



Analysis of Fang Puncture Wound Patterns in Isfahan Province's, Iran, Venomous and Non-Venomous Snakes

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ABSTRACT

Aims Venomous snake bites are public health problems in different parts of the world. The most specific mainstay in the treatment of envenomation is anti-venom. To treat the envenomation, it is very important to identify the offending species. This study was designed to determine the penetrating pattern of fangs and teeth of some viper snakes.

Materials & Methods This descriptive study was performed on live venomous and non-venomous snakes from 2010 till 2011. All 47 sample snakes were collected from different regions of Isfahan province such as Kashan City, Ghamsar, Niasar, Mashhad Ardehal, Taher-Abad and Khozagh. Their mouths were inspected every two weeks and development of their fangs and teeth were recorded by taking clear digital photos. Fangs and teeth patterns of samples were drawn and the results were compared.

Findings One or two wounds appeared as typical fang marks at the bite site of venomous snakes while non-venomous snakes had two carved rows of small teeth. Three different teeth and fang patterns were recognized in venomous snakes which were completely different.

Conclusion The fang marks of venomous snakes do not always have a common and classic pattern and there are at least 3 different patterns in Isfahan province, Iran.

Keywords Bites and Stings; Snake Venoms; Venoms; Viper Venoms

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Introduction

The snake venom apparatus is a unique, diverse and proficient bioweapon among venomous vertebrates. This sophisticated system is equipped with venom glands, which are connected to the grooved or hollow fangs and a group of compressor muscles that adjust the entrance of injected venom amount and depth into the prey [1, 2]. On average, venomous snake bites are public health problems in different parts of the world [3] ranges from 2.1 to 5.5 million cases per year which lead to 125000 deaths, mostly in south east of Asia [4, 5].

The most specific mainstay in the treatment of envenomation is anti-venom which may be monovalent (for specific species) or polyvalent (effective against different species) [6, 7]. To treat the envenomation, it is very important that the offending species is identified. In using effective monovalent anti-venoms, lower doses are needed and lower levels of adverse reactions were caused, than that with polyvalent anti-venoms [8, 9]. Not identifying the snake species will put the patients in a dangerous condition, which necessitates the treatment with other supportive medicines which sometimes lead to improper treatment and high expenses of unnecessary or wrong decisions [10-12]. All snakes have a series of simple and ordinary, cone-shaped teeth. Only venomous and semi-venomous snakes have two more specialized teeth or fangs. Fangs are hollow and tubular or groove shaped teeth in the upper jaw, connected to the venom glands [13]. They have varieties of shapes, locations and ability of movement. The presence and location of these fangs is very important for differentiating the venomous and non-venomous snakes.

Based on the type of fangs, snakes are categorized into three groups including

- Opisthoglyphous (with grooved fangs at the back of their mouth);
- Proteroglyphous (have fixed fangs at the front of their mouth including Elapidae and Hydrophidae families); and
- Solenoglyphous (have moveable hollow fangs at the front of their mouth including Crotalidae and Viperidae families) [14, 15].

The two last groups strike prey and leave particular puncture marks on their victims [15, 16]. Observation of one or two pairs of puncture wounds in place of bite along

(classic fang marks) with discoloration, immediate pain, swelling and burning sensation count as the primary signs of venomous snakebite, which can be specific to the species of striking snake [6, 17].

The fangs are not permanent and fall out several times and re-grow. During this process, fangs vary in size and shape and if the snakes bite, their fang marks may not be classic and therefore cannot be easily identified [18]. Therefore, recognition of the snake by its fangs marks on skin of victims is a great help for medical staff to administer snake-specific anti-venom and other supportive medicines properly [6, 19].

This study was designed to determine the penetrating pattern of fangs and teeth of some viper snakes and also compared with non-venomous snakes. Also, to evaluate other unexpected patterns that may be seen on victim's body which in turn lead to wrong recognition and therefore wrong treatment.

Materials & Methods

This descriptive study was performed on live venomous and non-venomous snakes from 2010 till 2011. All 47 sample snakes were collected from different regions of Isfahan province such as Kashan City, Ghamsar, Niasar, Mashhad Ardehal, Taher-Abad and Khozagh (Figure 1). They were kept, according to laboratory instructions of ethical codes in keeping the animals, in suitable containers, fed with mouse, baby rats and small lizards and continuously monitored during this study.

Figure 1) Frequency of collected venomous and non-venomous sample (n=47) snakes and their hunting area

Snake species	Rural area	Urban area	Total
<i>Vipera lebetina</i>	4	-	4
<i>Pseudocerastes persicus</i>	2	-	2
<i>Pseudocerastes fieldi</i>	1	-	1
<i>Echis carinatus</i>	2	-	2
Non-venomous	24	14	38
Total	32	14	47

By taking series of digital photos, precise photographs are used to illustrate the snake fangs and drawing the possible bite marks [20].

Their mouths were inspected every two weeks and development of their fangs and teeth were recorded by taking clear digital photos. After considering the logging-related changes, fangs and teeth patterns of venomous snakes and teeth patterns of non-venomous snakes were drawn and the results

were compared.

