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DOUBLE-CHECKED PREOPERATIVE LOCALIZATION OF BRAIN LESIONS

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ABSTRACT - We describe two simple methods that can be used together or alone to localize brain convexity lesions. These methods are based on computerized tomography or magnetic resonance imaging to calculate the position of a given lesion under the skin and help neurosurgeons to plan their surgical approaches. Using spatial fixed points traced on the radiological scans and transposing them to the skin scalp allows the lesion to be projected or drawn on the calvaria.

KEY WORDS: brain lesion, preoperative localization, computerized tomograph, magnetic resonance imaging.

Localização pré-operatória de lesões cerebrais através de método de dupla checagem

RESUMO - Descrevemos dois métodos simples que podem ser usados em conjunto ou separadamente para localização de lesões situadas na convexidade cerebral. Esses métodos são baseados na utilização da tomografia ou ressonância magnética para calcular a projeção da lesão no couro cabeludo do paciente, possibilitando melhor planejamento do acesso cirúrgico. Utilizando-se de alguns pontos fixos traçados nos exames de neuroimagem e fazendo a transposição deles para o couro cabeludo do paciente possibilita a projeção ou desenho da lesão na calvária.

PALAVRAS-CHAVE: lesão cerebral, localização pré-operatória, tomografia computadorizada, ressonância magnética.

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[1-4]. 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 computerized tomography (CT) and magnetic resonance (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.

Since 1997 we have been using a simple and non-expensive method to localize and treat traumatic and spontaneous intracerebral hematomas located on the brain convexity. More recently this method was used for tumors and a second parameter to localize brain lesions was added. These two methods were called "double-checked" preoperative localization of brain lesions.

METHOD

Calculation techniques

The first method to localize a brain lesion uses three spatial points on the skull convexity and is a simplification of the method described by Vilela Filho et al.[5] These points are called: *height of the lesion, starting point, and ending point*. The height of the lesion is found by calculating the distance between the orbitomeatal (OM) line and the chosen slice of the lesion.

With a pencil one can draw the OM line on patient's skin using a flexible ruler. After it, a parallel line is drawn above the OM line, thus finding the *height of lesion* on the skull convexity (Fig 1). The next step is to find out the entry point on the oval shape of the skull. This can be accomplished by measuring the midline frontal skull from the chosen slice (*starting point*), following the shape of the skull with a ruler (dotting every centimeter) until the *ending point* (Fig 2).

This measured distance is not real and has to be translated to the actual distance, using the scale available on every picture frame of the CT or MR scans. The right placement of a burr hole or a small craniotomy can be performed with accuracy, after these easy and fast calculations on the operating room. Attention must be paid if the radio-

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Fig 1. Phantom case. On this scout view the lesion is 79.5 mm above the OM plane. This distance is the difference between the "TP" numbers (arrowed) depicted on the chosen slice of the lesion (Fig 2) and the axial OM slice (Fig 3).

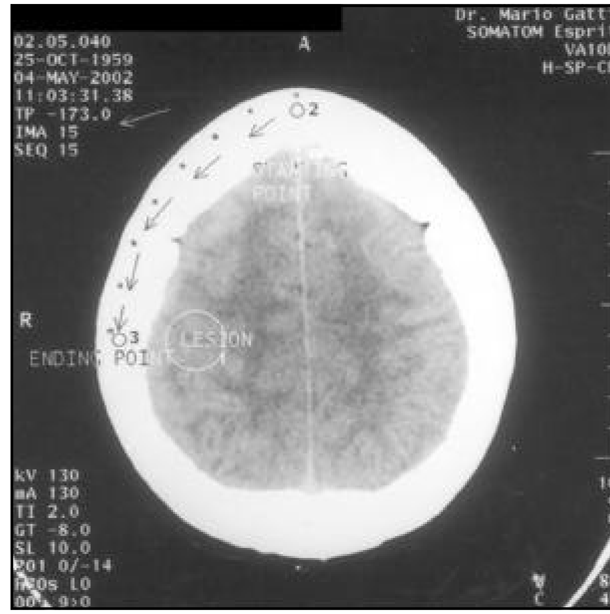

Fig 2. Phantom case. The entry point is the distance between the starting point and ending point. Every single dot is 10 millimeter apart from each other on the film. The distance from point 2 to 3 has to be converted to the true distance using the scale. The false distance on the film is 70 mm but the true distance on the scalp is 105 mm. An arrow is pointing the "TP".

