



Original Article

A Comparative Morphometric Study on *Odontobuthus bidentatus* and *Odontobuthus doriae* (Scorpionida: Buthidae) in Iran

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Abstract

Scorpions are one of the most venomous animals which cause serious public health problems. The sting of scorpions can sometimes be fatal depending on the scorpion species involved. So far, sixty-six (66) scorpion species have been identified in Iran. Annually, about 40-50000 cases of scorpionism are reported in Iran. *Odontobuthus doriae* and *O. bidentatus* are among the most medically important scorpion species in Iran, and they are very similar to each other in coloration, carination, and trichobotrial patterns. This morphometric study aimed to compare some of the important morphological characteristics in order to identify the key differences between these two species. A total of 45 morphological characters were measured using calipers and stereomicroscope, and 55 morphological characters and ratios (relative of length to width ratio of morphological characters of scorpions) were analyzed. The independent sample t-test in SPSS software (version 24) was used for the statistical analyses in this study. The mean total length, carapace width, length of fixed and moveable fingers, and chelicerae length of *O. doriae* were greater than those of *O. bidentatus* in our study area. The morphological measurements displayed a clear distinction between *O. doriae* and *O. bidentatus* in our study area; therefore, they can be used as morphological identification keys for distinguishing between these two species.

Keywords: *Odontobuthus bidentatus*, *Odontobuthus doriae*, Scorpion, Morphometric, Iran

1. Introduction

Till now, 66 species of scorpions belonging to three scorpion families of Buthidae, Hemiscorpidae, and Scorpionidae have been identified in different localities of Iran. Scorpionism is a major public health concern and can sometimes be fatal. Annually, about 40-50000 cases of scorpionism are reported in Iran. Among the Iranian scorpion fauna, the most medically important

species include *Mesobuthus eupeus*, *Mesobuthus phillipsii*, *Androctonus crassicauda*, *O. doriae*, *Hottentotta saulcyi*, *Hottentotta zagrosensis*, *Compsobuthus matthiesseni*, and *Hemiscorpius lepturus* (1-15).

The *Odontobuthus* spp. are among the burrowing scorpion species in Iran, and they mostly burrow to find shelter and protection against predators. The genus

Odontobuthus (Family Buthidae) is comprised of four species in Iran, namely *Odontobuthus bidentatus*, *Odontobuthus brevidigitus*, *Odontobuthus tigrari*, and *Odontobuthus tavighiae*. *Odontobuthus doriae* has a wider distribution range from the west to central parts of Iran at higher altitudes. *Odontobuthus brevidigitus* is commonly distributed in the Zagros mountain ranges in the West, whereas *O. tavighiae* has only been reported in the southern region of Iran (Hormozagan Province). *Odontobuthus tigrari* is mostly observed in the eastern region of Iran. Epidemiologically, *O. doriae* is considered among the scorpions of medical importance in Iran, and morphologically, it is similar to *O. bidentatus* (16-18). There are no morphometric data on the comparison between these two species; therefore, comparing morphometric measurements between these species can be of great help in accurate identification of these scorpion species, providing the basis for the production of appropriate regional antivenom. In light of the aforementioned issues, the present study aimed to analyze and compare basic morphometric measurements of *O. doriae* and *O. bidentatus*.

2. Materials and Methods

2.1 Study Area and Specimens Collection

The scorpion specimens were captured from Tehran, Markazi, Khuzestan, and Kerman Provinces between 2014-2015 using the digging and ultraviolet methods (Figure 1). The specimens were kept in plastic bottles containing 75% ethylic alcohol and transported to the Medical Entomology lab of the School of Public Health, Tehran University of Medical Sciences. Valid Iranian scorpion identification key (Farzanpay 1987) was used to identify the scorpion species (19). Following scorpion identification and sex determination, two species (*O. doriae* and *O. bidentatus*) (Figure 2) were selected for further morphometric studies. Only females were included in this study, and 55 morphological characters and ratios were examined according to recommended nomenclature by Stahnke (20).

