

## Morphological study on the form and number of eyes in scorpions and spiders

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### ABSTRACT

Scorpions and spiders belong to the class Arachnida in phylum Arthropoda. Scorpions are easily distinguished by median eyes on obvious the center of the carapace and have one pair, and lateral eyes have 2-8 in some species. Scorpions do not have good eyesight so the median eyes have always been simple and they are more sensitive than the lateral pairs. They have anterior median eyes (AME) with narrow field of view and pairs of lateral eyes (LE) with more sensitivity and response to light. Family Buthidae have 2-6 lateral eyes in *Compsobuthus Mesobuthus*, *Hottentotta*, while Vaejovidae, Chactidae and Chaerilidae have 2 pairs of lateral eyes. In addition, 3 pairs are found in *Orthochirus* and *Androctonus*. Spiders have six eyes in family Pholcidae, Sicariidae, Araneidae, Salticidae, while eight eyes in Theridiidae, Lycosidae and some with two eyes or four in the carapace of the prosoma. Spider have anterior median eyes, anterior lateral eyes, posterior median eyes, or posterior lateral eyes. Scorpions and Spider eyes are not compound but simple. There is one lens for each eye. Spiders have poor vision, not able to see light and darkness. Scorpion and spider taxonomy is based on the forms and number of eyes. So, the reasons to study these organisms are important in studies of medical, ecology, morphology and taxonomy. and it is a little known about their biology and fauna.

**Keywords:** Scorpions ,Spiders Anterior eyes, Lens, Posterior eyes, Resolution.

**Article type:** Report.

### INTRODUCTION

Arachnids are important groups to the ecosystems. Scorpions and spiders are generally predatory species and have various hunting and survival techniques, different with each other. All scorpions are nocturnal and very shy animals. They hide themselves under stones, barks and are found all over the world. Spiders inhabit almost all terrestrial and some aquatic habitats (Browneel & Polis 2001; Foelix 2011; Mizhir 2022). Scorpions have one pair of median and 2-12 pairs of lateral eyes. These eyes are simple (ocelli). There are no compound eyes like eyes of insects. AME (anterior median eyes) have a narrow field of view, while pairs of LE (lateral eyes) have more light sensitivity and firstly response (Fet *et al.* 2006; Barker & Gaffin 2014). However, unlike spiders, scorpions can have up to five lateral eyes on each side, depending on the species. Spiders eyes are six to eight simple eyes or four, two or none are present. The eyes are generally of two kinds, black or diurnal and white or nocturnal (Clemente, *et al.* 2010; Daniel *et al.* 2010). The eyes are arrangement in rows or groups that can be straight or curved. The spider eyes are named according to their position on the head: anterior median eyes (AME), anterior lateral eyes (ALE), posterior median eyes (PME) and posterior lateral eyes (PLE; Barth 2002; Clemente *et al.* 2010; Foelix 2011).

### MATERIALS AND METHODS

Scorpions and spiders were collected in 2021-2022 from Baghdad. The scorpions were established under objects such as wood, stone, trees, while spiders from green land garden or shed. Specimens were transferred to laboratory for examining and recognizing. The identification and preservation of specimens were performed according to the keys of Kovařík *et al.* (2016), Platnick (2005), Ronald (2016), Stockmann & Ythier (2010). However, the spiders

were kept in freezer for 6 h, then transferred to 70-80% alcohol (either ethyl alcohol or isopropyl alcohol). Afterward, scorpions were killed in boiled water at 99 °C, then placed in fixation solution (Formalin; Loria and Prendini 2014) and 12% isopropyl alcohol 30%, glacial acetic acid 2% and distilled water 56% for 24-48 h. Moreover, they were transferred to 50% isopropyl alcohol for 1 h and 70% isopropyl alcohol for storage (Farley 2000; Kovarik 2009; Ledford 2004). Specimens were examined under the dissecting microscope (20 x) and compound microscope (10 x), and taken pictures using camera with resolution of 10 pixel.

