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Effects of Beak Trimming on Pecking Force

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Abstract: Beak trimming of the production laying hen has come under great scrutiny by welfare and consumer advocacy groups as a potential source of acute and chronic pain as well as having the potential to inhibit the freedom to express normal behaviors such as feeding behaviors. Although several studies have shown evidence of immediate pain response from beak trimming, the long term effects on bird welfare are not well understood. In the present study we investigated the force with which chicks peck during feeding. Chicks were beak trimmed using hot blade trimming at 2 days of age and were tested on a force plate at 3, 4 and 5 weeks of age. Both the time spent pecking and the forces of those pecks were measured. Beak trimmed birds spent significantly less time pecking at the feed and used less force than untrimmed birds at 3 weeks of age ($p<0.05$). However, at 4 and 5 weeks of age the difference was no longer significant ($p>0.05$). Beak trimmed birds also had a higher pecking ratio (peck force:time, $p<0.05$) than untrimmed birds. The difference was no longer apparent at 4 and 5 weeks of age ($p>0.05$). Our data suggest that beak trimming alters feeding behavior at a young age. However, changes in pecking force and time spent feeding were not long lasting and became similar to those of untrimmed birds after 3 weeks post-trimming.

Key words: Laying hen, peck force, actimeter, beak trim

INTRODUCTION

Beak trimming is a common husbandry practice in egg production facilities. Beak trimming is used to prevent or reduce damages and stress due to aggressive and feather pecking as well as to reduce mortality from cannibalism. This practice is a sensitive topic for persons concerned with animal well-being (Cunningham, 1992). Conventional beak trimming, or hot blade trimming, is usually performed within the first 10 days of age and generally removes between 1/3 and ¼ of the beak. Hot blade trimming uses a guillotine style blade heated to upwards of 750 degrees Celsius to cut and cauterize the tissue simultaneously (Jendral and Robinson, 2004). The effects of beak trimming on the physiology and behavior of the birds are only just beginning to be understood. Many questions remain unanswered, including the effects of beak trimming on the physics of pecking such as pecking force.

The levels of bite force in mammals, similarly to pecking force in birds, has been used as an indicator of the functional status of the masticatory system and its underlying biophysiological mechanisms give us a unique look into the social dynamics of many species (Husak *et al*., 2006; Anderson *et al*., 2008; Herrel *et al*., 2005). We can now modify sensitive force plate technology to determine the difference in forcefulness of foraging pecks.

A better understanding of beak mechanics and how they are affected by beak trimming could help us better understand the welfare implications of beak trimming on laying hens. Animal welfare is most often defined by using "the five freedoms," including the animals' freedom from pain and freedom to express natural behaviors (FAWC, 1979). Biomechanical investigation of pecking behavior, including pecking force and the time spent pecking in a foraging bout, can help us to determine whether beak trimming alters welfare by limiting the freedom of hens to perform natural feeding behaviors, resulting from beak trimming-associated pain and abnormal shape of the beaks.

This study was designed to determine the effects of beak trimming by hot blade process on the force of foraging pecks and the time spent in this behavior from three to five weeks of age.

MATERIALS AND METHODS

Experimental animals: Twelve 2 days old female white leghorn chicks were randomly assigned to either beak trim or untrimmed control groups (n = 6). For the beak trimming group, the birds were trimmed using a hot blade. Birds were group housed at the Livestock Behavior Research Unit's Animal housing facility. Standard starter diet and water were provided *ad libitum*.

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Fig. 1: Actimeter Force Plate apparatus from Bioanalytical Systems, Inc

Peck force testing: From 2-5 weeks of age birds were transported 15 min to Bioanalytical Systems, Inc research facility for two days per week for testing. Birds were then given a 4 h acclimation period following transport and prior to testing during which feed was restricted. Birds were placed in the Force Plate Actimeter (FPA) testing apparatus (Fig. 1, part number CX-9000, BASi) (Fowler, 2002) for one hour. The testing apparatus consisted of four Plexiglas walls and a force plate floor. Feed was placed on the floor of the testing apparatus to instigate pecking behavior. Birds were allowed 30 min to adjust to the testing apparatus and video recording and force recordings were taken of the following 30 min in the testing apparatus. The timing of the pecks was determined through video analysis and was used in determining the location of peck force reads on the Actimeter force plate readout. The ratio of pecking was calculated as peck force:time.