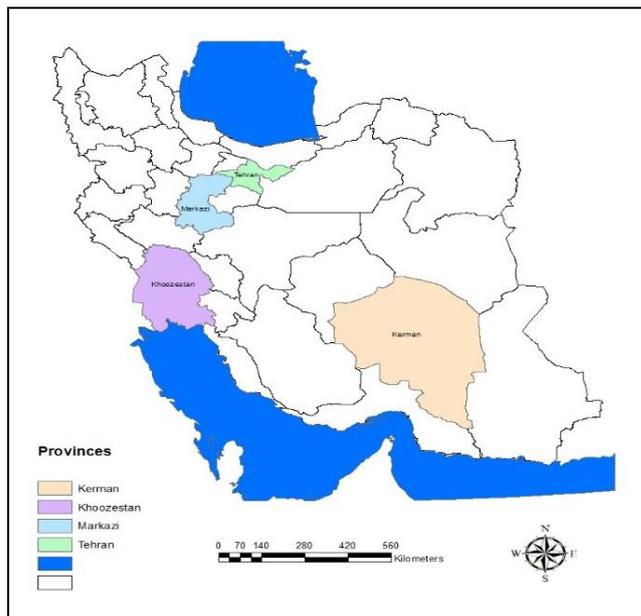


Figure 1. Provinces of scorpion collection sites (*Odontobuthus doriae* was collected from Tehran and Markazi Provinces, *Odontobuthus bidentatus* was collected from Khuzestan and Kerman Provinces)

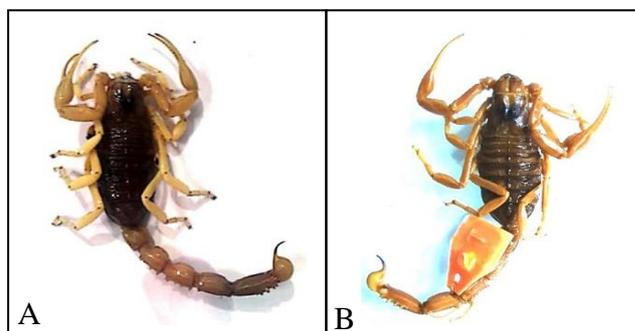


Figure 2. A: *Odontobuthus bidentatus*, B: *Odontobuthus doriae*

2.2 Morphological Characters

The 55 morphological characters and ratios examined in the current study were as the following: the length of body, Chelicerae length, width, and height, length and width of chelicerae, distance between median eyes, distance between median and lateral eyes, distance between median eyes and the anterior margin of the carapace, length of carapace, anterior and posterior width of carapace, height of carapace, length, width, and height of trochanter, length and width of the trochanter, length, width, and height of femur, length of femur/width of the femur, length, width, and height of

patella, length of patella/ width of the patella, length of manus, length, width, and height of chela, length of chela/width of chela, length of I, II, III, IV, and V, length of metasomal segment I, II, III, IV, and V/ width of the metasomal segment I, II, III, IV, and V, length, width, and height of telson, length of pectines moveable finger, length of the fixed finger, length, width, and height of metasomal segments (15).

2.3 Data Analysis

These measurements were carried out using calipers and a stereomicroscope equipped with a caliper (accuracy to one-hundredth of a millimeter), and the data were transferred into an excel sheet for each species. Independent samples T-test was performed in SPSS software (version 24) to compare the studied characters between these two species (Table 1).

Table 1. Morphometric parameters of studied females of *Odontobuthus doriae* and *Odontobuthus bidentatus* in Iran from 2014-2015

