

# Neuroborreliosis and Empty Sella Sign

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## Abstract

### Background:

The pituitary gland lies in the sella turcica (turkish saddle). The stirrups alongside the saddle are the cavernous sinus. The subarachnoid space between the pia and arachnoid mater is a potential space exterior to the cavernous sinus where lymphatic fluid can aggregate. On normal MRI images of this space, there is a negligible amount of cerebrospinal fluid (CSF). When the subarachnoid space is filled, the pituitary appears crescent shaped or absent, hence the term "empty sella" (empty saddle). This anatomically refers to the accumulation of CSF in the subarachnoid space adjacent to the cavernous sinus. This study aims to discover the correlation between Neuroborreliosis and an empty sella sign.

### Materials and Methods:

A 3-tesla unit MRI of the orbits, cavernous sinus, and/or internal auditory canal was taken in 167 patients, all previously diagnosed with neurological Lyme. Patients who had MRIs of the brain or the pituitary were excluded from the study.

### Results:

Out of 167 patients, 86 had an MRI taken and 68 of these had an empty sella. Out of 77 patients who exhibited Argyll Robertson pupil, 60 had an empty sella. Additionally, out of 80 patients with lateral-gaze diplopia (H49.20), 65 had an empty sella. Finally, out of 70 patients with orthogonal-gaze diplopia, 58 had an empty sella.

### Conclusion:

Patients with a neurological manifestation of Lyme had statistically significant cases of an empty sella presumably caused by an increase in intracranial pressure.

## Study Aim

The empty sella is divided up into two types: primary and secondary. When an empty sella is primary, the cause is idiopathic. When secondary, it is typically caused by elevated intracranial pressure. Therefore, the purpose of this study is to determine if an empty sella is the result of increased intracranial pressure in patients with Neuroborreliosis.

## Methods

- ❖ Medical/radiological data of 167 patients in Lyme endemic areas were taken from two medical centers.
- ❖ A retrospective cohort study was conducted on patients with confirmed neuroborreliosis, lateral diplopia, orthogonal diplopia, and/or Argyll Robertson pupil.
- ❖ A 3-tesla unit MRI of the orbits, cavernous sinus, and internal auditory canal was taken for 81 of the patients.
- ❖ Patients who had MRIs of the pituitary or the brain were excluded from the study.
- ❖ Statistical analyses of these were done to determine a p-value on the significance of an empty sella.

## Hypothesis

- Null - There is no correlation between the empty sella and Lyme symptoms.
- Experimental - The cerebrospinal fluid located in the subarachnoid space adjacent to the cavernous sinus translocates to the suprasellar cistern, therefore crushing down onto the hypophysis.

