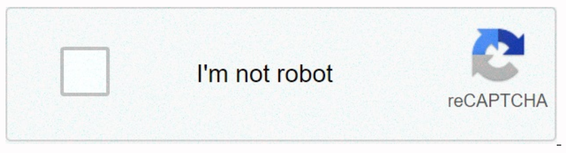

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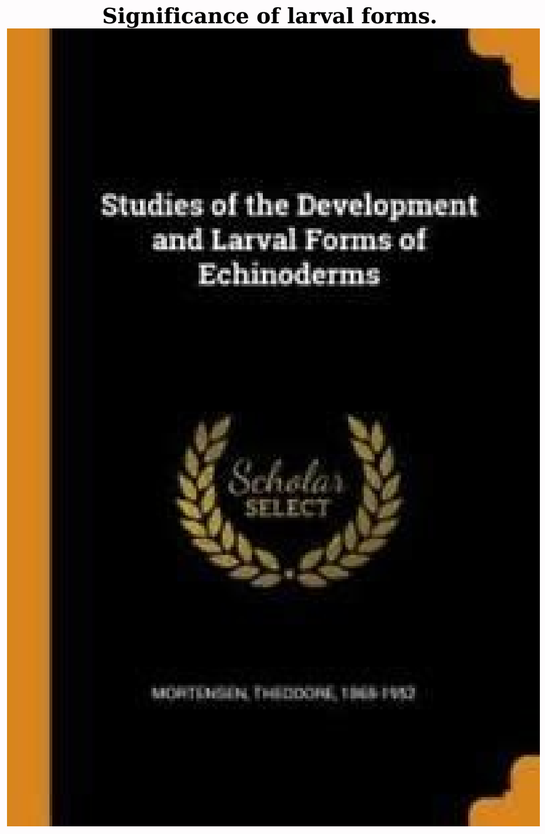
Larval form of echinodermata pdf

Significance of larval forms.



What is a larval form. What is the larval form of echinoderms known as. Different larval forms of echinodermata.

In this article we will discuss about:- 1. Pluteus Larva 2. Auricularia and Doliolaria Larvae 3. Doliolaria Larva of Crinoidea 4.

EVOLUTION & DEVELOPMENT 15:1, 5–17 (2013)
DOI: 10.1111/ede.12010

Larval myogenesis in Echinodermata: conserved features and morphological diversity between class-specific larval forms of Echinoidae, Asteroidea, and Holothuroidea

Vyacheslav Dyachuk[a,b,*] and Nelly Odintsova[a,b]
[a] A. V. Zhirmunsky Institute of Marine Biology, FEB RAS, Palchevsky 17, Vladivostok 17 Palchevsky Str., 690059, Vladivostok, Russia
[b] Far Eastern Federal University, 8 Sukhanova Str., Vladivostok, 690950, Russia
*Author for correspondence (e-mail: slavad82@gmail.com)

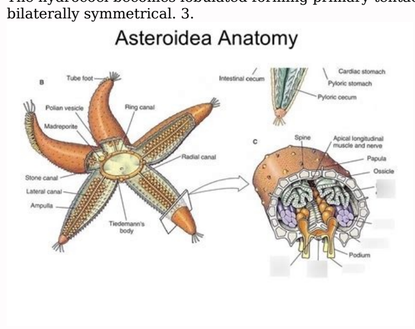
SUMMARY The myogenesis of class-specific larval forms of three classes belonging to the phylum Echinodermata (Echinoidae, Asteroidea, and Holothuroidea) was investigated via gross-anatomy and comparative morphology of larval muscles. Using staining with phalloidin and antibodies against the muscle proteins, with subsequent CLSM and 3D imaging, we have examined myogenesis in the larvae from the gastrula stage to pre-metamorphosis larval stages. We have shown that temporal and spatial expression of muscle proteins is similar in echinoidea and asteroidea larvae but differs in holothuroidea larvae at early developmental stages. New insights regarding the protein composition of maturing muscular fibrils during development in echinoderm larvae were detected. The first differentiating muscle structures in all tested classes have been found to be circular esophageal muscles that are associated with larval feeding. During early differentiation of echinoderm larval muscle cells, we observed that the expression patterns of the muscle proteins were not uniform but with a characteristic diffuse distribution, which is typical for smooth muscle. An unusual pattern of expression of the muscle proteins was detected in larval sphincters: the thick muscle proteins were first expressed during the early developmental stages, whereas F-actin appeared at later stages. In addition, paired star-shaped muscles were revealed in the mature Echinoidae plutei, but were absent in the Asteroidea, and Holothuroidea larvae. All tested species of Echinodermata exhibited both conserved features of muscle morphology during development indicating a common life history strategy and a planktonic habitat, and also an extensive morphological diversity representing specific anatomical adaptations during development.

