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DENSITY AND MORPHOLOGIC FEATURES OF PRIMARY EPIDERMAL LAMINAE IN THE FEET OF THREE-YEAR-OLD RACING QUARTER HORSES

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Purpose: The purpose of the study was to count the total number of primary epidermal laminae (PEL), identify distribution patterns around the hoof wall perimeter, and to describe histological (microscopic anatomy) characteristics of the laminar junction.

Methods: We obtained cadaver feet (both fronts) from nine 3-year old Quarter Horse racehorses that had been euthanized after an injury at the racetrack. Using a band-saw, we cut the frozen feet into several thin slices parallel to the ground. The bottom slice we studied under the dissecting microscope, counting laminae around the entire solar surface, including the bars. Small samples were taken from higher up in the foot and processed for microscopic analysis.

Findings: The total PEL count, including bars, averaged 551 laminae per foot, ranging from 450-600. Dividing the foot down the midline (through the mid-frog) revealed almost equal numbers of laminae in each half of the foot. However the distribution patterns showed that the PEL were not equally spaced from side to side. In general the PEL were more crowded together in areas of slight wall flare on the lateral side and at the slightly underrun heel on the medial side. Microscopic analysis of samples taken from the toe region from 6 feet showed variable morphology (shape), consistent in part with previous reports of histological laminitis.

Comments: The total numbers of PEL that we found are consistent with what has been reported in farrier texts. The distribution differences of higher laminar density in the toe than in the back part of the foot is also consistent with previously published work. There are three key new findings in our study. The regional variation from medial to lateral has not been reported before. The bar numbers have not been reported before. And finally, the variable morphology of the toe laminar junction was a surprising finding that has not been previously documented in feet that have no known history of disease.

Clinical significance: Further study is needed to identify clinical relevance of these laboratory findings. Our study has described some new findings, but rather than giving us clear answers about hoof biology, it has generated more questions and new hypotheses. We believe that one way the foot may adapt to stress is by changing laminar density in certain regions. For example in feet that have a diagonal flare (commonly seen as a lateral toe quarter flare with a crushed and/or underrun medial heel), laminar density appears to be increased in these areas. To test this hypothesis we would need to study a larger group of feet, comparing horses with obvious diagonal flares to those with less visible asymmetry.

We do not know the biological significant of laminar density but we suspect there is some “ideal” density for each hoof area. If the laminae become too crowded, the dermal space between them is reduced, which in turn reduces area available for blood vessels. Regarding laminar morphology at the toe, we need further study to determine if laminar appearance that deviates from the textbook uniformity is really pathological. Variation in laminar appearance may reflect normal wear and tear during training. It is well known that muscle and bone respond to demands of training induced micro-trauma by increasing muscle strength and remodeling of bone. If the horse is appropriately rested before damage causes tissue failure, bone or muscle will heal with an increased capacity to withstand stress. Perhaps the laminar junction adapts in a similar way. The microscopic analysis from some of our racehorse feet was consistent with previously published reports of subclinical laminitis in experimentally induced cases of the disease. We cannot say at this time whether the laminar appearance in our specimens represents an early pathological change or a normal stage of adaptation. One way to test this would be to get biopsy samples from live horses during the course of training and rest cycles, and compare these to samples taken from horses that are not in training.