Tooth wear in goats fed diets of different abrasiveness for half a year

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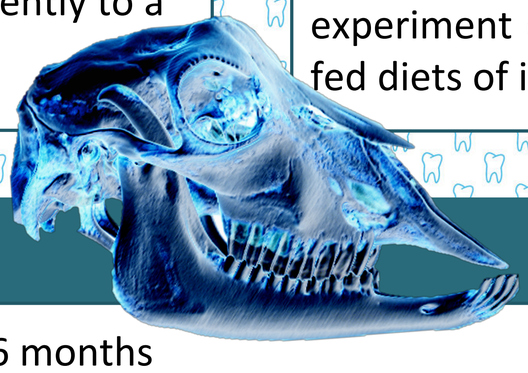
Objectives

- What are the different evolutionary pressures created by phytoliths and grit on tooth height?
- How long does dietary signal take to develop at the macroscopic level?
- How do tooth crown and roots react independently to a highly abrasive diet?

Introduction

In herbivores' natural diets, the main abrasive factors contributing to tooth wear are phytoliths (plant silicates) and grit (Fortelius and Solounias, 2000). However, the different aspects in which they impact tooth wear and the timeframe a wear signature takes to develop, still remain unexplored. The effect of intrinsic (phytoliths) and extrinsic (grit) abrasives was investigated in goat teeth during a controlled feeding experiment over a 6 month period, where four groups were fed diets of increasing abrasiveness.



Material and Methods

- Model species: 28 ♀ goats (ruminant) fed for 6 months
- 4 diet groups of increasing abrasiveness: lucerne (L), grass (G), grass/rice husks (GR), grace/rice husks/sand (GRS)
- CT scans at beginning and end of experiment to observe wear development over time
- Mesowear (tooth profile) & tooth volume analysis on skulls and 3D renderings

Results

Comparing diet groups showed no significant mesowear effect after 6 months. However, when assessing the difference in mesowear signal between the first and last CT (Fig. 1), groups GR and GRS showed higher wear than L and G. Surprisingly, GRS did not create the most wear. A feeding period longer than 6 months is therefore deemed necessary for clear development of a mesowear signal.
During volume analysis, significant differences in crown loss appeared between L/G and GR/GRS. Furthermore, a significant, positive correlation between crown volume loss and root volume gain (Fig. 2) was noted; a surprising finding for adult animals. This growth could be attributed to cementum deposition, attenuating wear caused by abrasive diets.

