Poison apparatus and the biting mechanism of snakes

Snakes belong to limbless group (ophidia) of class- Reptilia (Phylum–chordata). Most of the snakes are non poisonous and there are four poisonous genera of snakes, In India every year 30,000 persons die of the Snake bite. Snakes do not chew their food but swallow its whole food. All the poisonous snakes have poison apparatus in their heads, which is not found in non–poisonous snakes. Poison apparatus of snakes consist toxic substance which is considered as poison and venom. The poison and venom both substances are toxic in nature but the difference are; if the plants and animals produce toxic reaction after eating them than the plants and animals supposed to be poisonous. When substance injected into the body of enemy or organism by those animals having poisonous apparatus it is called venomous.
Poisonous apparatus of snakes include the following parts;

- A pair of poison glands
- Poison ducts
- Fangs
- Muscles

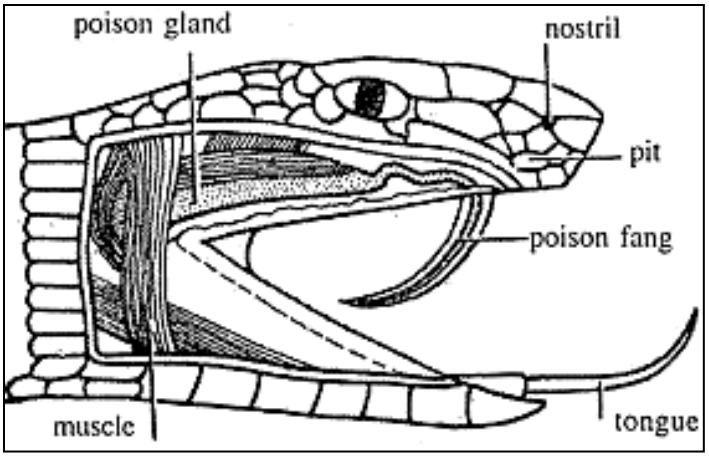


Fig: Poison apparatus of snake

1. Poison Glands

The poison apparatus of snakes consists of a pair of poison glands, their ducts and a pair of fangs. In poisonous snakes the poison glands are situated one on either side of the upper jaw. The poison glands are possibly the superior labial glands or parotid glands. Each poison gland is sac-like and provided with a narrow duct at its anterior end. Capsule sends vascular fibrous septa that separate the glandular substances into

secretory pockets. The duct passes forward along the side of the upper jaw and loops over itself just in front of the fang and opens either at the base of the fang or at the base of the tunnel on the fang. The poison gland is held in position by ligaments. An anterior ligament attaches the anterior end of the gland to the maxilla. A posterior ligament extends between the gland and the quadrate. Fan-shaped ligaments are situated between the side walls and squamoso-quadrate junction.

2. Poison Ducts of Snakes

The gland is provided with a narrow duct at its anterior end. The duct passes forward along the side of the upper jaw and loops over itself just in front of the fang and opens either at the base of the fang or at the base of the tunnel on the fang. The duct actually opens in a pocket of mucous sheath that covers the basal part of the fang. In spitting cobras (*Naja nigricollis*), the poison duct is modified in that it has an "L" shaped bend, just prior to exiting the fang, with the discharge orifice being located on the front of the fang.

3. Fangs:

The fangs of snakes evolved to inject venom into the pray of various snakes that possess them. the term fangs refers to a grooved or tubular tooth that is used to inject venom. It has pared pointed and hook like teeth, which are the modified form of maxillary teeth. They are long, curved, sharp and pointed.
Fangs are divided into three types on the basis of structure and position which are given bellow;

(a) Proteroglyphous (protero, first):
Proteroglyphous types of fangs are small, grooved and articulated and permanently erect at the anterior end of maxillae. Such fang is found in cobras, kraits, coral snakes and sea snakes,

(b) Opisthoglyphous (opistho, behind):
Opisthoglyphous fangs are also small, grooved but remain associated with the posterior end of maxillae.

(c) Solenoglyphous (solen, pipe + glyph, hollowed)**:**
Solenoglyphous fangs in vipers and rattle snakes, a large functional fang occurs on the front of each maxilla. This contains a narrow hollow poison canal with enamel, which opens at the anterior end of the fang. The fangs are movable and turned inside to lie in the roof of mouth when it is closed.

