

Ruler Test and Empty Sella Sign



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Abstract

Background: The sella turcica houses the pituitary gland (turkish saddle). The stirrups of the saddle are the cavernous sinus. The abducens nerve (VI) and trochlear nerve (IV) transit from their nuclei to the orbit traversing inside the walls of the cavernous sinus. The abducens (VI) and the trochlear (IV) nerves control the lateral rectus (lateral movement) and superior oblique (diagonal movement) muscles respectively. An increase of intracranial pressure in the adjacent subarachnoid space causes fluid to press along the cavernous sinus. When this occurs, patients manifest a head tilt and eye tracking movements controlled by the two aforementioned cranial nerves become limited, resulting in blurry vision and diplopia. This study aims to discover the relationship between eye-tracking ability and fluid aggregation in the subarachnoid space.

Materials & Methods: A MRI of the orbits, cavernous sinus, and internal auditory canal was taken in 48 patients diagnosed with neurological Lyme Disease. Patients were asked to read a line of material while their head movement was observed. The patients were then asked to read with and without a ruler while their head movement was restricted. If reading was easier for the patient with the ruler, the test was considered to be positive. Otherwise, the ruler test is deemed negative.

Results: Of the 48 patients, 46 demonstrated a positive ruler test while 32 of these patients had an empty sella.

Conclusion: These results support that the ruler test could be an accurate bedside measure of the accumulation of fluid at the cavernous sinus arena or sella turcica in patients diagnosed with Neuroborreliosis.

Study Aim

Fluid aggregation along adjacent subarachnoid space of the cavernous sinus can interfere with the function of the sixth nerve (lateral eye movement). The cavernous sinus is adjacent to the sella turcica. Therefore, manifestation of lateral diplopia should indicate fluid aggregation along the walls of the cavernous sinus and the intrasellar space. The goal of the study is to determine if the ruler test correlates with an empty sella, which would indicate fluid aggregation in the intrasellar space.

