Program/Abstract # 236

Multipotency and endoderm–mesoderm specifications in an indirectly developing polychaete

Cesar Arenas-Mena

Department of Biology, SDSU, San Diego, CA, USA

Gastrulation by invagination is widespread among bilaterians. The polychaete Hydrodices elegans gastrulates by invagination and forms a feeding-trochophore larva endowed with a tripartite gut. In contrast, other polychaetes with yolky eggs gastrulate by epiboly, develop a non-feeding trochophore and form their two-end gut epithelium later during segmented stages. The characterization of transcription factors Sal, Krox20, blimp, Otx, Brain, T-brain, Tbx-2/3, Brachyury, Snail, Sox, Gata1/3 and FoxA helps to understand the function and evolution of the overlapping gene regulatory controls of endoderm specification, mesoderm specification, gastrulation, tripartite gut subdivision and dorsal fate specification. For example, FoxA1 has the earliest and broadest expression in endoderm and mesoderm blastomere precursors, and accordingly its RNAi-mediated downregulation compromises endoderm formation. Otx is expressed early and broadly in prospective foregut and midgut blastomeres that lead gastrulation movements and similar robust Otx expression in endoderm precursors of bilaterians suggests an ancestral role related to gastrulation by invagination. In contrast, Otx expression restricts to the larval stomodeum in another polychaete that gastrulates by epiboly. In addition, only multipotent and undifferentiated cells in the annelid and sea urchin larvae maintain high expression of a histone variant known to facilitate transcriptional regulation in unicellular organisms. This expression suggests a transient developmental role promoting transcriptional regulatory multipotency that is lost during differentiation.

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Nervus trigeminus development in quail, duck, and quck chimeras

Christian Mitgutsch, Katie Au, Benita Wong, Brian F. Eames, Richard A. Schneider

Department of Orthopaedic Surgery, UCSF, San Francisco, CA, USA

The craniate jaw complex contains a diversity of neural, muscular, and skeletal elements and has evolved into a stunning range of morphologies. How is neuromuscular and musculoskeletal integration achieved during development and what mechanisms ensure functionality of the jaw complex despite its evolutionary plasticity? To address this question we investigated the development of the N. trigeminus in the Japanese quail, Coturnix coturnix japonica (Aves: Galli), and the mallard, Anas platyrhynchos (Aves, Anatidae) using whole mount immunostaining, classic histology, and 3D reconstruction. We found species-specific differences in ganglion development from relatively early time points in ontogenesis and temporal shifts of developmental when compared to Hamburger/Hamilton staging criteria. Particularly obvious was the massively more robust morphology of the ganglionic parts in the duck, as well as a comparatively early additional branching in the quail mandibular branch. To explore further patterning mechanisms that underlie the integration of the neural components with their respective muscular elements, we created quail–duck chimeras by grafting unilateral cranial neural crest populations from quail donors into stage-matched duck hosts. Our preliminary results show a less robust trigeminal ganglion on the donor side, which could be indicative of a donor (quail)-specific development. This would support our conclusions drawn from comparable experiments addressing the integration of muscular and connective tissues that the spatiotemporal integration of elements results from neural crest-mediated modularization and hierarchical organization.

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Program/Abstract # 238

Developmental mechanisms of musculoskeletal integration in the avian jaw complex

Masayoshi Tokita, Richard A. Schneider

Dept. of Orthopaedic Surgery, UCSF, San Francisco, CA, USA

The musculoskeletal anatomy of the avian jaw complex is highly varied and intimately coupled to species-specific differences in feeding. However, developmental processes that produce such diversity are poorly understood. To identify molecular and cellular mechanisms that may have played a role during evolution of the jaw complex, we conducted a comparative ontogenetic analysis of avian jaw musculature with associated connective tissues. We examined jaw muscle morphogenesis in two species of birds, quail (Coturnix coturnix japonica) and duck (Anas platyrhynchos) which display considerable differences in jaw morphology. We used histology, immunohistochemistry and in situ hybridization to follow myogenesis. Spatial and temporal patterns of myogenic gene expression and muscle-specific protein localization appear similar in quail and duck during relatively early stages of myogenesis (specification and differentiation). In contrast, species-specific morphological differences were observed in later stages of myogenesis (pattern formation). To understand the basis for these species-specific differences in muscle morphology, we generated quail–duck chimeras. Previous data have indicated that patterning of head muscles might involve connective tissues derived from the cranial neural crest. Thus, we exchanged premigratory neural crest cells between quail and duck embryos to test the extent to which donor neural crest cells pattern host jaw muscles. Our results reveal the role of neural crest-derived connective tissues during muscle morphogenesis and suggest that development has played a generative and regulatory role during evolution of the avian jaw complex.

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