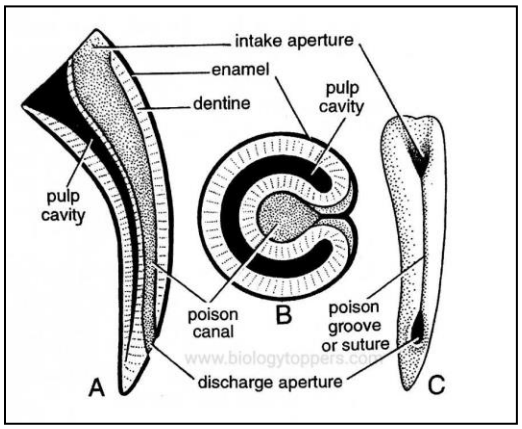


Fig. A. Sonlenoglyphous fang in L.S. B. Sonlenoglyphous fang in T.S. C. Entire grooved fang

4. Muscles :

The poison apparatus is associated with specialized bands of three types of muscles viz. i. digastrics

ii. Sphenopterygoid

iii, anterior and posterior temporalis

i. Digastric muscle – Attached to the squamosal of the skull at one end and articular of the lower jaw at the other end. It helps in opening jaws.

ii. Sphenopterygoid – attached anteriorly to the spheroidal region and posteriorly to the dorsal surface of the pterygoid. It assists in pulling the pterygoid forward.

iii. Anterior and posterior temporalis – attached to the side walls of the cranium and the lower jaw. They help in closing the lower jaw.

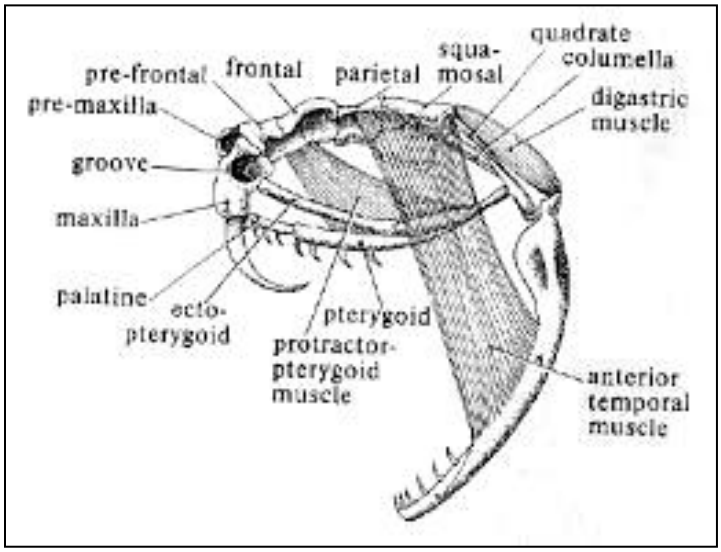
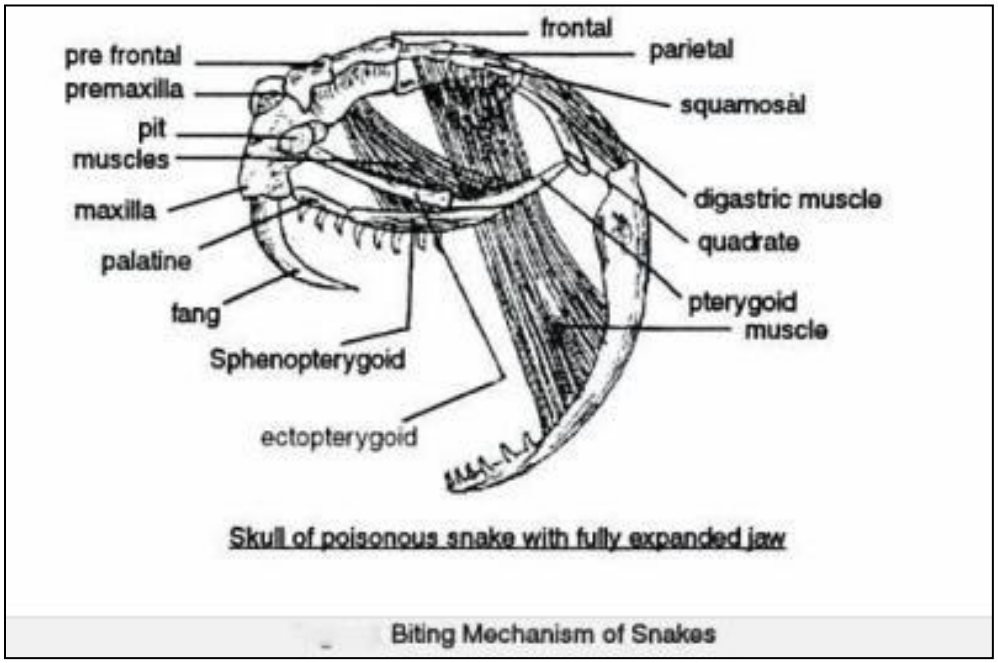