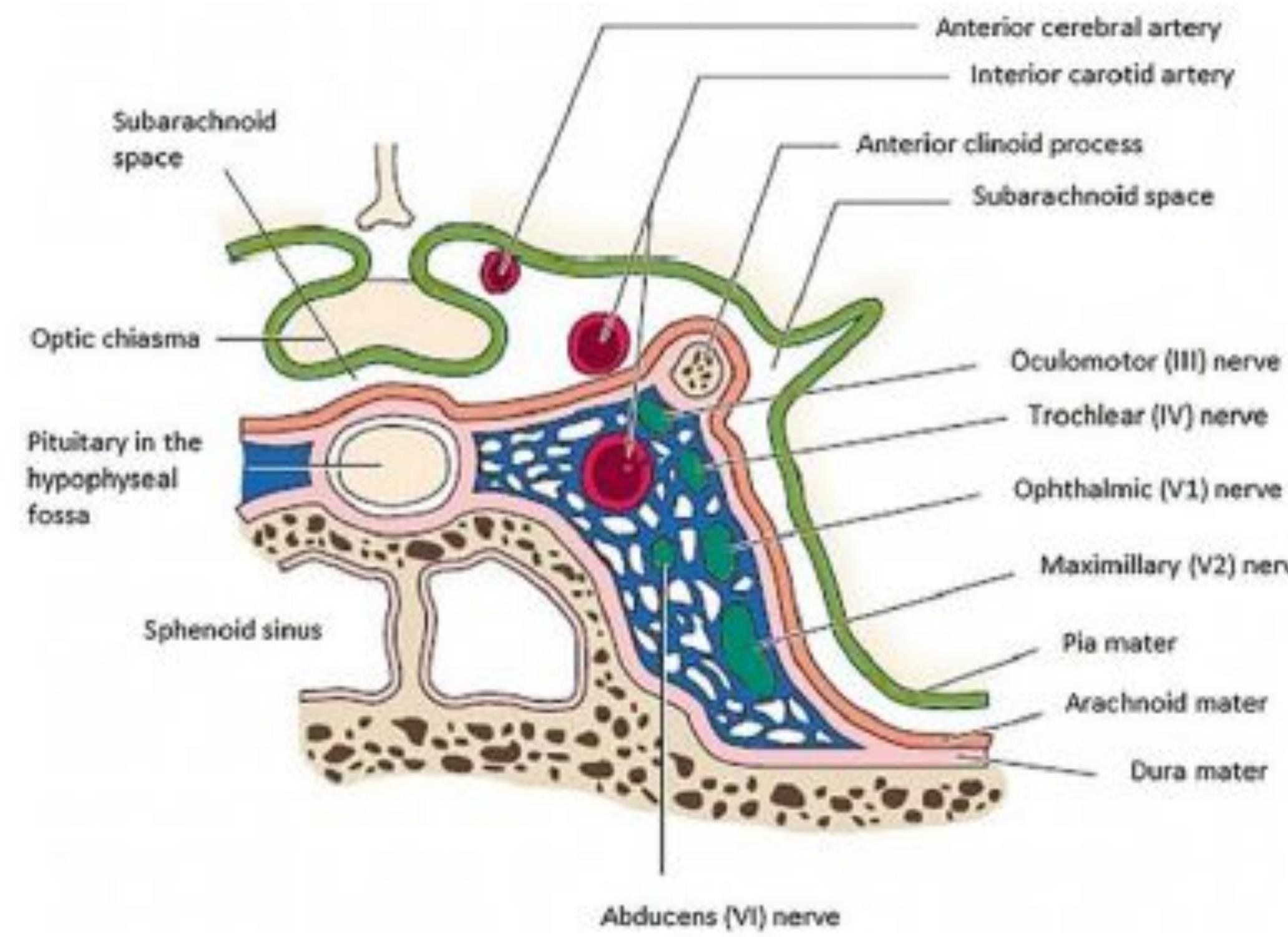
## Results

- Statistical analysis suggested a significant correlation between empty sella and:
  - Argyll Robertson pupil ( $p<0.0013$ )
  - Lateral Diplopia ( $P<0.0001$ )
  - Orthogonal Diplopia ( $P<0.0001$ )
  - Lyme Disease, unspecified ( $P<0.0001$ )
- The most accurate data came from patients whose MRIs were of the orbits. 68 of the 81 patients exhibited an empty sella.
- These patients were also diagnosed with mastoiditis and facial nerve enhancement.