## RESULTS AND DISCUSSION

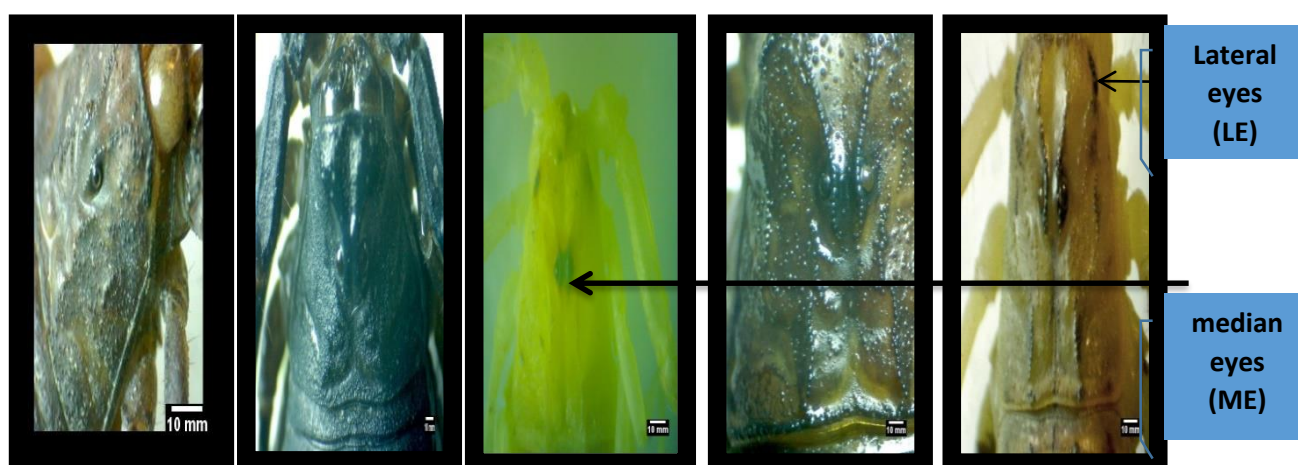
Scorpions have multiple (2-8) eyes. These eyes are not always paired. The anterior median eyes (AME) have a narrow field, while pairs of lateral eyes (LE) are more sensitive and response to light. Some species also have 2-6 lateral eyes. The Scorpions in family Buthidae have 2-6 lateral eyes on each side in *Compsobuthus iraqensis*, *Mesobuthus eupeus* and *Hottentotta zagrosensis*, while in the family Vaejovidae, Chactidae and Chaerilidae have 2 pairs of lateral eyes and also 3 pairs in *Orthochirus scrobiculosus* and *Androctonus crassicauda*. Depending on the species of scorpions, lateral eyes are placed as clusters on the cephalothorax. The median eyes in scorpions have always been simple, and more sensitive than the lateral pairs. The anterior margin of the carapace are straight or concave. Spider eyes on the basis of the positions consist of four pair including anterior median eyes (AME), anterior lateral eyes (ALE), posterior median eyes (PME) and posterior lateral eyes (PLE). Anterior median eyes are not found in spiders with six eyes, but in the spiders with eight eyes, anterior median eyes are present which have a very narrow field of view and excellent spatial resolution, responsible for the excellent visual. Posterior eyes are used for sensing motion with wide field and sensitive for nocturnal, while posterior median and lateral eyes have little resolution. However, they have very good sensitivity such as anterior lateral eyes (Fig. 1). Spiders have eight or six eyes arranged on the prosoma and this is good characters to identify spiders family (Fig. 2). In this study we show this result:

Pholcidae, Sicariidae, Araneidae and Salticidae are spiders with six eyes (Figs. 3-6).

Eight-eyed spiders (Figs. 7- 8) are Theridiidae and Lycosidae.

Some species have four and two eyes and also some spiders did not see very well. They live in caves or underground (Mammola & Isaia 2017).

Arachnida belongs to the class of Arthropoda. They do not have compound eyes. One of the most interesting differences between the scorpion and spider photoreception is in the metasoma or tail of the scorpion (Levi & Levi 2001; Harland & Jackson 2012; Loria & Prendini 2014). In scorpions two types of visual organs are present called the median and the lateral eyes. Most scorpions have a single pair of median eyes, however, the number of pairs of lateral eyes varies very much between the different scorpion taxa and even within some species (Loria & Prendini 2014; Stockmann 2015). Most spiders have eight eyes arranged in two rows of four eyes on head. The eyes can be divided to anterior median (AME), anterior lateral (ALE), posterior median (PME), and posterior lateral (PLE), and some have six eyes. Most spider eyes can have little brightness and motion (Daniel *et al.* 2010; Harland & Jackson 2012).



**Fig. 1.** Median and lateral eyes in scorpions; *Mesobuthus eupeus*, *Androctonus crassicauda*, *Compsobuthus iraqensis*, *Hottentotta zagrosensis* and *Orthochirus scrobiculosus*.

