Addition of Sensory Structures and Associated Neurons to the Crayfish Telson during Development

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Summary. 1. Many features of the arrangement of mechanoreceptors on the adult crayfish (Procambarus clarkii) tail are present in young animals; certain characteristic groups of receptors are seen in their proper arrangements as early as the first instar.

2. Sensory structures are added mainly to the most lateral regions of the telson, though there is some addition in medial areas and interstitially, within already-developed groups and rows of receptors.

3. The predictable arrangement of receptors in groups and rows, the addition of entire new rows of morphologically distinctive receptors in sparsely populated areas, and the addition of mechanoreceptors to already crowded rows indicate that the addition of receptors is non-random and also independent of the density of existing sensory structures.

4. When mechanoreceptors are added late in development, the associated primary afferents in the adult animal do not exhibit lower average conduction velocities than those of primary afferents associated with "pioneer" receptors. They therefore are probably not smaller cells.

Introduction

In a set of mechanoreceptors on the tail of the crayfish, Procambarus clarkii, cuticular sensory elements and their associated primary afferent neurons are added continuously during development: new receptors are found on the telson at each successive molt, and more axon profiles appear in the sensory nerve that innervates the receptor surface (Kennedy, 1974).

These mechanoreceptors are often directionally sensitive, and each is supplied by one afferent neuron responsive to rostral displacement of the receptor hair and another responsive to caudal displacement. Similar mechanoreceptors on the crayfish thorax are innervated by pairs of bipolar sensory neurons lying under the pit of soft cuticle at the base of the receptors (Mellon, 1963); at least two, and possibly as many as eight or ten primary sensory neurons, underlie...
the telson receptors (Letourneau, unpublished). Each pit on the telson usually contains one central receptor and two peripherally located hair-like structures. Wiese (in prep.) has evidence that these peripheral "guard hairs" may also be directionally sensitive sensory structures, and that some single receptors may be innervated by three afferents. Since primary afferent neurons result from the division and differentiation of peripherally located epithelial cells, it may be assumed that the appearance of a new receptor has been accompanied by the differentiation of at least one and perhaps three or more associated primary afferents.

The morphology of the receptors, and the predictable location of particular types, allows many of these mechanoreceptors to be individually identified. A map of the sensory structures (Fig. 1) has been drawn up for the adult telson; it identifies several groups of receptors that are innervated by the fourth root of the sixth abdominal ganglion (G6R4) (Kennedy, 1971). The P group receptors, so designated because of the phasic nature of the associated sensory neurons, are found near the lateral edge of the muscle insertion located rostrally on the telson. The rest of the receptors innervated by the fourth root are