Craniomapper: An Accurate 2D Plane in Localizing Lesion during Craniotomy

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ABSTRACT

Background: Localizing lesions in the brain while marking for craniotomy is sometimes considered a difficult task. Many times we miss the margin by a few millimeters, which lead to the use of excessive brain retraction and/or bone resection. This is particularly true in high convexity areas where the landmarks are obscured and reference bony points are far.

Objective: The objective of this study is to judge the efficacy of Craniomapper in localizing intracranial lesions.

Patients and Methods: Craniomapper is an external plastic frame embedded with radio opaque markers placed around the patient head during CT scanning. This craniomapper was used in thirty two patients suffering from high convexity intracranial lesions with computed tomography scanning for better and easy localization of the lesion.

Results: Thirty two patients were included in this study. Twenty one patients suffered from intracerebral hemorrhage and the other eleven patients suffered from high convexity tumors. This new device gives the surgeon perfect lesional localization by scalp marking. There were no lesional boundaries in all studied patients that need extra bony removal or more brain retraction. The more precise localization provided thereby facilitated planning and performance of surgery.

Conclusion: Craniomapper is rapid, simple and inexpensive CT technique for marking the scalp in patients with high cerebral convexity lesions. It is safe to use this Craniomap frame and needs no special training. It is also not costly and can address the issue, where image guidance and or stereotactic systems are not available.

INTRODUCTION

In general, a craniotomy will be preceded by computerized tomography (CT) scans and/or magnetic resonance (MR) images which provide an image of the brain that the surgeon uses to plan the precise location for bone removal and the appropriate angle of access to the relevant brain areas. The amount of skull bone that needs to be removed depends on the type of surgery being performed.

The precise localization of brain convexity lesions can be inaccurate due to the oval shape of the skull and also to unreliable external landmarks. Accuracy can be improved by using intraoperative ultrasound, conventional and frameless stereotaxis and neuronavigation. Neuronavigation has become a standard procedure in many neurosurgical centers, however in most departments worldwide this tool is not available due to its high cost.

As long as CT and MR imaging are more accessible in hospitals or private institutions, good precision may be achieved by using these radiological tools to calculate the localization of brain convexity lesions beneath the skin. Unfortunately not all the neurosurgical services can have such sophisticated and expensive intraoperative stereotactic systems.

The purpose of this prospective clinical study is to judge the efficacy of Craniomapper as 2D plane in localizing intracranial lesions.

PATIENTS AND METHODS

Thirty two patients were included in this study. Nineteen patients were females and thirteen patients were males. Age ranged from 17 years to 61 years (average 42.7 years). Twenty one patients suffered from intracerebral hemorrhage and the other eleven patients suffered from high convexity tumors. This study was approved by the Institutional Review Board of Menoufia University. All patients provided written informed consent.

All patients included in this study underwent CT scanning perioperatively while wearing Craniomapper over their heads. Craniomapper (Surgiwear, India) is an external plastic frame embedded with radio opaque markers placed around the patient head during CT scanning. The vertical and horizontal lines of the frame serve as a guide to a particular site.
Fig. 1: Craniomapper (Surgiwear, India) is an external plastic frame embedded with radio opaque markers placed around the patient head. The vertical and horizontal lines of the frame serve as a guide to a particular site.

A CT topogram is superimposed over the frame. The radioopaque markers are visible on an axial plane, from the anterior to the posterior direction. Any particular axial section of interest is marked by laser light inside the gantry, and the distance from the midline is counted following the markers. Then, the most target part is outlined by a permanent marker pen. It accurately provides a 2D plane.

After finishing CT scan, the lesion’s location is determined by the use of both horizontal and vertical opaque markers which appear in CT scans and mark the patient’s head before removing Craniomapper over their heads (Fig. 2).

Fig. 2: Patient’s picture shows the scalp mark of the supposed craniotomy needed in a tumor case.

RESULTS

The scalp land marks were followed in every case while performing the craniotomy. In the twenty one patients who suffered from intracecebral hematomas, a burr hole was performed according to the craniomapper land marks of the hematoma and the hematoma was approached through a small burr hole not exceeding one cm in diameter. The hematomas where significantly evacuated through these small opening without brain damage.

In the other eleven patients who suffered from high convexity brain tumors, the craniotomy land marks where determined by Craniomapper as mentioned before and in all cases, the operating author did not need either any further brain retraction “to reach the surface boundaries of the tumor” during tumor removal or extended craniotomy to achieve better tumor visualization.

Case presentations
Case 1 (Fig. 3)

Fig. 3a-d: 30 years old male presented by sudden onset of right side weakness and aphasia. A: CT scans show large left mid and high parietal intracerebral hematoma with midline shift, b: shows scalp markers on patient’s head as rectangular mark is the hematoma, the circular mark is site proposed to be around the bur hole and the two pints are the sites to place brain cannula, c: shows the burr hole used to evacuate hematoma, and d: postoperative CT scans show highly significantly evacuated large hematoma with subsequent resolved midline shift.
with very small ones, because even with the most meticulous calculation some minor difference may occur. In the present study, we used the Craniomapper (Surgiwear, India) which is an external plastic frame embedded with radio opaque markers placed around the patient head during CT scanning. This frame allows the surgeon to define precisely the 2 D planes for the targeted lesion in the brain and allow him/her to do operate the lesion with very small skull opening.

In all cases operated in the present study, the margin of bony mistake “either for intracerebral hematomas or high convexity tumors” was almost totally vanished. From the results of the current study, using the Craniomapper as a new device for lesion localization proved to be very accurate either in the 21 patients who operated by a one cm diameter burr hole to evacuate intracerebral hematomas or in the 11 patients who were treated for high convexity tumors by using very optimal craniotomy to totally remove the tumor. There were no lesional boundaries in all the studied patients that need extra bony removal or more brain retraction.

Some craniotomy procedures may utilize the guidance of computers and imaging in highly equipped neurosurgical centers (called intraoperative monitoring) to reach the precise location within the brain that is to be reached. This technique requires the use of a frame placed onto the skull or a frameless system using superficially placed markers on the scalp. When either of these imaging procedures is used along with the craniotomy procedure, it is called stereotactic craniotomy.

Scans made of the brain, in conjunction with these computers and localizing frames, provide a three-dimensional image, for tumor within the brain. It is useful in making the distinction between tumor tissue and healthy tissue and reaching the precise location of the abnormal tissue.

Further, the use of a stereotactic frame or neuronavigation systems is not available widely in neurosurgical services in most of low socioeconomic countries. The Craniomapper can be an alternative in such neurosurgical centers, when precise craniotomy is required for brain lesion in high convexity area. This particularly can be applied in routine or emergency surgery where wide craniotomy is not desired. Also, the Craniomapper does not need any special training for the users and it is very safe for the patients.

CONCLUSIONS

Craniomapper is rapid, simple and inexpensive CT technique for marking the scalp in patients with small cerebral convexity lesions. It is safe to use this Craniomap frame and needs no special training. It is also not costly and can address the issue, where image guidance and or stereotactic systems are not available.
Declaration
The author(s) declare no conflict of interest or any financial support and confirm the approval of the submitted article by the concerned ethical committee.

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