Findings

One or two wounds appeared as typical fang marks at the bite site of venomous snakes while non-venomous snakes had two carved rows of small teeth (Figure 2).

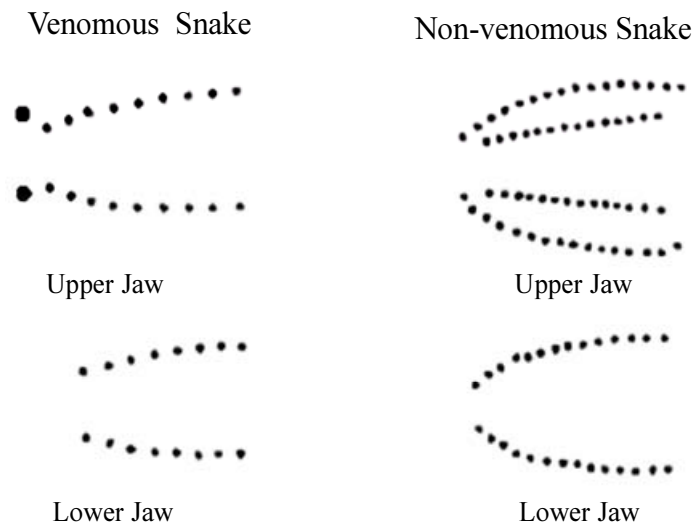


Figure 2) The common location of teeth and fangs in upper and lower jaws in venomous snakes (left) in compare to non-venomous snakes (right)

Three different teeth and fang patterns were recognized in venomous snakes which were completely different. In the first pattern, two fangs along with non-venomous teeth were observed in the upper jaw. This was a normal and classic condition of the teeth and fangs which was usually observed on envenomed victims (Figure 3a). In the second pattern, three fangs along with non-venomous teeth were observed in the upper jaw. This was an unusual pattern in which two equal fangs in a binary arrangement were located in one side of the upper jaw while a single fang was located in the opposite side of the same jaw (Figure 3b). In the third pattern, two distinct fangs along with non-venomous teeth were observed in the upper jaw. This pattern was also an unusual condition in which a non-developed fang on one side and a well grown fang on the opposite side of the upper jaw were present (Figure 3c).

Discussion

Snake envenomation is an emergency and dangerous condition with a significant medical risk of disability or even death. One of

the main signs of all grades of envenoming is fang marks on prey's body; therefore it is necessary to learn different bite patterns of venomous snakes in each region. Snakebite identification has three decisive inspection steps. In the first step, it is critical to distinguish the snake bite from other animal bites such as spiders, scorpions' stings, etc. [21]. In the second step, it is necessary to differentiate the bites of venomous snakes from those of non-venomous snakes, and finally, if the snake is venomous, to identify the species. This study was performed by the aim of determining the penetrating pattern of fangs and teeth of some viper snakes and comparing with non-venomous snakes.

However, some believe that snake identification cannot be trusted and bite marks have limited use since some non-venomous snakes such as wolf snakes leave just two fang marks, or some species have two enlarged front teeth which leave two single puncture marks. In addition, some venomous snakes like kraits, may leave no bite marks and some snakes that have more than two fangs, causes multiple puncture marks.

