Chronic neurophysiological and anatomical changes associated with infra-red beak treatment and their implications for laying hen welfare

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Abstract

The long-term effects of infra-red beak treatment (IRBT) in laying hens were investigated by examining beak-nerve function and anatomy over a range of ages. In IRBT and control (intact) birds that were ten, 30 or 50 weeks old, the responses of single sensory nerve fibres were recorded from the intramandibular nerve, which provides sensation to the lower beak. The beaks were also measured and subject to microscopic and radiographic examination. The responses of 386 nerve fibres were recorded including mechanoreceptors, thermoreceptors and nociceptors. Receptive field positions indicated that the entire lower beak was sensitive to thermal and mechanical stimuli, regardless of age or treatment. There was no evidence of a treatment effect on nociceptive thresholds at any age. Beak measurements demonstrated that application of IRBT at day-old affected, on average, 36% of beak area, and resulted in a 44% reduction in beak length by four weeks of age. Radiographs produced no evidence of adverse or pathological change in relation to IRBT. Microscopic evaluation of beak-tip anatomy revealed evidence of healing including re-epithelialisation, fibrovascular hyperplasia and bone remodelling. By four weeks of age there was limited nerve regeneration in IRBT beaks, including re-population of mechanoreceptors in some birds. In older birds, re-innervation and scarring was visible, but no neuromas or abnormal proliferations of nerve fibres were observed at any age. Collectively, the results suggest that IRBT does not result in chronic pain or other adverse consequences for sensory function.

Keywords: animal welfare, beak trimming, infra-red beak treatment, laying hen, pain, nociceptors

Introduction

Beak trimming, involving the partial amputation of the beak, is routinely carried out to prevent or control feather pecking and cannibalism in the egg industry. Beak trimming is normally carried out in the first week of life and the most common method used in the past was the application of a hot-blade which simultaneously cuts and cauterises the beak. A new approach, infra-red beak treatment (IRBT), has recently been widely adopted in which the beak is subject to a localised, non-contact, high intensity infra-red energy source; after approximately two weeks the beak has healed proximal to the damaged area and the tip of the beak is lost. The avian beak is a complex structure consisting of bone, dermal and epidermal cellular layers and a smooth, hardened, keratinised layer (the rhamphotheca). The cellular layers contain mechanoreceptors (Herbst and Grandry corpuscles), blood vessels and free-nerve endings including nociceptors (Kuenzel 2007). Removal of up to 50% of the upper and lower beak (the extent of beak trimming expressed as a percentage of the total length of the intact upper bill, as measured from the distal portion of the nasal opening to the bill tip) will result in a loss of rhamphotheca, mechanoreceptors, nociceptors, other free-nerve endings (eg thermal receptors) and the bill-tip organ (Gentle & Brew 1986).

Welfare concerns regarding beak trimming are numerous and include loss of normal beak function (reduced ability to feed, drink and preen) as well as short-term pain and debilitation. There is ample evidence for temporarily reduced feeding and bodyweight after beak trimming (Blokhuis et al 1987; Glatz & Lunam 1994; Gentle et al 1997) while negative, non-significant or positive effects on preening and plumage condition have been reported (Duncan et al 1989; Lee & Craig 1991; Sandilands & Savory 2002). Acute pain after beak trimming has been investigated in electrophysiological, behavioural and physiological studies. Based on evidence of nerve injury discharge during trimming (Gentle 1991), reduction in beak usage (guarding) after trimming (Gentle et al 1991) and increased heart rate (Glatz 1987), it appears that removal of the beak tip does result in short-term pain, although it has been suggested that this occurs after an initial pain-free period of up to 26 h (Gentle 1991; Gentle et al 1991).