Methods

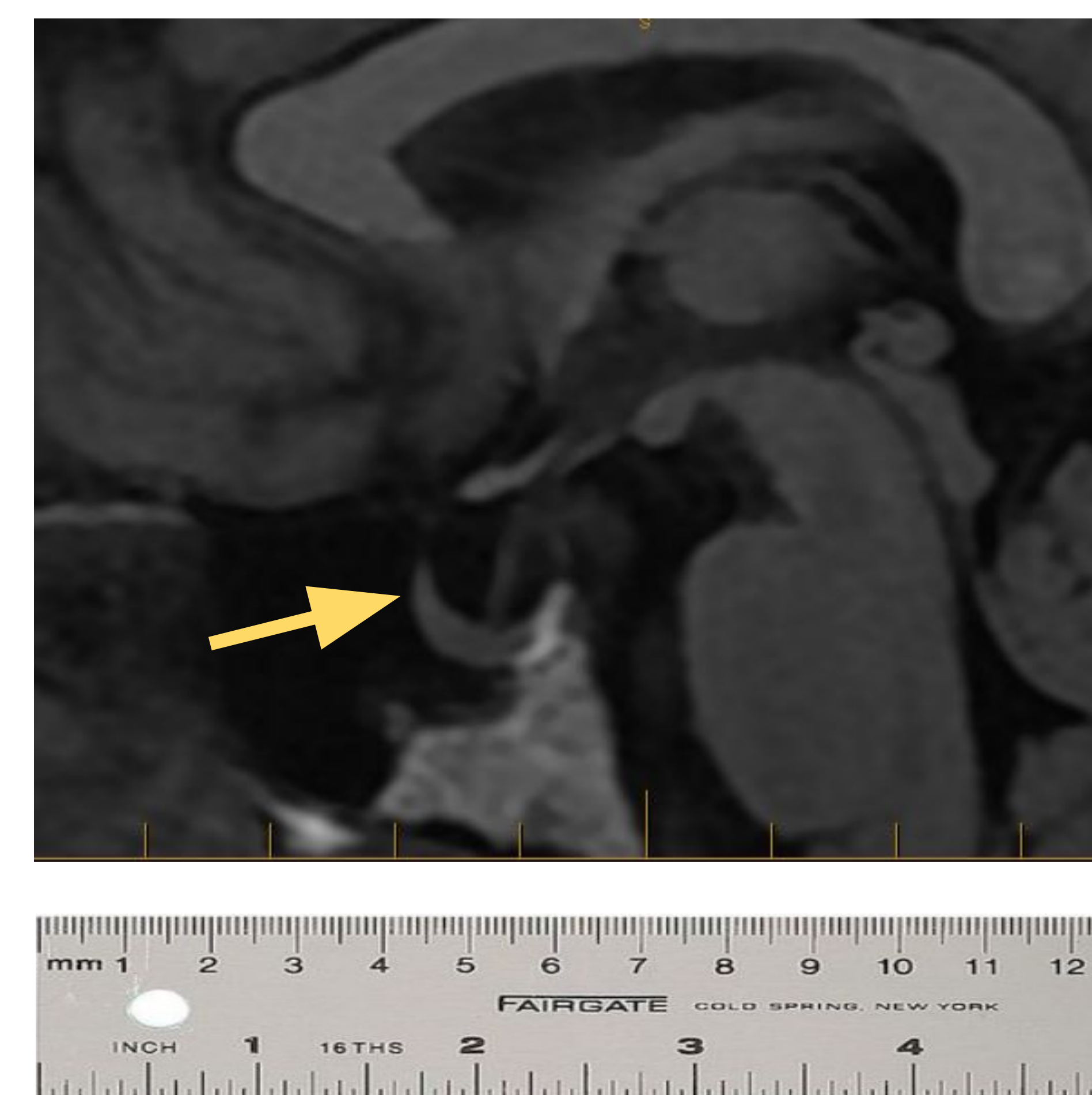
- ❖ Data was extrapolated from 56 patients in two lyme endemic communities.
- ❖ A retrospective and continuous cohort study was done on patients with confirmed Neuroborreliosis.
- ❖ A 3-tesla unit MRI of the orbits, cavernous sinus, and internal auditory canal was taken in 48 patients diagnosed with neurological Lyme Disease.
- ❖ All 56 patients were asked to read a line of material presented within a comfortable reading distance. They were asked to read another line while their head movement was restricted. The patients were then given another line to read but a ruler was placed underneath the text, with head movement still restricted. Finally, they were asked whether it is easier to read with or without the ruler. If the patients affirm that reading is easier with a ruler then the ruler test is positive. Otherwise, it is considered to be negative. For the purpose of this presentation, this procedure is called the “ruler test”.

Hypothesis

- Null - There is no correlation between the findings of the ruler test and empty sella.
- Experimental - A difference in the ability to read with and without a ruler implies that there is fluid in the subarachnoid space, placing pressure on the fourth and sixth cranial nerves. Positive ruler test results correlate with intracavernous pressure caused by fluid in the subarachnoid space.