Parameters	<i>Odontobuthus bidentatus</i>			<i>Odontobuthus doriae</i>		
	No.	X	±SE	No.	X	±SE
Length of body*	16	59.60	2.07	16	71.57	1.20
length of chelicerae*	16	2.67	0.32	16	3.46	0.59
Width of chelicerae*	16	2.35	0.37	16	2.75	0.21
length of chelicerae/ Width of chelicerae	16	1.21	0.05	16	1.26	0.05
Height of chelicerae	16	1.68	0.07	16	1.88	0.07
Distance between median eyes	16	1.33	0.47	16	1.40	0.05
Distance between median and lateral eyes	16	2.69	0.14	16	3.12	0.08
Distance between median eyes and the Anterior margin of the carapace*	16	3.20	0.09	16	3.51	0.08
Length of carapace*	16	7.00	0.28	16	8.91	0.23
Anterior width of carapace*	16	4.45	0.16	16	5.29	0.10
Posterior width of carapace*	16	8.59	0.30	16	9.76	0.21
Height of carapace	16	5.02	0.26	16	5.87	0.34
Length of trochanter	16	2.66	0.17	16	2.81	0.88
Width of trochanter*	16	2.35	0.07	16	2.66	0.04
Length of trochanter/ Width of trochanter	16	0.13	0.05	16	0.05	0.03
Height of trochanter	16	2.32	0.88	16	2.41	0.10
Length of femur*	16	6.27	0.25	16	7.16	0.16
Width of femur*	16	1.92	0.07	16	2.11	0.05
Length of femur/ Width of femur	16	0.13	3.25	16	3.40	0.09
Height of femur	16	1.60	0.06	16	1.58	0.06
Length of patella*	16	7.13	0.23	16	8.16	0.12
Width of patella	16	2.49	0.12	16	2.69	0.09
Height of patella	16	2.19	0.09	16	1.99	0.08
Length of patella/ Width of patella	16	1.03	0.03	16	1.11	0.04
Length of chela*	16	13.28	0.47	16	14.52	0.27
Width of chela*	16	2.87	0.13	16	3.39	0.01
Height of chela	16	2.65	0.96	16	2.58	0.13
Length of chela/ Width of chela	16	4.49	0.10	16	4.29	0.06
Length of fixed finger*	16	8.25	0.27	16	9.51	0.25
Length of moveable finger*	16	9.31	0.34	16	10.37	0.25
Length of metasomal segment I	16	4.53	0.22	16	4.26	0.12
Width of metasomal segment I	16	4.56	0.16	16	5.34	0.20
Length of metasomal segment I/ Width of metasomal segment I	16	0.99	0.03	16	0.82	0.06
Height of metasomal segment I	16	3.42	0.22	16	3.88	0.20
Length of metasomal segment II	16	4.72	0.23	16	4.98	0.13
Width of metasomal segment II*	16	4.01	1.48	16	4.83	1.36
Length of metasomal segment II/ Length of metasomal segment II	16	1.16	0.04	16	1.04	0.05
Height of metasomal segment II	16	3.62	0.18	16	3.82	0.20
Length of metasomal segment III	16	4.92	0.34	16	5.37	0.12
Width of metasomal segment III*	16	3.71	0.09	16	4.47	0.13
Length of metasomal segment III/ Length of metasomal segment III	16	1.28	0.07	16	1.22	0.06
Height of metasomal segment III*	16	3.55	0.10	16	3.87	0.18

Parameters	<i>Odontobuthus bidentatus</i>		<i>Odontobuthus doriae</i>			
	No.	X	No.	X		
Length of metasomal segment IV*	16	5.64	0.24	16	6.55	0.17
Width of metasomal segment IV *	16	3.63	0.13	16	4.22	0.14
Length of metasomal segment IV / Length of metasomal segment IV	16	0.43	0.04	16	0.44	0.05
Height of metasomal segment IV	16	3.08	0.12	16	3.34	0.17
Length of metasomal segment V	16	7.00	0.42	16	7.90	0.041
Width of metasomal segment V	16	3.25	0.09	16	3.65	0.18
Length of metasomal segment V/ Width of metasomal segment V	16	2.28	0.66	16	2.23	0.81
Height of metasomal segment V	16	2.55	0.08	16	2.65	0.11
Length of telson*	16	6.35	0.19	16	8.33	0.17
Width of telson*	16	3.28	0.10	16	3.80	0.05
Length of telson/ Width of telson*	16	1.97	0.33	16	2.19	0.14
Height of telson	16	3.18	0.10	16	3.08	0.14
Length of pectin*	16	6.55	0.17	16	7.32	0.19

*significant values

3. Results

A total of 32 scorpion specimens, including 16 specimens of *O. doriae* and 16 specimens of *O. bidentatus*, collected from the aforementioned provinces were examined. The following morphological measurements from the two scorpion species were significantly different ($P < 0.05$): body length, length and width of chelicerae, the distance between median eyes and the anterior margin of the carapace, carapace length, anterior and posterior width of carapace, trochanter width, length and width of the femur, patella length, length and width of chela, the width of metasomal segment II, III, length and width of metasomal segment IIII, length and width of telson, length of telson/width of telson*, and pectin length.

In almost all cases, the mean value of each measurement from the morphological characters was greater in *O. doriae*, as compared to that in *O. bidentatus*. These two burrowing scorpions are very similar to each other, except for one morphological character: the number of lateral lobes on the anal arch. *Odontobuthus doriae* has two lateral lobes on the anal arch, whereas *O. bidentatus* has three lateral lobes on the anal arch. The results of the present study pointed out that *O. doriae* has a larger body size than *O. bidentatus*: mean body lengths were 71.57 and 59.60 mm for *O. doriae* and *O. bidentatus*, respectively.

