Torsion and Detorsion in Gastropoda

Definition:
Torsion (twisting) is the rotation of visceral organs in anticlockwise direction through an angle of 180° on the rest of the body during larval development. The phenomenon takes place in the free-swimming (veliger) larva of gastropods and converts the symmetrical larva into an asymmetrical adult.

Contraction of the larval retractor muscles and differential growth are possibly responsible for such rotation .Entire rotation results within few minutes. Asymmetry is encountered at the early stage in Veliger larva where the mesodermal bands develop asymmetrically. The mesodermal band on the right side is larger than its left counterpart.

The right band is composed of five mesoderm cells which elongate to form muscle cells. With the transformation of the muscle cells the visceral hump is displaced to the left side.These cells on the right side converge and transform into the larval retractor muscles. The muscle cells are absent on the left side. Torsion of the visceral hump commences as soon as the larval muscle cells attain the power of contraction.

Conditions before Torsion:
1. The mantle cavity is situated at the posterior side containing the pallial complex.

2. The ctenidia and two nephridiopores are located posteriorly.

3. The alimentary canal is straight with the mouth at the anterior side and anus at the posterior side.

4. The auricles are placed behind the ventricle.

5. The nervous system is bilaterally symmetrical.

6. Firstly, the embryo is bilaterally symmetrical in the veliger stage when foot and a planospiral shell are formed first in this stage.

Remarks:

Torsion is not the coiling of the shell and all the evidences indicate that the shell evolved before torsion.

How Torsion Occurs:

1. The morphological phenomenon of bending on the ventral side which takes place in an antero-posterior sagittal plane about a transverse axis of the animal results.

(a) Firstly, the displacement of the mantle cavity towards the right side and then to the anterior end of the body but the head and foot remain fixed.

(b) The looping of the digestive tract and approximation of mouth and anus take place.

(c) The original saucer-shaped visceral mass and the shell become cone- shaped and finally become spirally coiled.

2. Simultaneous coiling up of these structures results in an exogastric coil.

3. Ventral portion of the visceral mass and mantle rotate about 180° or little more.

4. Twisting of dorsal mass occurs in such a manner that organs such as right gill and right auricle remain and corresponding parts on the left side are often lost.

5. During the completion of metamorphosis there is a lateral torsion subsequent to primitive ventral plexus with the result that the original coil of the visceral sac and the shell which was originally dorsal or exogastric becomes ventral or endogastric. So the lateral torsion leads to the attainment of condition of gastropods following certain changes in original organisation.

Cause and Significance of Lateral Torsion:

1. Lateral torsion is due to arrested growth of one side and active expansion of the other. Generally the growth of the right side becomes retarded so that the mantle cavity and pallial complex

gradually pass down to the right side and to the anterior side on account of the better growth of visceral mass towards the left.

2. This is necessary for protection, compactness and provision for continuous growth. This is the response with necessity in life of animal for best adaption.

Effect of Torsion and Shuttling of Pallial Complex:

1. Displacement of mantle cavity:
The mantle cavity was originally posterior in position but after torsion the mantle cavity opens just behind the head and its associated parts shifted forward.

2. Changes in relative position:
Before torsion the anus and ctenidia are pointed backwards and auricles are situated behind the ventricle. After torsion the anus and ctenidia come forward and the auricles come to lie in front of ventricle.

3. Twisting of alimentary canal:
The alimentary canal which was primarily straight is twisted in the form of a loop and approximation of mouth and anus takes place.

4. Origin of chiastoneury:
Crossing of the pleuro-visceral connectives is due to the fact that the pallial complex must have changed its position from the posterior to the anterior part of the body arid become twisted in the form of 8. The right connective with its parietal ganglion passes over the intestine called the supraintestinal and the left connective passes below the intestine called the infraintestinal.

5. Endogastric coil:
The coil of visceral sac which was primarily dorsal or exogastric becomes ventral or endogastric after torsion. The coiling of the shell is not associated with the torsion and was a separate evolutionary event and the shell remained a symmetrical spiral.

6. Loss of symmetry:

It is due to displacement of anus towards right side of the mantle cavity and loss or reduction of paired parts of the primitively left or topographically right side.

In majority of the gastropods torsion, as already stated, is resulted in two stages, viz., Stage-I and Stage-II:

Stage-I:

The contraction of the larval retractor muscles account for 90° of the rotation of the visceral hump. This process usually lasts for only a few hours. At the end of Stage-I, the mantle cavity (which was initially situated ventrally and posteriorly) comes on the right side with the foot projecting on the left side.

Stage-II:

The rest of the torsion is the result of differential growth and is usually longer in duration. Actual mechanism of torsion in gastropods is not proper y known and it is difficult to give a generalised account of torsion in gastropods.