

## **CORTICAL BONE DENSITY AND TRABECULAR WIDTH IN THE DISTAL PHALANX OF RACING QUARTER HORSES**

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**Purpose:** We began with the question is there variation in cortical density and trabecular spicule thickness in different regions of the distal phalanx in racehorse feet? The purpose of this study was to quantify dorsal cortical bone density and trabecular bone thickness of the distal phalanx in cadaver specimens from 3-year old racehorses.

**Methods:** Feet from five 3-year old racing Quarter Horses were obtained after death from catastrophic racing injury. One front foot from each horse was used to obtain samples for histological analysis. Feet were cut in cross-section with a bandsaw. Samples were cut from three sites on each foot: toe, medial quarter and lateral quarter. Samples were taken from the middle 1/3 of the distal phalanx and included outer cortex and approximately 3 millimeters of trabecular bone. Microscopic analysis was conducted using BIOQUANT OSTEO software.

**Findings:** Bone density was highest at the toe with an average of 79.8 %, ranging from 62.9% to 90.5%. The average cortical density on the medial side was 76.8%, and ranged from 52.2% to 90.9%. Cortical density on the lateral side was the lowest, with an average of 73.7%, ranging from 67.9% to 81.2%. Trabecular width averages were 0.11 mm at the toe and lateral side, and 0.12 mm on the medial side. Trabecular width at the toe ranged from 0.09mm to 0.12mm, on the medial side the range was 0.09mm to 0.14mm, and on the lateral side from 0.07 mm to 0.14 mm.

Results from individual feet varied and did not always follow patterns identified by averages. Morphology of the dermal-bone junction was also examined and variation was noted between feet and in different regions within each foot. In some feet the dermal-bone interface was well-defined and in others there was irregularity marked by numerous holes in the cortical bone. No association was identified to link the findings of irregular dermal-bone interface with other variables or specific sample site regions.

**Comments:**

It is known that remodeling of bone is influenced by mechanical stress, but precise data on mechanical stress in the equine distal phalanx has not yet been described. Investigation of the dermal-bone junction, cortical, and trabecular regions may offer clues about forces that were acting on the live foot. What can we infer about hoof loading from investigation of post-mortem bone analysis? Our findings suggest that subtle asymmetrical loading of the hoof may be manifest early on predominantly by hoof wall tissues. The racehorse feet in this study looked almost symmetrical to the naked eye, but measurements across the solar surface revealed statistically significant differences between medial and lateral ground surface width. Yet measuring bone density differences did not reveal statistical differences.

Our small sample size shows trends in the data, but larger numbers are needed for statistical analysis. With a larger sample size it is possible that more distinct patterns may become evident. Research in our lab on a random sample of 5 asymmetrical coffin bones from horses of unknown age and history showed larger differences between medial and lateral cortical bone density than was found in our racehorse samples.

**Clinical significance:** Future research in our lab will expand the present study in three ways: by adding more racehorse feet, obtaining age and breed-matched controls of pleasure horses, and obtaining samples from older performance horses. We hypothesize that age and breed-matched pleasure horses will show lower bone density at the toe. We believe that stress generated by toe-grabs in these racehorses may account for the higher average density of cortical bone at the toe. We hypothesize that in mature performance horses there will be quantifiable differences between medial and lateral cortical bone associated with the commonly seen long-term asymmetrical loading of feet of older horses. Based on our previous findings of distinct regional variation in hoof wall morphology and laminar density, we had expected to find more notable patterns in the distal phalanx cortical bone. Although bone density may be affected by multiple factors including age, breed, nutritional status, hormonal status, and genetics, we believe that hoof loading patterns (influenced by trimming, shoeing, and ground surface) are likely to play a large role. It may be that in these young horses with well-balanced, well-shod feet, the distal phalanx is loaded fairly symmetrically.