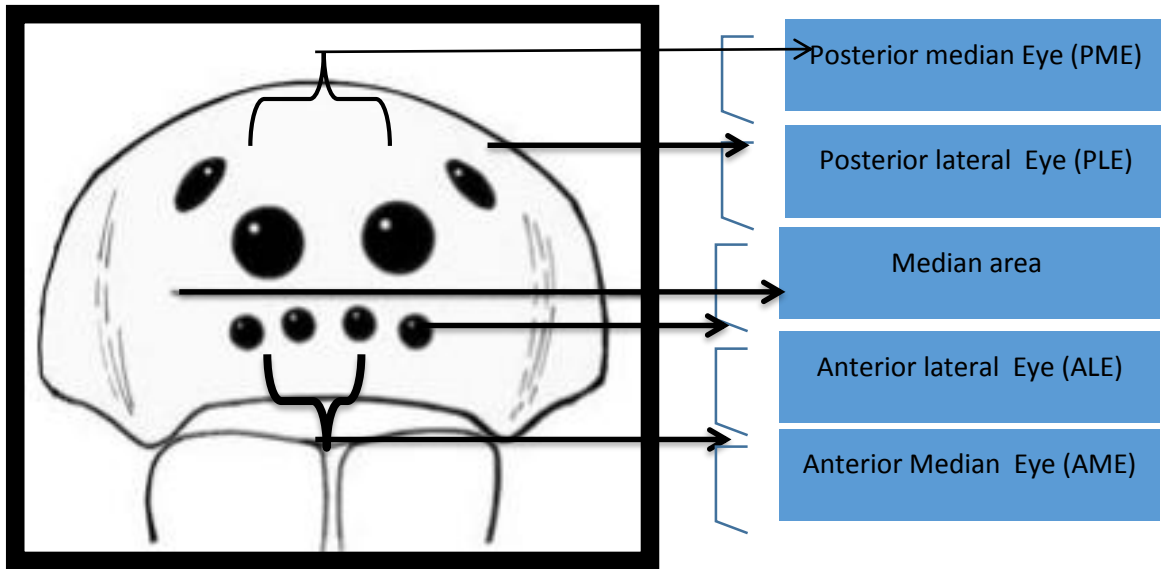


Fig. 2. Eyes arrangement in spiders

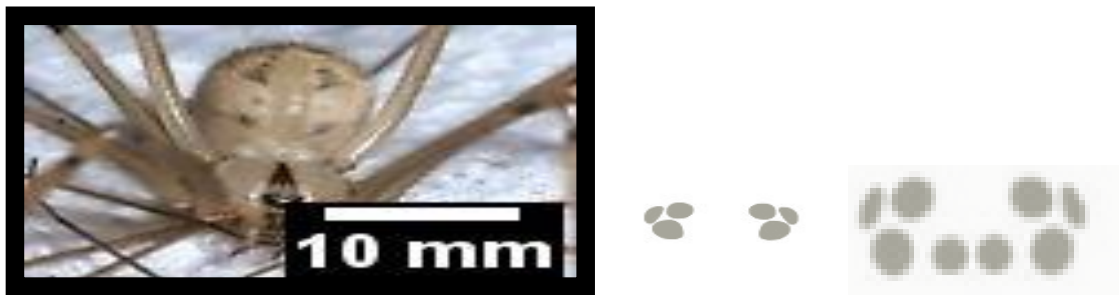


Fig. 3. Pholcidae with six or eight eyes.



Fig. 4. Sicariidae with six eyes.

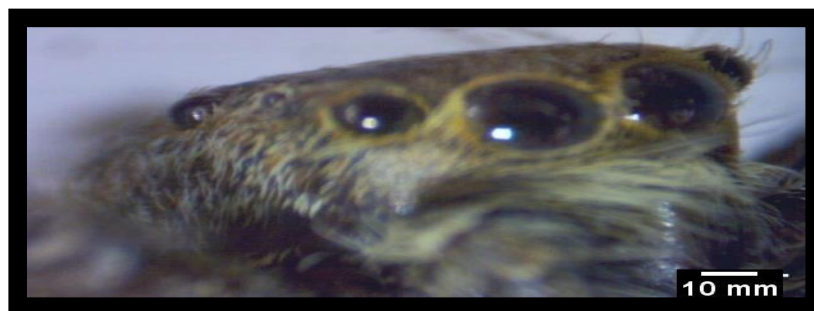


Fig. 5. Salticidae with six eyes.



Fig. 6. Araneidae with six eyes.



Fig. 7. Lycosidae with eight eyes.



Fig. 8. Theridiidae with eight eyes.

## CONCLUSION

In the present study, we examined the eyes arrangement in scorpions and spiders is one of the characters used to identification and classification of different species and genera and family (Ubick & Silva 2005; Stockmann & Ythier 2010; Ronald & Shripat 2016). Scorpions have one pair of median and 2-12 pairs of lateral eyes (Fet *et al.* 2006). Spider eyes are six to eight simple eyes or four, two or none on the basis of the positions to the four pair of eyes including anterior medians (AME), anterior laterals (ALE), posterior medians (PME) and posterior laterals (PLE; Foelix 2011).

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