INTRODUCTION

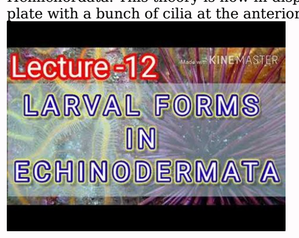
Echinoderm species are classical model organisms and excellent models for embryological and molecular biological studies. Most of these studies have been focused on early developmental history, including fertilization, cleavage, blastulation, gastrulation, germ layer formation, and cellular interactions (Wolpert and Gustafson 1961; Wessel and McClay 1985; Cameron et al. 1989; Armstrong et al. 1993; Wray 1999; Kominami and Takata 2004). The earliest events in myogenic determination and differentiation are similar in echinoderm embryos and have been well studied in sea urchins and starfish (Wolpert and Gustafson 1967; Ishimoda-Takagi et al. 1984; Burke and Alvarez 1988; Ettensohn 1990; Crawford and Martin 1998). The first step of gastrulation is the transition of cells from an epithelial to a mesenchymal phenotype and subsequent ingression of primary mesenchyme cells into the blastocoel (Kominami et al. 2004). Primary mesenchyme cells are located in the vegetal plate and then give rise to the skeletogenic cells of the embryo (Ibsook and Keller 2003). The second step of gastrulation is characterized by the appearance of secondary mesenchyme cells that differentiate into pigment cells, basal cells, cells of the coelomic pouches, and circumesophageal muscles (Burke and Alvarez 1988; Cameron et al. 1991).

The fate of larval muscles during echinoderm development is less well understood. The appearance and growth of the esophageal muscles have been described in sea urchin embryos by light- and electron microscopy (Burke and Alvarez 1988), and histological and ultrastructural data have provided more details of the arrangement and fine structure of digestive tract muscles (esophageal muscles and sphincters). However, these data are scarce and available only for some developmental stages of echinoids (Kawaguti 1964, 1965; Kawaguti and Kamishima 1965; Saita 1969; Strathmann 1971; Smith et al. 1981), holothuroids (Kawaguti 1964; Kawaguti and Ikemoto 1965; Lanzavecchia 1967; Strathmann 1971), and asteroids (Strathmann 1971; Eylers 1976). There have been few studies of the timing of muscle development from embryos to

Dipleurula Theory 5. Pentactula Theory 6. Regeneration in Echinoderms. Pluteus Larva: 1. Five to six pairs of arms supported by calcareous rods and with pigmented tips. 2. Presence of four ciliated bands forming epaulettes at the base of the postoral and posterodorsal arms. 3. Arms are preoral, anterolateral, anterodorsal, postoral, posterodorsal and posterolateral. Two types of pluteus larvae, ophiopluteus and echinopluteus, are present: Ophiopluteus larva: 1. Free-swimming. 2. Arms are four pairs, slender and supported by calcareous skeleton. 3. Posterolateral arms are longest and directed forward, giving the larva V-shaped appearance. 4. Ciliated bands are present on the edges of arms. 5. The alimentary canal is divisible into mouth, oesophagus, stomach and intestine opening through the anus (Fig.
27.10A). Ophiopluteus is the larva of Ophiuroidea. In viviparous forms, Amphiura vivipara, the pluteus stage is omitted.
In Ophionotus hexactis, the development takes place in ovary and pluteus larva (Fig. 27.10B) is devoid of arms and anus.
Echinopluteus larva: 1. Free-swimming. 2. Arms five or six pairs, pigmented and supported by calcareous skeleton. 3. The posterolateral arms are very short and directed outward or backward. 4. The skeletal rods simple or thorny or fenestrated or branched. 5. The zones of the alimentary canal are mouth, oesophagus, stomach and intestine opening through the anus. Echinopluteus (Fig. 27.11) is the larva of Echinoidea. Auricularia and Doliolaria Larvae: These larval forms occur in Holothuroidea. Auricularia larva: 1. A free-swimming form. 2. Body barrel-shaped and bilaterally symmetrical. 3. The preoral lobe is well formed. 4. A single winding ciliated band, which may be produced into lobes (Fig. 27.12 A). 5. Gut with mouth, sacciform stomach, hydrocoel and right and left stomocoels and anus. 6.
The hydrocoel becomes lobulated forming primary tentacles and communicates with the hydropore by a canal. 7. Calcareous rods replaced by spheroid or star-shaped or wheel-like bodies. The auricularia larva is transformed into a Doliolaria larva similar to that of Crinoidea. Doliolaria larva: 1. A free-swimming form. 2. Body barrel-shaped and bilaterally symmetrical. 3.



