

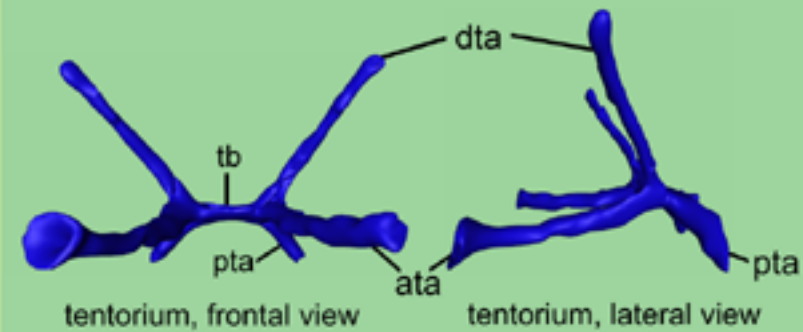
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The tentorium is the inner skeleton of the arthropod head that serves as a stabilizing element and muscle attachment structure. It is formed by invagination of the head capsule at two points, visible externally as anterior and posterior tentorial pits. The anterior and posterior tentorial arms are connected by the tentorial bridge. Dorsal tentorial arms are evaginations of the anterior tentorial arms.

The tentorium has been studied in adults and larvae of various arthropod taxa and has provided informative characters for reconstructing phylogenies. This inspired us to study the tentorial structures in Neuroptera. The aim is to recognize ground pattern characteristics in the neuropteran tentorium. Possible synapomorphies must be distinguished from homoplasies and functional adaptations.



Results & Discussion

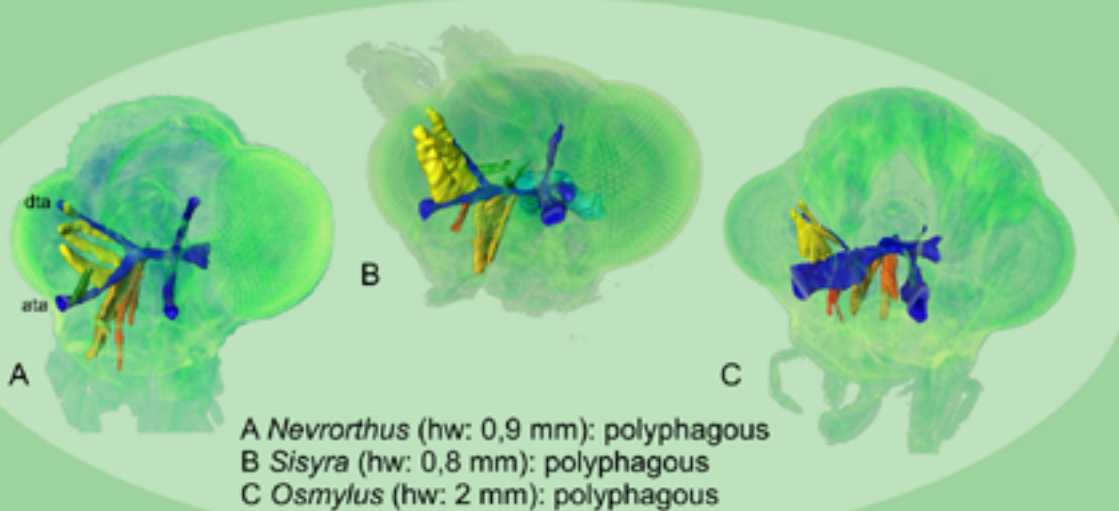


Fig. 1: heads, latero-frontal view

These three Neuropterans have dorsal tentorial arms which serve as the attachment structure of one antennal muscle.

Dorsal tentorial arms

Dorsal tentorial arms are present in Nevrorthidae, Sisyridae, Osmylidae and Chrysopidae (Morse 1931), as well as in the outgroup-orders Raphidioptera and Megaloptera (Achtelig 1967). The dorsal tentorial arms certainly represent a plesiomorphic feature that has been reduced in all other families studied.

Materials and Methods

Species examined (adults): *Nevrorthus apatellus* (Nevrorthidae), *Osmylus fulvicephalus* (Osmylidae), *Sisyra nigra* (Sisyridae), *Libelloides macaronius* (Ascalaphidae), *Nemoptera sinuata* (Nemopteridae), *Mantispa styriaca* (Mantispidae), *Podallea vasseana* (Berothidae), *Dilar turcicus* (Dilaridae).

The studied specimens were fixed in Bouin's fluid, stained in iodine-ethanol solution and scanned with an Xradia MicroXCT system (University of Vienna, Dept. Theoretical Biology). The software Amira 5.1 was used for 3D-reconstruction and analysis of the data.