Statistical analysis: Time spent pecking and forces of pecking data were analyzed using a Mixed Model repeated measure Analysis of Covariance (ANCOVA) for differences over time of days of treatment. Log transformation was used in to correct for assumptions of homogeneous variances. Original (untransformed) Least Square Means (LSMeans) and Standard Error of the Mean (SEM) were reported for all groups. Contrasts were used to determine significance using the Bonferroni adjustment to maintain an experimental alpha of 0.05 (0.10 was considered a trend). Data were analyzed using PROC MIXED of SAS 8.2 software (Cary, NC) the main effect was beak trimming treatment (trimmed or untrimmed).

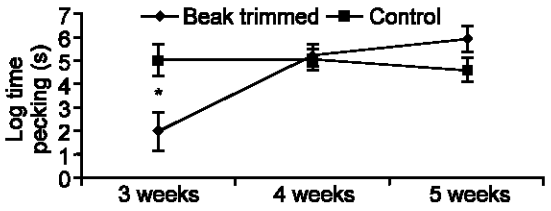

Fig. 2: Log of time spent pecking at the feed source in seconds by age in weeks of beak trimmed and control (untrimmed) chicks. Data presented as LSMeans ± SEM. *Denotes a significant difference between treatments at a given age

RESULTS AND DISCUSSION

Behavioral and physiological measures have been used to assess the short and long term effects of beak trimming (Gentle *et al*., 1982; Jendral and Robinson, 2004). However, the physiological mechanics of behaviors such as pecking force have been difficult to determine. In this study we utilize both video and force plate analysis to obtain an objective measure of time spent pecking and pecking force from trimmed and untrimmed birds. Alterations to the mechanics of pecking may indicate the presence of pain or alterations to the physiology of the beak severe enough to alter the mechanics of feeding behaviors.

At 2 weeks of age only one trimmed and one untrimmed chick engaged in foraging pecking behavior. Therefore, only weeks 3 through 5 were used for analysis.

The present study showed that beak trimmed birds spent less time engaging in pecking at the feed at 3 weeks of age compared with untrimmed birds ($p<0.05$; Fig. 2). Similar to the current finding, previous studies have also shown a reduction in time spent feeding in young beak trimmed birds (Cunningham, 1992). Reduced feeding behavior suggests potential pain at the trimming site, reducing the birds' desire to peck for food. The difference in pecking disappeared at 4 weeks of age and onward, suggesting that the pain associated with pecking may be eliminated or reduced by 4 weeks of age. Trimmed birds also pecked with less force ($p<0.05$; Fig. 3) but had a greater ratio of force to time spent pecking than their untrimmed counterparts at 3 wks of age ($p<0.05$; Fig. 4). This difference is no longer seen at both week 4 and 5 post-trimming ($p>0.05$). A reduction in force at this early age is further indication that trimming associated pain alters feeding behavior.

The broader, less pointed beak tip of the trimmed birds distributes the force over a larger area. In a study of Darwin's finches, Herrel *et al*. (2005) found that beak depth, width and shape were all predictors in determining bite force. In beak trimming birds, the shape, depth and width at the tip and average depth and

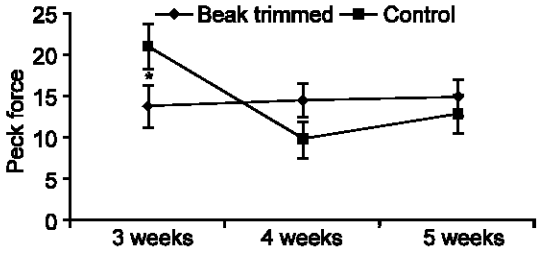

Fig. 3: Peck force of pecks at the feed source in seconds by age in weeks of beak trimmed and control (untrimmed) chicks. Data presented as LSMeans ± SEM. *Denotes a significant difference between treatments at a given age

