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Selective decline in the prevalence of slowly adapting type I mechanoreceptors during development

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Highlights

- Electrophysiological recordings were made from sinus hair follicles in vitro from rats aged from 6 to 50 weeks old.
- The prevalence of slowly adapting type I mechanoreceptors declined abruptly from 6 to 14 weeks, stabilizing thereafter.
- In contrast, the prevalence of slowly adapting type II mechanoreceptors did not show any decline over the study period.
- These findings suggest that there is pruning of Merkel nerve ending mechanoreceptors with age.
- The importance and triggers for these changes remain to be established.

Abstract

Merkel nerve endings are identified physiologically as slowly adapting type I mechanoreceptor units. They are important for fine acuity tactile perception. We examined the effect of age on the electrophysiological availability of different types of slowly adapting mechanoreceptor units. Using 6 - 50 week old rats, we observed an obvious decline with age in the probability of recording from St I units of the deep vibrissal nerve. The precipitous decline occurred between ages 6 – 14 weeks and then stabilized. By contrast, the prevalence of St II units, the other type of slowly adapting mechanoreceptor, remained constant over the age range studied. These observations correlate with anatomical findings reported elsewhere.

Introduction

Understanding changes in sensory systems during development and aging is important to facilitate therapeutic intervention, adaptation and compensation (1). Studies have shown that vibrotactile sensation declines with age (2) which may partly explain the greater susceptibility of the elderly to falls. In contrast, the sensory nerve fibres involved in pain perception show no such decline (3). Slowly adapting type I (SA I) mechanoreceptors in primates, including humans, are responsible for high resolution pattern discrimination by the fingertips (4). Terminations of SA I afferents arborize in the epidermis to give rise to disc-like endings apposed to Merkel cells and are known as Merkel nerve endings. The highest concentration of Merkel nerve endings in rodents is found in their sinus hair follicles (5). Many animals bear prominent sinus hairs which act as complex tactile organs to sense their immediate environment, especially useful in nocturnal species. Their use aids spatial navigation, hunting and foraging. The rat's vibrissa system has a discriminative ability similar to that of primate fingertip tactile perception (6), and this system is widely used as a model for high acuity tactile sensation. Rat SA I mechanoreceptors, known as St I mechanoreceptors, are located in the sinus hair follicle complex and play an important role in the well-developed discriminative abilities of rats and in other whisker-bearing animals. The