■ tentorium ■ muscles of antenna ■ muscles of mandible
■ muscles of maxilla ■ muscles of labium ■ muscles of pharynx
hw = head width; dta = dorsal tentorial arm; ata = anterior tentorial arm; pta = posterior tentorial arm; tb = tentorial bridge

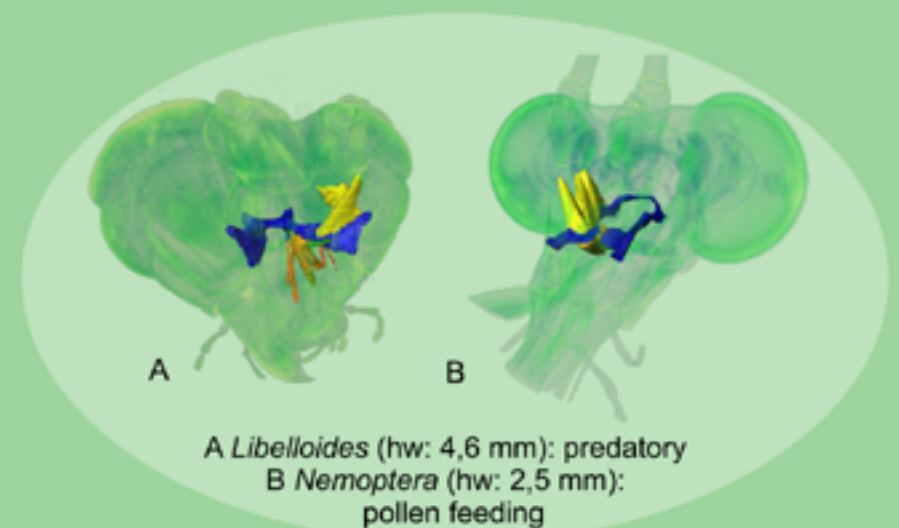


Fig. 2: heads, latero-frontal view

These two Neuropterans lack dorsal tentorial arms, but otherwise differ strongly.

Adaptations to feeding habits

These two families belong to the well-established clade Myrmeleontiformia. Nevertheless, no synapomorphies in the tentorial structures have been found. This can be explained by their highly diverse and specialized feeding habits and corresponding changes in the head morphology.

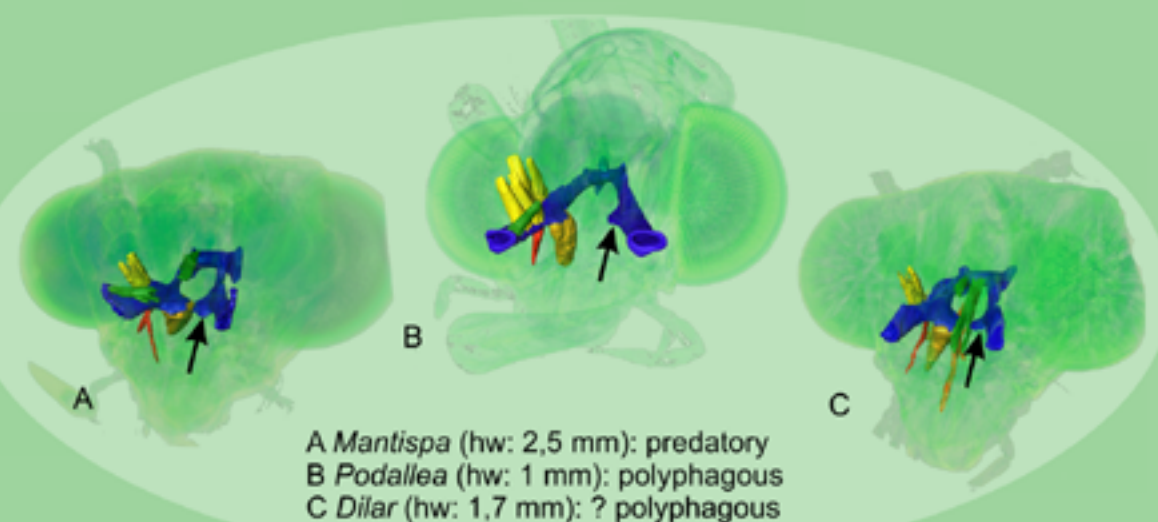


Fig. 3: heads, latero-frontal view

These three Neuropterans have shovel-like extensions of the anterior tentorial arms, where maxillary muscles attach. The anterior tentorial arms are arranged in a V-shape. Dorsal tentorial arms are absent.

Shovel like extensions

Shovel-like extensions of the anterior tentorial arms occur in many neuropteran families. They serve as attachment areas for maxillary muscles and in *Nemoptera* for antennal muscles as well (Fig. 2B). The "shovels" might be a synapomorphy of all Neuroptera except Nevrorthidae and Sisyridae, thus corroborating the hypothesis of these two families branching off independently (Aspöck & Aspöck 2008).

The tentoria of the larvae

In contrast to the adults, in the larvae two character states of posterior tentorial pits have been recognized (MacLeod 1964): a postero-ventral position near the cervix and a more anterior position. This is associated with differences in the head capsule and is consistent with the monophyly of Myrmeleontiformia and Hemerobiiformia.

Conclusions

The tentorium is significant in the "average" polyphagous Neuropterans: Ground pattern characteristics are recognized in the tentoria of *Nevrorthus* and *Sisyra*. Shovel-like extensions of the anterior tentorial arms are interpreted as a synapomorphy of all other families. Caution is advised in certain specialized feeders, as the shapes of their tentoria may be modified due to adaptation.

References

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