Preoral lobe well-developed. 4. Wavy, continuous band break into 3-5 flagellated, transverse rings (Fig. 27.12B). 5. The gut with distinct zones. Phylogenetic relationship: Due to presence of enterocoelic coelom and some other minor resemblances, attempts have been made to establish a relationship between auricularia and tornaria larva of Hemichordata. This theory is now in dispute. Garstang (1894) propounded that the tadpole larva of Ascidia probably evolved from auricularia larva. Doliolaria Larva of Crinoidea: 1. A free-swimming form. 2. Body elongate oval, a little narrower posteriorly (Fig. 27.13). 3. Presence of 4-5 transverse ciliated bands around the body. 4. An apical sensory plate with a bunch of cilia at the anterior end. 5. An adhesive pit over the first ciliary band in the mid-ventral line close to the apical plate. 6. Gut with distinct zones and the stomodaeum between the second and third ciliated bands.



7. The skeletal structures present. The larva attaches itself to some support and the internal organs rotate at 90° angle from ventral to posterior position. A stalk develops and the larva turns to a cystidian larva, which metamorphoses to a young individual. Homology and phylogeny of echinoderm larvae: Except for the crinoids, a sedentary group, the larvae of Asteroidea, Holothuroidea, Echinoidea and Ophiuroidea exhibit some fundamental resemblances. 1. Preoral and postoral loops. 2. Ciliated bands V-shaped. 3. Presence of gut with its divisions and openings.
4. Coelom enterocoelic. These and other common features indicate they had a common ancestor. Two theories have been forwarded to trace the common ancestry of different groups of echinoderms: Dipleurula Theory: Bather (1900) suggests that different forms of echinoderms possibly evolved from a common ancestor resembling a hypothetical dipleurula larva. Dipleurula larva: 1. Body oval, bilaterally symmetrical with a flat, ventral surface (Fig. 27.14). 2. Gut straight with a stomodaeum, stomach and proctodaeum. Anus is supposed to be formed by atriopore. 3. Three paired coelomic sacs—axocoel, hydrocoel and somatocoel, with water pores on the dorsal side. 4. Absence of skeletal structures. The drawback of the concept is that it fails to explain the derivation of water vascular system, the most distinctive feature of echinoderms. Pentactula Theory: Advocated by Samon (1888), developed by Bury (1895), Hyman (1955). The concept advocates evolution of different groups of echinoderms from a common ancestor resembling pentactula larva. Pentactula larva. 1. Free, hollow tentacles around the mouth with coelomic branches from hydrocoel (Fig. 27.15). 2. Hydrocoel separated from the coelom to form water vascular system. However, the opening of the system of coelomic canals on the surface through a canal developed from another portion of the coelom, i.e., the axocoel is not explained. Divergence in larval forms follow pentacula stage: a. The reproductive organs never became radial following their separation, the attachment was entirely lost during life history. b. In asteroids and echinoids the gonads separated after the radial arrangement. c. In crinoids the attachment of the gonads is retained. It may be presumed that echinoderms are descendants of a common free-swimming ancestor, possibly pentactula. Regeneration in Echinoderms: Echinoderms have the remarkable ability to regenerate lost body parts following autotomy. In case, an arm is injured or grabbed by some predator or held up in some object, it is usually cast off (autotomy) near the base of the nearest ambulacral ossicle. The broken end is immediately closed by the contraction of adjacent muscles of the body wall for protection of internal organs, and a new arm starts forming from the broken point.