

Torsion and detorsion in Gastropoda (Mollusca) ①

All molluscs except the Gastropoda, retain ancestral bilateral symmetry of the body with mantle cavity lying posteriorly or laterally. Gastropods possess an asymmetrical body with mantle cavity lying anteriorly and the shell and the visceral mass coiled spirally and directed posteriorly. Gastropoda are generally believed to have descended from an unsegmented and bilaterally symmetrical ancestor with a low conical shell, a straight alimentary canal ending in a posterior anus, and mantle cavity posterior, lying behind the visceral dome. Anterior situation of the mantle cavity in gastropods is due to torsion or twisting of the visceral mass during development.

Torsion - Torsion or twisting is a process during larval development of gastropods which rotates the visceropallium anticlockwise through  $180^\circ$  from its initial position, so that the mantle cavity, with its pallial complex, is brought in front of the body, in adult.

In larval gastropods, only visceral mass undergoes rotation through  $180^\circ$  whereas head and foot remain fixed. Actual site of torsion is neck behind the head foot, through which oesophagus, rectum, anterior visceral nerve loop and shell muscle pass. Thus actual twisting involves the neck tissue and structures within it.

Process of torsion → The process of torsion can be understood by study of



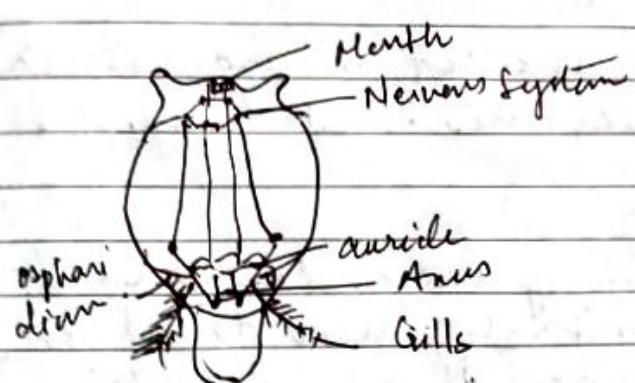
embryogeny of living gastropods. Before torsion, larva<sup>2</sup> is quite symmetrical, the mantle cavity faces backwards and downwards, alimentary canal is straight and anus opens posteriorly in middle line. A ventral flexure of the body results in looping of alimentary canal and approximation of mouth and anus. Shell and visceral mass, originally saucer shaped, becomes first cone shaped and later spirally coiled. Shell lies dorsally and forms a lid on the anterior side. Such a shell is called exogastric. Visceral flexure is followed by a lateral torsion, so that dorsal or exogastric shell becomes ventral or endogastric. Lateral torsion is probably due to arrest of growth on one side and active extension on the other. Generally growth of the right side becomes retarded so that the mantle cavity and pallial complex gradually pass round to right side, and so too to the anterior side, on account of greater growth of the visceral sac towards the left.

The whole process completes in 2 or 3 minutes in *Acmaea*. Actual process of torsion is supposed to be asymmetrical position and pull of the larval retractor muscles running from the velar lobes to the shell. They are present only on the right side, there being no related muscles on the left side. Contraction of larval retractor muscles bring about the rotation or torsion; only narrow neck of larva is actually twisted. Consequently everything between head and anus undergoes an anti-clockwise rotation or torsion through an angle of  $180^\circ$  around a vertical axis passing a dorso-ventral direction.

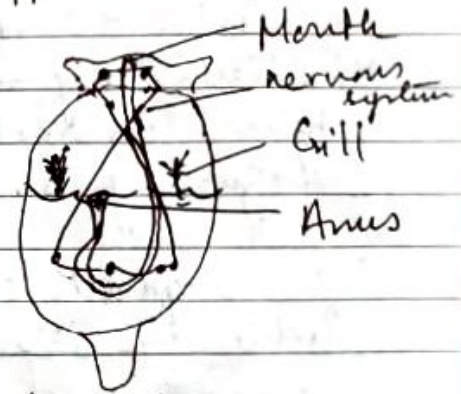
Thomson (1958) recognized 5 ways in which torsion can take place



- 1) Complete or 180° rotation achieved by muscle contraction alone, is known only for Acmata.
- 2) 180° rotation achieved in two stages, first 90° movement by contraction of larval retractor muscles and later a slower 90° rotation by differential growth. It is the commonest method of Italicus and Paltilia.
- 3) 180° rotation by differential growth alone vivipara.
  - 1) Rotation by differential growth processes with anus coming to a position appropriate to adult stage eg. Aplysia
- 5) Torsion no longer recognisable as a movement of viscero pallium, the organs in post torsional position from their first appearance eg. Adalaria



Before torsion



After torsion

fig - Effects of torsion upon position of gills, digestive tract and nervous system.

Effects of torsion - Spengel (1881) described the effects of torsion on gastropods -

- 1) Displacement of mantle cavity: Mantle cavity was primitively posterior in position. Increase in length of ventral foot, tends to remove the mantle cavity and pallial complex away from the head. After torsion the mantle cavity opens just behind the head and its associated parts are shifted forwards.



changes in relative position - Before torsion, anus, ctenidia and renal orifices point backwards and the auricles lie behind the ventricle. After torsion, anus, ctenidia and renal orifices project forward, and the auricles lie in front of ventricle. Original posterior face of visceral sac becomes the actual anterior face, so that visceral organs morphologically of the original right side, become placed topographically on the left side, and vice versa.

3) Looping of alimentary canal - Digestive tract which was initially straight, is thrown into a loop.

4) Chiastomery - long uncoiled pleuro visceral nerve connective becomes twisted into a figure of 8.

5) Endogastric coil - coil of visceral sac and shell which primitively was dorsal or exogastric, becomes ventral or endogastric after torsion.

6) Loss of symmetry - Anus is displaced towards right side of the pallial cavity so that original symmetry of organization disappears.

Significance of Torsion - According to ~~Hall~~ Morton (1958) main advantage of torsion is promotion of stability in adult by placing bulky mass of animal near the substratum. After torsion mantle cavity is curled anteriorly so that all three currents flow in the same direction pushing the mantle cavity with fresh clean water and increasing its ventilation. Gills become exposed to external currents and the pallial complex shift back to their original position.

By Dr. Bibho Verma  
Dept of zoology