In the study area, the prosoma of *O. doriae* was wider than that of *O. bidentatus*: The mean values of anterior width of the carapace were reported as 4.45 and 5.25 mm for *O. bidentatus* and *O. doriae*, respectively, and the mean values of posterior width of the carapace were 8.59 and 9.76 mm for *O. bidentatus* and *O. doriae*, respectively. In the present study, *O. doriae* had a wider metasoma in some segments, compared to *O. bidentatus*, and the telson of *O. doriae* (mean telson length and width: 8.33 and 3.80 mm, respectively) was bigger than that of *O. bidentatus* (mean telson length and width: 6.35 and 3.28 mm, respectively).

4. Discussion

The present study was conducted to compare 55 morphological characters and ratios between *O. doriae* and *O. bidentatus*, both of which belong to the family Buthidae. *Odontobuthus bidentatus*, previously known as *O. odonturus*, is mainly distributed in southern Iran. *Odontobuthus doriae* has a wider distribution extending from the west to the central part of Iran at higher altitudes, such as mountainous areas (19). Numerous morphometric studies have previously been conducted on scorpion species identification (21-26). Nonetheless, there is no morphometric study comparing *O. doriae* and *O. bidentatus* in Tehran, Markazi, Khuzestan, and Kerman provinces in Iran.

In the current study, almost all the morphological

measurements from *O. doriae* and *O. bidentatus* were significantly different ($P < 0.05$). The mean measurements of the morphological characters of *O. doriae* were larger, as compared to those of *O. bidentatus*. Molecular and morphometric studies on the genus *Odontobuthus* performed in Iran by Mirshamsi demonstrated that *Odontobuthus tirkari* was morphologically different from *O. doriae* and *O. bidentatus* (16). On the other hand, unlike the results of the present study, *Odontobuthus doriae* scores were lower than the other species. This discrepancy can be ascribed to differences in collection sites. In the current study, *O. doriae* was collected from Tehran and Markazi provinces, whereas *O. bidentatus* was collected from Khuzestan and Kerman Provinces.

It is worth mentioning that the geographical populations of *O. doriae* and *O. bidentatus* that are distributed in different localities in Iran (10, 13, 17-19, 27-33) are different in body size. In a morphometric study on *O. bidentatus* carried out by Ahmadi, Vazirianzadeh (34) in Khuzestan province, the pectines in the males were longer and more, as compared to those in the females. In the abovementioned study, the mean total body length of *O. bidentatus* was 74 mm; nonetheless, in the present study, it was 71.57 mm. This small difference in mean total body length between the present study and that of the research by Ahmadi et al. can be attributed to measurement errors.

In another study which was also conducted in Khuzestan province, the mean total length of *O. bidentatus* was reported as 77 mm (35), which is by far larger than the measurement in the current research. Regarding this finding, it can be stated that minor changes in the habitats of scorpions can affect their body size. Therefore, we reiterate that the results of the present research are only reliable in our study area. In another study, the mean total length of *O. tavighiae* was 49.8 mm (34). Based on the results of the present study, it can be concluded that total body size can be used to distinguish *O. tavighiae* from *O. bidentatus* in our study area.

5. Conclusion

Odontobuthus doriae and *O. bidentatus*, both belonging to the family Buthidae, have triangle sternum and are morphologically very similar to each other. They are categorized as burrowing scorpions. They have similar coloration and carination, making it difficult to distinguish between them. The findings indicated that there are significant ($P < 0.05$) distinguishing morphological characters between these two species, especially the mean total body length, as well as the length of carapace, chelicerae, metasoma, and telson. The mean measurements of all morphological characters in *O. doriae* were greater than those of *O. bidentatus* in our study area. The morphological measurements demonstrated a clear distinction between *O. doriae* and *O. bidentatus* in our study area; therefore, they can be used as morphological identification keys for distinguishing between these two species. It is recommended that morphometric studies be conducted on the specimens of these species in other parts of Iran to clarify the differences between them.

Authors' Contribution

M. F., A. M., and J. R. designed the study, M. M. B. did the morphometric analyses and prepared the manuscript, and S. N. contributed to writing the manuscript and specimen identification.

Ethics

All the procedures were approved by the ethics committee of the Research Deputy of Tehran University of Medical Sciences (TUMS) Iran.

Conflict of Interest

The authors declare that they have no conflict of interest.

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