Results

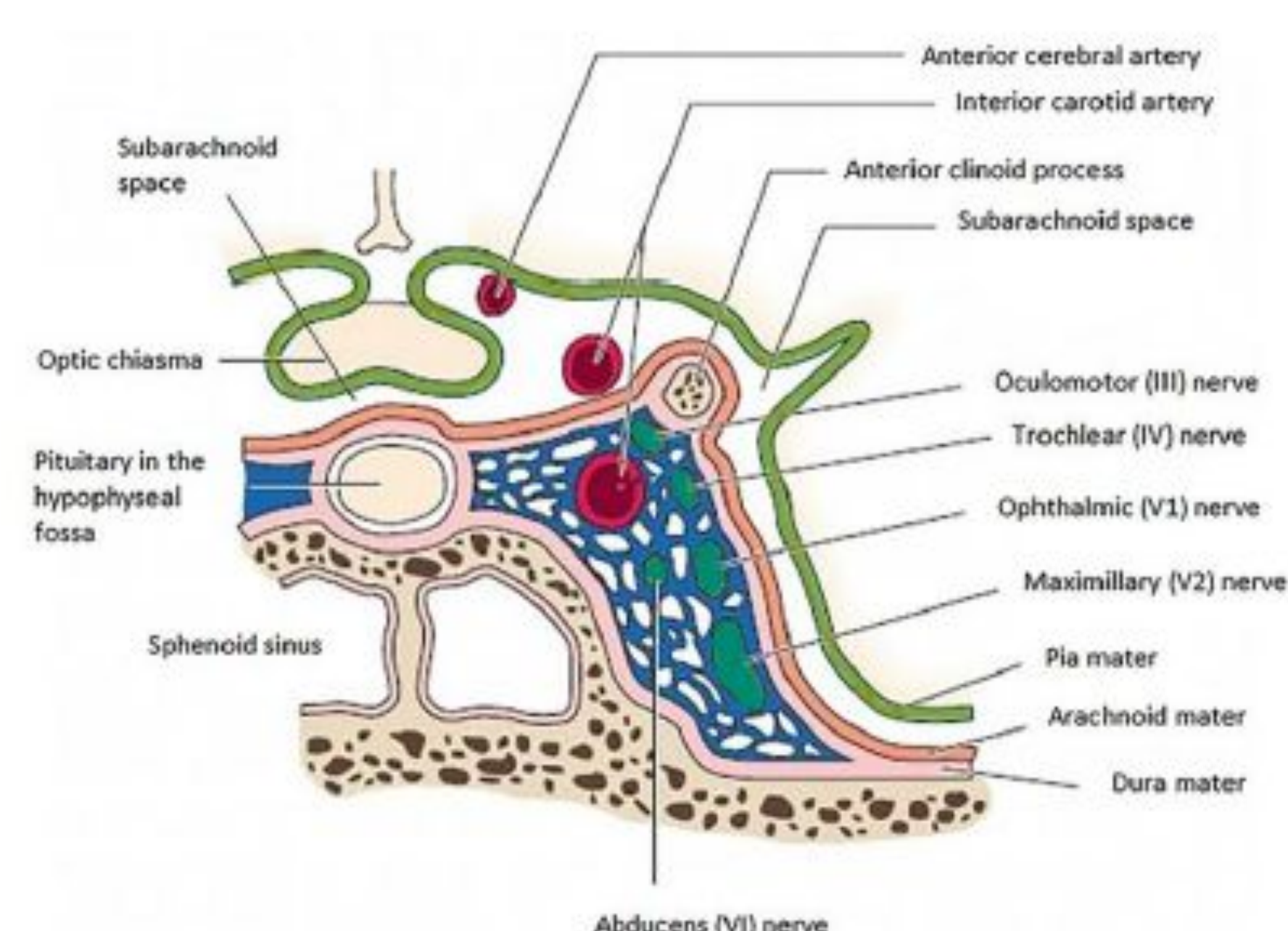
- Of the 48 patients diagnosed with Neuroborreliosis, 32 patients exhibited an empty sella on MRI. 46 of these patients tested positive for the ruler sign.
- Of the 46 patients who tested positive, 40 exhibited lateral diplopia.
- Patients were in varying stages of treatment.
- 2 patients at the end of the treatment had both negative ruler tests and an absence of an empty sella on their MRIs. These patients had a positive empty sella and positive ruler test in the midst of treatment.
- There is a strong indication that the ruler test provides an indication of fluid in the subarachnoid space



Discussion

- The sella turcica (meaning turkish saddle) houses the pituitary gland. The stirrups of the saddle are the cavernous sinus. The sixth and fourth nerve traverse from their nuclei in the midbrain into the cavernous sinus - the only area where these cranial nerves are proximal to each other. These nerves control lateral and diagonal movement respectively.
- In patients with lyme, fluid can aggregate along the walls of the cavernous sinus in the adjacent subarachnoid space. This increases intracranial pressure, as the subarachnoid space is an elastic space. The sixth and fourth nerves, housed by the cavernous sinus, become subject to compression, which limits nerve function. This manifests as lateral and orthogonal diplopia respectively. When this occurs patients manifest a chronic head tilt over time.
- The occurrence of empty sella in which the pituitary appears crescent-shaped or absent indicates fluid buildup within the subarachnoid space. The cavernous sinus is the only point in the body at which the fourth and sixth cranial nerves appear at the same location. The fluid within the subarachnoid space pushes against these nerves causing them to be inflamed which also hampers eye tracking ability.
- The ruler test offers a measure of potential fluid within the subarachnoid space, by assessing eye-tracking ability. Because the subarachnoid space is synonymous throughout the brain, this test could be used a bedside confirmation of an empty sella, as an alternative to costly MRIs.

Figure 1. Cavernous Sinus



References

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