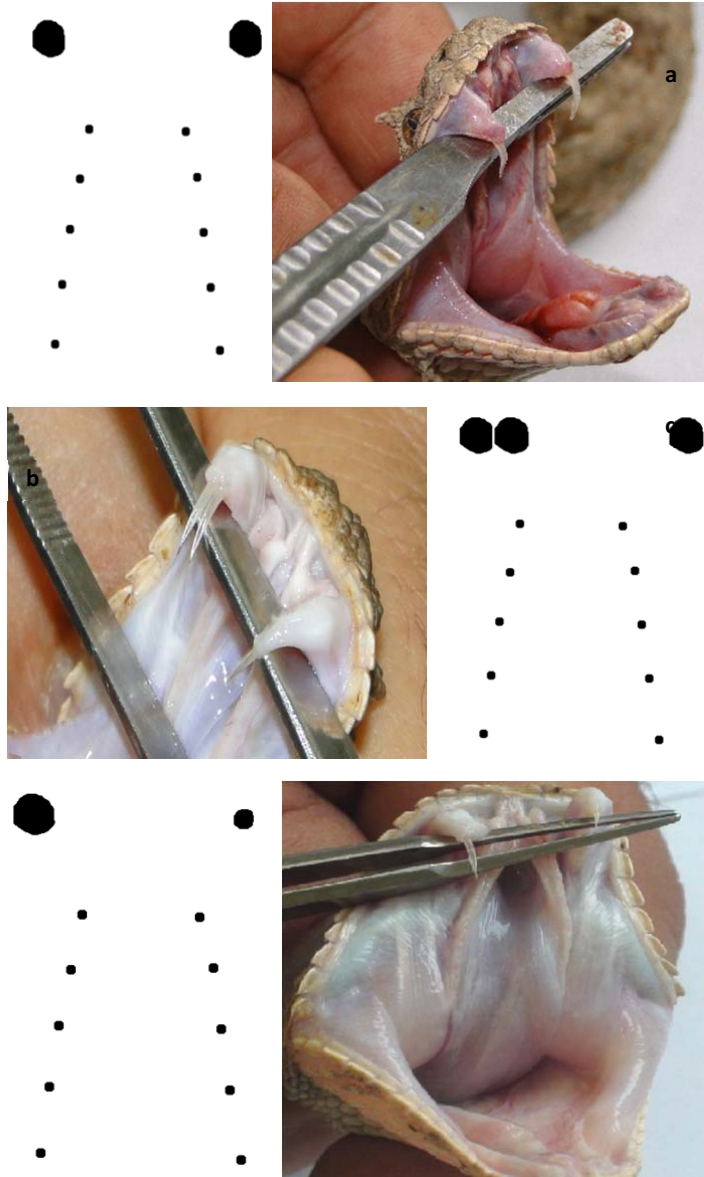


Figure 3) a. *Pseudocerastes persicus* (Persian Horned Viper) fangs and its possible fang marks in victims **b.** The triple fangs in viper, binary fangs in one side and single fang in another side of upper jaw and its possible fang marks in victims **c.** Incompatible fangs in viper's upper jaw, one is relatively grown, while the other is just emerged and its possible fang marks in victims

Moreover, availability of polyvalent anti-venoms to use in all suspected snake bite makes the identification of fang mark less important in some regions [15, 22].

In contrast, many researchers and medical staff indicate the snake identification is a crucial step to improve prognosis and optimal clinical treatment [12, 23]. For a positive identification, it is recommended to bring the live or dead snake safely to the hospital (in only possible and safe conditions), or if it is not possible take digital photos from a safe distance [15, 24]. In absence of the offending

snake, its photo and direct visual identification by victim or others, clarifying the main species of snake is difficult, if not impossible. The real confirmation is the fang mark that always remains on victims [15, 25].

Although the absolute necessity of snake identification is controversial, without a positive identification, confusion could lead to an improper, ineffective or wrong treatment and even death, especially when polyvalent anti-venom is not available. Time and cost of treatment and also prolonged hospitalization and range of laboratory testing can be

decreased by the correct decision to use the type of anti-venom, the essential dose and other necessary medicines depend on the snake species [26]. For example, in some countries like India, the available anti-venom is polyvalent which neutralizes the venom of Cobra, Russell's viper, common Krait and Saw Scaled Viper. As the fatal doses of their venoms are different, the mixed neutralizing anti-venom is practically increased compared with monovalent anti-venom against each snake separately [11].

Although, the most frequent bite patterns are classic or usual and can be recognized easier and faster [27], the results of the present study showed that the same usual bite pattern is unlikely to be observed in every envenomed patient, and other bite patterns could also be expected. The results also indicated that the fang marks of venomous and non-venomous snakes were different; therefore by inspection of the bite puncture on the patient's skin, it will become possible to differentiate them.

The signs of non-venomous snakes revealed in our study can help distinguishing between the species of striking snake whether venomous or not [6].

Vipers have two front fangs; therefore their bites create two puncture wounds on the skin. The depth of them relates to the size of their fangs, which in turn correlates with the size and maturity of snake and also the condition of bite. Normally there are no signs of other teeth at the bite site. The fang marks are variable and sometimes a pair of two marks can be seen and rarely one or more teeth marks in the form of line or wounds are observed [14, 17].

At the time of examination of victims, it is necessary to look for two puncture wounds on their skin, in the first stage. However, sometime just one fang penetrates the skin, as the snake may have lost one of its fangs in previous attacks. Unlike Cobras and Sea Snakes, the vipers do not need to close up their jaws to bite. They attack by their fangs, inject their venom in prey skin very quickly and retract their fangs to their original position [28, 29].

Training of emergency medical staff to become acquainted with local fauna, identification of their bite patterns and awareness of usual and unusual fang puncture

marks can make a great improvement in treatment of envenoming and decreasing the resulted damages and treatment cost. The current study was not designed to investigate fang marks of all venomous snakes. Therefore, there were a few limitations; first, this study has only examined the viper species and second, the sample size was relatively small. Working with

Venomous snakes in both field and laboratory is vital and requires special skills and equipment. Because of that, research on such animals is difficult and is limited by the small number of snakes. Although this study revealed three different patterns of fang marks, but still the variation of these patterns is the main source of uncertainty for identification of offending snake. Therefore future studies need to be done on large number of both snakes and the envenomed victims to provide more evidence for establishing a greater degree of accuracy.

Conclusion

The fang marks of venomous snakes do not always have a common and classic pattern and there are at least 3 different patterns in Isfahan province, Iran.

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Ethical Permission: We followed animal rights properly during this study. All animals properly housed, fed and handled. We released all animals to nature at the end of the experiment.

Conflict of Interests: There were no conflicts of interests.

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