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Anterior & Lateral Extension of Optic Radiation & Safety of Amygdalohippocampectomy Through Middle Temporal Gyrus: A Cadaveric Study of 11 Cerebral Hemispheres

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OBJECTIVE: *This is a cadaveric anatomical study on the localization of the optic radiation within the temporal lobe and to find whether surgical intervention to the temporal lobe, especially amygdalohippocampectomy, can damage the optic radiation or not.*
METHOD: *11 cadaveric cerebral hemispheres were used for the study. A 2 cm long antero-posterior incision was done with a sharp knife, on middle temporal gyrus, starting 3 cm posterior to temporal pole. The incision was deepened perpendicular to surface of the gyrus to reach the temporal horn. The optic radiation was dissected under operating microscope using Klinger's fiber dissection technique and measurements were taken to define the anterior and lateral extension of optic radiation. The optic radiation in each hemispehere was inspected for any incision related damage.*
RESULTS: *No damage to the optic radiation was found, caused by the 2 cm long anterior-posterior incision on middle temporal gyrus 3 cm posterior to temporal pole. Most anterior 9mm (8-10mm) of the Meyer loop was completely on the roof and there was no extension over lateral wall of the temporal horn. In next posterior 17.5mm (16-20 mm) it extended over lateral wall of temporal horn with gradual progression. The most anterior extension of optic radiation was 26mm (23-31mm) posterior to temporal pole.*
Amygdalohippocampectomy through a 2 cm long horizontal incision on the middle temporal gyrus , starting 3 cm posterior to the temporal pole, to enter into the temporal horn through the lower aspect of the lateral wall is unlikely to cause damage to the Meyer's loop. Any entry from the superior aspect of the temporal horn and any temporal lobectomy inclusive of the superior temporal gyrus to enter the temporal horn is likely to cause Meyer's loop injury.
CONCLUSION: *The findings support the fact that the more inferior the surgical trajectory to the temporal horn of the lateral ventricle, the lover is the risk of visual field damage.*

Keywords: Optic radiation, Meyer loop, Middle temporal gyrus, Amygdalohippocampectomy

INTRODUCTION:

Surgical intervention to the temporal lobe caries the risk of injury to the optic radiation.[4,5,6]. The risk of injury varies with each approach, as the extent tissue removal is different form one surgical technique to the other. During surgery it is almost impossible to differentiate the optic radiation from other white fibers.[1,2,3]. Amygdalohippocampectomy is one of the common surgeries used to treat temporal lobe epilepsy and the operation may be performed with several modifications[7,8,9,10,11&12]. The approach through the middle temporal gyrus is a common modification. We have conducted a cadaveric anatomical study to localize the optic radiation within the temporal lobe, define its anterior and lateral extension and to test if a

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standardized incision to the middle temporal gyrus damages it.

MATERIALS AND METHODS:

This is a cadaveric anatomical study. 11 human cerebral hemispheres that were formalinated for 3-6 months were studied. The work was performed at the Department of Neurosurgery, King Edward Memorial Hospital, Parel, Mumbai, India. The optic radiation was dissected out using Klinger's fiber dissection method under operating microscope (Figure-1). Dissection was done with a small spatula made of bamboo and a surgical dissector. Dissection was started from lateral and inferior surfaces of cerebral hemisphere. Following removal of gray mater, short and long association fibers, superior longitudinal fascicle, extreme capsule, claustrum, external capsule and lentiform nucleus the internal capsule was reached. Then a 2 cm length anterior-posterior incision was made on middle of middle temporal gyrus extending from 3cm posterior to temporal pole. The incision was continued perpendicular to surface up to temporal horn of lateral ventricle (Figure-2). Roof of the temporal horn was exposed from below by removing the lower part of temporal lobe and lateral part of floor of temporal horn with preservation of hippocampus (Figure-3).Then stepwise dissection of optic radiation from lateral geniculate body to visual area was made. The localization of the optic radiation in the sublentiform and retrolentiform area was confirmed (Figure-4). These white fibers were dissected from lateral geniculate body to the visual area situated on the upper and lower lip of calcarine sulcus. The anterior bundles of optic radiation(Meyer's loop) that initially pass anteriorly on the roof of the temporal horn and turning posteriorly to pass along the roof and lateral surface of the temporal horn was dissected out followed by middle and superior fibers. Middle fibers (Macular fibers) from lateral geniculate body pass to the roof of inferior horn and turned posteriorly to pass along the lateral wall of atrium and occipital horn of lateral ventricle to reach visual cortex. The upper (posterior) fibers pass directly backward around the atrium and occipital horn to reach upper lip of calcarine sulcus. Temporal pole, amygdala and hippocampus were preserved. Anterior and lateral extension of optic radiation was studied. Examination was done, to see whether any damage to optic radiation was made by the incision or not. The

Figure-1: Dissection of optic radiation -1. Meyer is loop,2.middle and posterior bundle of optic radiation,3.internal capsule,4.lantiform nucleus,5.uncinate fascicle, 6.hippocampus in temporal horn,7.occipital lobe.

