentorial herniation, concussion, acceleration - deceleration injury. The use of neuroimaging to identify the type of tentorial notch and its regional anatomy may facilitate neurosurgical decision making.

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