摘　要

神經塑性在視覺皮質神經網路的發育過程中扮演著重要的角色，然而，神經塑性對於視網膜神經網路發育之影響仍未釐清。近來的研究指出，經由光照剝奪處理以改變小鼠的視覺經驗後，其視網膜上神經突觸路徑的成熟情形會受到影響。因此，本研究是以兔子視網膜做為研究對象，進一步觀察分析哺乳類視網膜中，方向選擇性節細胞的成熟是否需要視覺經驗的參與。實驗所用之紐西蘭白兔分別飼養於具有正常光週期及全暗處理的動物房中，各個不同發育時期的兔子視網膜取下後，利用胞外記錄的方式去量測及比較方向選擇性節細胞各種感受域的特性，最後，利用胞內微量注射染劑以顯示所記錄細胞的形態，並檢驗記錄細胞與鄰近細胞間聯結之形式。實驗結果顯示，方向選擇性節細胞之典型感受域特性，例如方向選擇性之成熟，並不受視覺經驗的影響，然而，經由全暗處理之動物，其位於內層視網膜之無軸突細胞所調節的側向抑制作用，會與經由正常光週期飼養的動物不同，除此之外，全暗飼養的幼兔與正常光週期飼養的幼兔，其方向選擇性節細胞之樹突形態特徵及與其鄰近細胞間的聯結形式則無明顯差異。因此，本研究結果顯示，視覺經驗對於視網膜神經網路成熟之影響並不如對於視覺皮質發育之影響來的顯著。

關鍵字： 神經塑性，感受域，光照剝奪

Abstract

Activity-dependent neural plasticity is well known in the development of visual cortical circuitry. However, little is known about the role of neural plasticity in the developing retina. In light of recent findings that light deprivation alters the development of synaptic pathway in the mouse retina, I examined if visual experience is required for the maturation of the ON-OFF direction selective ganglion cells (DSGCs) in the rabbit retina. The DSGCs of whole mount rabbit retinas raised in the normal light-dark cycle and in the constant darkness were recorded extracellularlly at various postnatal stages. Receptive field properties, such as direction selectivity, velocity tuning, classical center-surround interaction, motion-induced surround inhibition, and contextual tuning were carefully characterized. Recorded cells were subsequently injected with Neurobiotin for morphological identification and examining the tracer coupling pattern. My results reveal that visual experience is not critical for the maturation of classical receptive field properties of the DSGCs, such as direction selectivity and velocity tuning. However, dark-reared animals showed altered surround inhibition mediated by amacrine cells in the inner retina. In addition, the DSGCs showed similar dendritic features and tracer coupling patterns in both normal-reared and dark-reared rabbits. Taken together, this study indicates that the effect of visual experience on retinal circuit maturation is not as profound as cortical circuit maturation.

Key words: neural plasticity, receptive field, light-deprivation