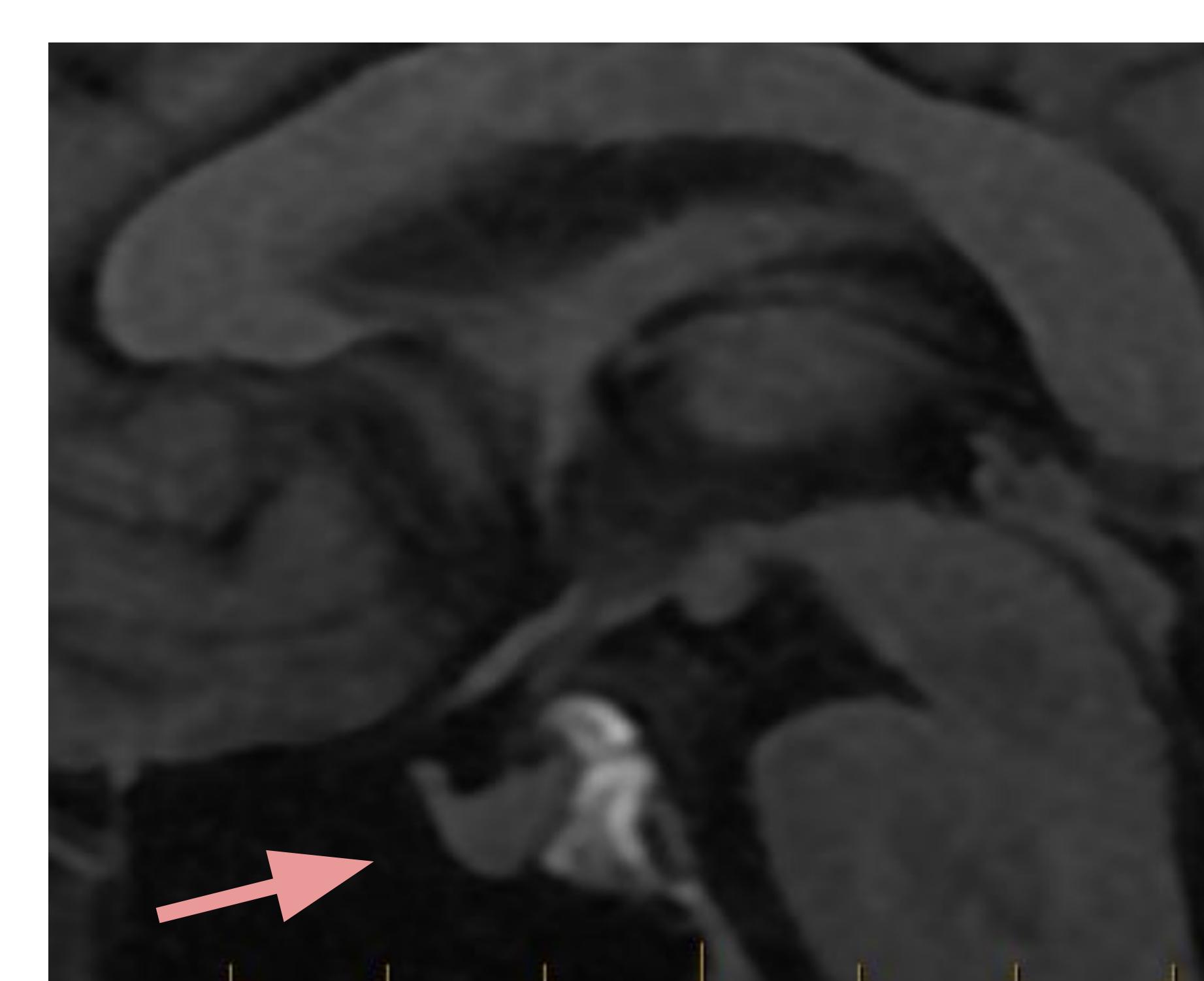
## Discussion

- In this study, an empty sella is defined as an aggregation of fluid in the subarachnoid space adjacent to the cavernous sinus.
- The fluid aggregation is caused by either a Lyme-enforced lesion or inflammation in the tissue along the subarachnoid space.
- This inflammation increases the volume of the elastic subarachnoid space and leads to an increase in intracranial pressure.
- CSF pulsations in the suprasellar cisterns are amplified by the increase in intracranial pressure, leading to a collapse of the pituitary and a crescent-shaped appearance.
- The cavernous sinus houses the sixth nerve (lateral eye movement) and the fourth nerve (orthogonal eye movement). The increased intracranial pressure applies compression on these cranial nerves, interfering with their functional abilities including eye-tracking mobility and control.
- Empty sella signs were only seen in patients who were diagnosed with Neuroborreliosis. 68 of the patients who were diagnosed with empty neuroborreliosis also had an empty sella. This increased intracranial pressure due to infection of the CSF by Lyme leads to the compression at the arachnoid mater and dura mater (directly around III, IV, and VI nerves), which externalizes as Argyll Robertson pupil, lateral diplopia, and orthogonal diplopia ( $p<0.0001$ ). The sella is simultaneously permeated with pressurized CSF, which pushes down on the hypophysis, creating an empty sella.
- The bedside indications of lateral and orthogonal diplopia may act as clinical indicators of an empty sella.

Figure 1. Cavernous Sinus



Pre-treatment  
Empty Sella



Post-treatment  
Normal Sella

## References

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