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# The role of abrasion in the development of toe tip necrosis syndrome: a preliminary study

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ABSTRACT

**Background:** Toe tip necrosis syndrome (TTNS), a hind limb lameness disorder of feedlot cattle, is characterized by separation of the white line, bone necrosis and abscess formation. The cause of white line separation, which is unclear, may be due to aggressive behavior whereby cattle damage the white line by dragging their hooves against coarse surfaces found in feedlots. This may result in micro-fissures, allowing organic materials to enter the hoof, causing infection and TTNS initiation. The objective of this preliminary study was to assess whether local elastic moduli (E) of the white line differs between control claws and claws subjected to dragging.

**Methods:** Lateral claws were divided into two groups: (1) dragged claws (n=2); and (2) healthy claws (n=2), worn down (via rasping) to the same depth as the dragged claws. Dragging was achieved by compressing claws against a moving concrete surface representing typical surfaces found in feedlots. Compressive loading (0.5 bodyweight) was performed while a linear actuator provided shear loading ($\mu_{static}$=0.93). Each claw was subjected to 800 cycles of loading, resulting in the loss of 1-3mm of solar tissue. Macro-indentation testing (3mm diameter round-shaped stainless-steel indentor), in combination with Herztian contact theory, was used to assess local E along the white line of claws of the dragged and rasped groups. Four sites were evaluated along the anterior tip of each claw. Due to a limited sample size, statistical analyses gauging the validity of observed differences between dragged and rasped claw were avoided. Instead, effect size calculations were performed using Cohen's *d*, whereby a Cohen's *d* >0.8 was considered large and statistically/clinically significant. Post-hoc sample size calculations ($\alpha$=0.05, power=0.80) were performed to determine the sample size necessary for a full-scale study to detect significant differences in local E.

**Results:** Local E along the white line of dragged claws (range: 23-30MPa) appeared lower (-19% to -39%) than that of the rasped claws (range: 41-76MPa). Cohen's *d* effect sizes were high (2.2-3.9). Statistical power analyses estimated that 6 specimens, per group, are required to differentiate measures of local E between dragged and rasped claws.

**Conclusion:** This preliminary (ongoing) study indicates that local E of the white line may be lower in claws subjected to dragging. These results suggest that dragging may be involved in the pathogenesis of white line degradation and the development of TTNS. This information could help guide farmers in placing less abrasive flooring systems in feedlots.