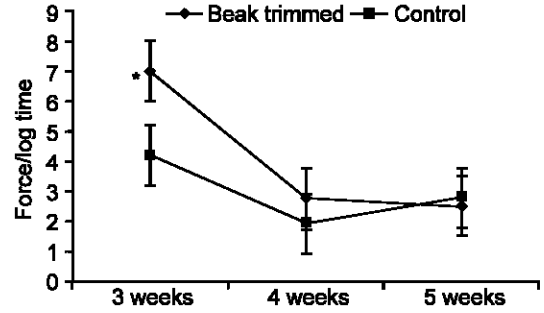

Fig. 4: Ratio of the Force of pecks by the Log of time spent pecking at the feed source in seconds by age in weeks of beak trimmed and control (untrimmed) chicks. Data presented as LSMeans ± SEM. *Denotes a significant difference between treatments at a given age

width have all been altered. Gentle *et al.* (1982) suggested that a "bird's normal method of feeding is inappropriate for the new beak shape." The new shape of the beak may in fact make a change in feeding behavior more efficient for trimmed birds. However, in the present study we see no difference in peck force or peck force/time spent pecking at both week 4 and 5 post-trimming.

Interestingly, beak trimmed birds pecked with a fairly consistent force over the three week period, while control birds pecked with significantly more force at 3 wks compared to weeks 4 and 5 ($p<0.05$). This pattern may be suggestive of different learning curves in trimmed and untrimmed birds. Previous studies have shown that in mammals learning a new task, there is a learning period during which the individual determines the correct amount of force required to correctly execute the task. Human subjects have been shown to use too much force in the beginning of a learning curve, especially when the subjects are very young (Swinnen, 1996). Fine motor adjustments in force are made through motor and sensory feedback, a process which may be interrupted or altered in the presence of painful stimuli. Amputation of the beak at day 2 may have disrupted the birds' normal learning curve for pecking force, causing them to start with less force until the task was achieved instead of starting with hard force and slowly reducing peck force to the minimal necessary level. A full learning curve, however, is not available as we were only able to elicit feeding pecks from one trimmed bird and one untrimmed bird at 2 wks of age. This is most likely due to an increase in freezing type fear behavior at 2 wks of age as has been previously reported by increased tonic immobility responses at 2 wks of age (Dennis *et al.*, 2010).

Research in mammalian locomotion has shown that, following nerve injury, a relearning period of natural behaviors and patterns of movement required during which force and timing must be readjusted (VanSwearingen, 2008). Here we see that untrimmed control birds are fairly consistent with the time spent pecking over time from 3 through 5 weeks of age. We also find that these birds initially peck with greater force at 3 weeks of age but by 4 weeks of age the birds appear to have found a more efficient pecking force that they maintain through 5 weeks. In contrast, the beak trimmed birds maintained a constant pecking force while increasing the time spent pecking. The alteration in learning curves, as it is described by frequency and force of pecking behavior, is suggestive of an early physiological adaptation to the loss of the beak tip.

Previous studies have shown that beak trimming and re-trimming can alter pecking behavior in laying hens (Gentle *et al.*, 1982; Jendral and Robinson, 2004). Amputation in mammals and humans has been shown to alter the physics of movement of the affected area, complex kinetic adaptations and compensations have been studied extensively in humans (Sanderson and Martin, 1997; Sjodahl *et al.*, 2002; Underwood *et al.*, 2004). However, the physical mechanics of the pecking behavior in birds is rarely observed. Our data show a need for in-depth investigation into the mechanics of pecking to better understand the long effects of beak trimming on bird behavior and welfare.

Differences in pecking force and time spent pecking at 3 weeks of age are evidence of alteration to the physical mechanics of pecking. This suggests that beak trimming-associated pain or physical alteration to the beak affecting the bird ability to perform feeding behaviors persists through the third week of age. At the later age, four and five weeks of age, no discernable difference in pecking force was noted. Our data show that beak trimming alters chick behavior and impacts well-being at a young age.

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