Fig: Muscles associated with poison apparatus

Biting Mechanism:

The skull and jaw bones in poisonous snakes are loosely and movably articulated, thus, allowing an enormous gape and swallowing whole of large prey. In cobras fangs are small and remain permanently erect, but in vipers the fangs are large and curved and lie against the root of mouth cavity when closed. Premaxilla, usually toothless and the bones of the upper jaw are loosely attached to rest of the skull. Quadrate jointed to the squamosal.

There are movable joints between the frontals behind and prefrontals and nasals in front and also between several other bones of brain case, palate and jaws. These joints have loose ligaments and allow movement in several directions and so permit a huge gap. The two halves of the lower jaw are connected together by elastic ligamentous tissue. So they are capable of being widely separated from one another.



Biting Mechanism of Snakes

There are four distinct phases when a poisonous snake bites: (i) The strike; (ii) opening of the mouth and elevation of the fangs; (iii) closing of the jaws and the injection of venom; (iv) retraction of the fangs.

I. The strike. – In this phase the snake throws itself forward with great rapidity and violence, the distance covered not generally exceeding one-third of its length. Vipers strike with greater velocity than the colubrids, some of which especially the hooded species raise the head from the ground thus compensating to some extent for the limited mobility of the fangs.

II. Opening of the mouth, rotation of maxilla and elevation of the fangs.- Most poisonous snakes commence the strike with closed jaws, but as the head approaches the victim the mandibles are depressed by a rapid contraction of the digastrics, cervico-mandibular and vertebro-mandibular muscles and simultaneously the fangs are elevated or rotated forward by the forward swing of the pterygo-palatine-transverse arch produced by the contraction of the sphenoand parieto-pterygoid muscles.

As the mouth opens the lower jaw moves down and the lower end of quadrate moves forward. Quadrate and squamosal are very movable. The pterygoid is movably attached to the palatine. Quadrate pushes the pterygoid forward and the pterygo-palatine joint bent.

This forward movement of the pterygoid is conveyed by the trans-palatine bone to the maxilla and causes it to rotate through about 90° upon its prefrontal articulation in such a way that the surface to which the fang is attached is carried forwards and ventral wards, and the fang is erected, i.e., is made to project downwards at the front end of the mouth. The contraction of sphenopterygoid muscles also helps in the movement of pterygoid forward.

III. Closure of the mouth and the injection of venom.- Closure of the jaws follows, a result brought about by the simultaneous contraction of the anterior, middle and posterior temporal muscles which strongly elevate the mandibles. In the colubrids the venom gland is also compressed by the superior and inferior portions of the anterior temporal muscles, producing torsion on its capsule with the expulsion of venom from the gland along the duct, the papilla of which becomes approximated to the groove at the base of the fang, but in certain Australian species venom may sometimes be observed to spurt a considerable distance during a snap bite at a time when no object is actually being bitten. In the vipers there is an entirely different anatomical arrangement of muscles acting on the venom gland; expulsion of its contents is instantaneous and independent of fixation of the lower jaw.

iv. Retraction of the fangs/ insertion of venom:

Immediately following the insertion of the fangs, and actually accompanying the discharge of venom, contraction of the retractor muscles which operate on the pterygo-palatine-transverse arch occurs, dragging the elevated fangs downwards and backwards through the tissues. At the time of insertion of venom the muscles contract after the piercing of the fangs**.** The contraction of the muscle causes the squeezing the poison gland into the groove or channel of the fangs**.**

Though the four stages including the inoculation of venom are described separately, they occur in nature as a series of rapidly co-ordinated movements, several lethal doses being injected in a fraction of a second in some instances especially with the vipers.

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