Fig 3. Phantom case. The axial OM plane is shown and a line is crossing both external meatus and the scale. An arrow is pointing the "TP".

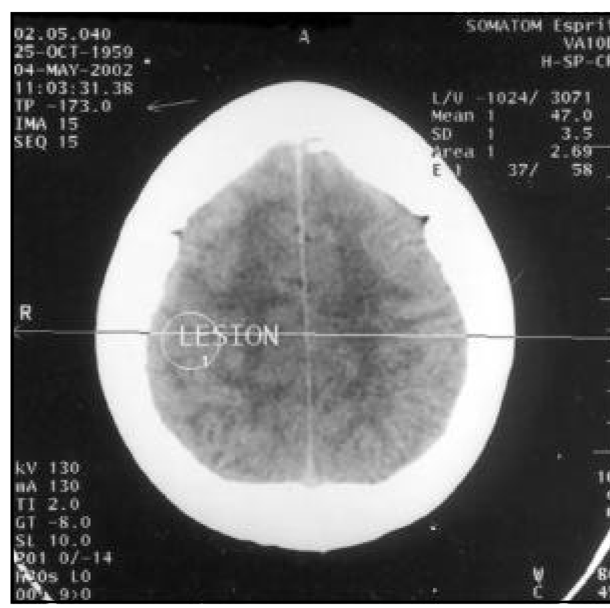

Fig 4. Phantom case. Another line is crossing the scale at the same level, corresponding to both external meatus line projected on the skull convexity. The distance of the lesion from this line and the midsagittal line can be straightforward calculated.

logical slices of the head were made through the OM plane. If is not the case, the line drawn on patient's skin must follow the plane done on the scout view.

The second method to localize a brain lesion uses both external auditory meatus as described by Penning[6]. On the picture frame of CT or MR depicting both external meatus a line is drawn from side to side passing on both external meatus (Fig 3). This line will cross the scale that is present on every frame. The same line is then traced on the chosen slice of the lesion passing at the same level on the scale (Fig 4). The distance of the lesion from this line is calculated, and neurosurgeons know immediately whether the lesion is, regarded to the external meatus. On the skin scalp, with a pencil one can draw a line connecting both external auditory meatus (this line must be perpendicular to the scout plane). This line enables the surgeon to figure out if the lesion is anterior, centered or posterior to the meatus and calculate its distance. The height of the lesion is calculated using the first method.

Using these double-checked measurements that take only two to three minutes to be done, neurosurgeons may be assured about the correct location of the lesion beneath the skin and plan a better approach or a minimally invasive approach to any convexity lesion.

RESULTS

The first localizing method was used to treat 28 traumatic intracerebral hematomas[7] using a 25-mm trephine or a limited craniectomy and good accuracy was achieved (the lesions were located within a 20-25 mm radius range related to the skin mark). In all cases the hematomas were found and evacuated. Recently we have added the second method to give an extra trustworthy landmark such as the external auditory meatus, letting the surgeon more confident about it and we have been using both methods to treat convexity tumors.

DISCUSSION

Several papers have already been written about preoperative localization of convexity lesions[8-17]. Some of these techniques have cumbersome details and other require expensive equipment and added intraoperative time. Constantini et al.[8] have reported the use of a radiopaque marker over the calculated lesion site to obtain a single slice of the lesion. This is an excellent method to accurately trace the lesion over the skin, but most patients seen in the emergency room or in the outpatient neurological office have already been submitted to CT or MR examinations and new radiological scans seems unwarranted and costly.

Perhaps the best and easiest way to localize a brain lesion is the technique described by Ashkenazi and co-workers[17]. The drawback of this technique is the fact that a midline sagittal MR image survey with projected coronal slices is necessary. This coronal survey is not routinely recorded and printed in Brazil.

CONCLUSION

Accurate localization of lesion on the calvaria may be difficult in some cases due to the shape of the skull and lack of reliable landmarks. More expensive methods such as neuronavigation or stereotaxis have been used. CT and MR equipments are available worldwide and these radiological tools may help neurosurgeons to precisely localize convexity lesions.

The aim of this article was to demonstrate the reliability and simplicity of an inexpensive method to localize convexity brain lesions, allowing a burr hole approach or a better craniotomy siting that can be used elsewhere. This technique is not recommended to approach deep-seated lesions and care must be taken with very small ones, because even with the most meticulous calculation some minor difference may occur.

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