Figure-2: Complete dissection of optic radiation with opening on the lateral wall of temporal horn through middle temporal gyrus incision-1.Meyer's loop,2.middle and posterior bundle of optic radiation,3.external capsule,4.temporal pole,5.uncinate fascicle,6.hippocampus in temporal horn seen through the opening on the lateral wall of temporal horn made by middle temporal gyrus incision. A-distance between Meyer 's loop and temporal pole.

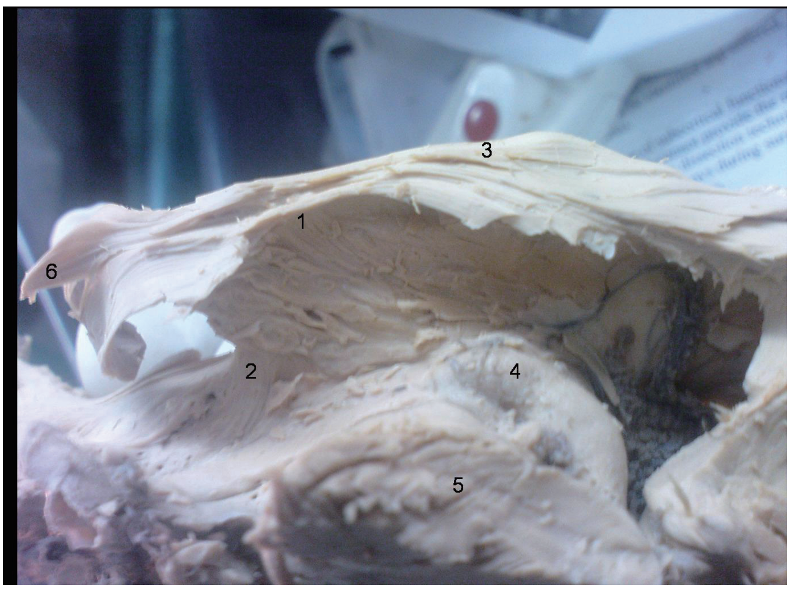

Figure-3:inferior view of roof of temporal horn, ependymal and tapetal layers were removed and optic radiation was dissected out.1.Meyer's loop,2.uncinate fascicle,3.optic radiation,4.lateral geniculate body,5.midbrain,6.temporal pole.

Figure-4: Complete dissection of internal capsule and optic radiation by removing whole lentiform nucleus.1.sublentiform part of internal capsule(IC),2.Retrolentiform part of IC,3.Posterior limb of IC,4.Genu of IC,5.Anterior limb of IC.

distances between anterior limit of optic radiation, anterior end of temporal horn (Figure-2) and the temporal pole were recorded.

RESULTS:

Anterior end of optic radiation extended 2mm (1-3.5mm) beyond the tip of temporal horn. The distance of optic radiation from temporal pole was 26mm (23-31mm). Most anterior 8.5mm (8-10mm) of the Meyer loop was completely on the roof and there was no extension over lateral wall of the temporal horn. In next posterior 17.5mm (16-20 mm) it extends over lateral wall of temporal horn with gradual progression. The incision that was made over the middle temporal gyrus entered into the temporal horn 2mm (1.5-2.4mm) below and lateral to the optic radiation at its anterior part and 0.9mm (0.75 to 1mm) below the optic radiation at its posterior end. Posterior end of incision is 1.5mm (1-2.5 mm) anterior to optic radiation margin. The incision did not damage optic radiation in any cerebral hemisphere (n=11) and entry point in temporal horn was below the optic radiation.

DISCUSSION:

During dissection of optic radiation, we found that fibers originating from lateral geniculate body can be traced to visual area as three bundles (anterior, middle and posterior) described in other articles.[3,13,14] In the published articles on the measurement between anterior extension of optic radiation and temporal pole is 21-30mm.[1,3,6,15] Rubino et al[6] and Pujari et al.[15] reported the extension of optic radiation is 2 mm anterior to tip of temporal horn. Rubino et al described that the Meyer's loop extended from roof to lateral wall of temporal horn during its way to visual area.[6] In our study, the 2cm anterior-posterior incision over middle of middle temporal gyrus 3 cm posterior to the temporal pole perpendicular to surface did not damage the optic radiation. So amygdalohippocampectomy through middle temporal gyrus approach with 2m incision 3cm behind the temporal pole is relatively safe in respect of optic radiation damage. But change of direction to upward or posterior extension of incision or dissection is prone to damage of optic radiation. We found that any surgical resection that involves the superior temporal gyrus more than 26 mm from the temporal tip is likely to injure the Meyer's loop of the optic radiation. In previously pulished series resections less tha 25-30mm were reported as sade resections[1,6,15].

CONCLUSION:

Amygdalohippocampectomy through an incision on the middle temporal gyrus of 2 cm length from 3 cm posterior to the temporal pole, to enter the temporal horn through the lower aspect of the lateral wall is more likely to miss the anatomical Meyer's loop. Any entry from the superior aspect of the temporal horn and any temporal lobectomy inclusive of the superior temporal gyrus to enter the temporal horn will produce Meyers loop damage. The findings support the fact that the more inferior the surgical trajectory to the temporal horn of the lateral ventricle, the lover is the risk of visual field damage.

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