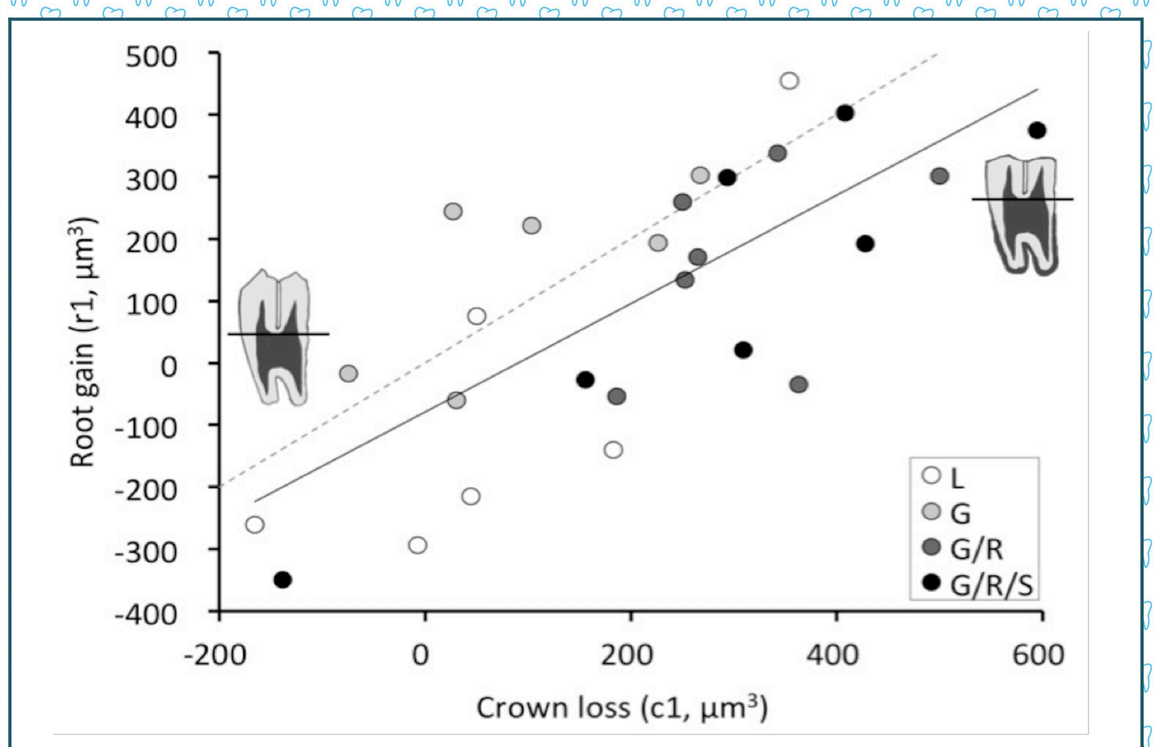


Figure 2: Relationship between crown tissue-loss (wear) and root tissue-gain (growth) of the upper secondary molar in adult goats. As indicated by tooth symbols: the more crown is worn away, the more cementum is deposited on the roots.

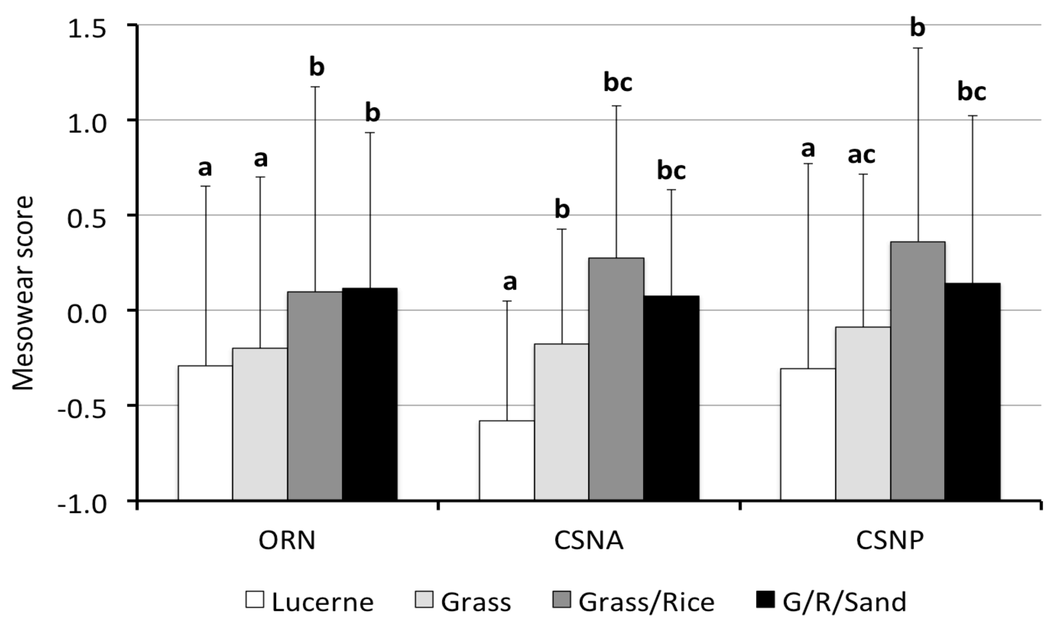


Figure 1: Averaged score difference between the initial and final CT scan for all molars. Each diet is represented according to the three mesowear scoring parameters: occlusal relief (OR), anterior cusp shape (CSA) and posterior cusp shape (CSP). Letters above error bars represent significance between diets, within groups. A negative difference indicates that OR became higher, and CS sharper, during the experiment.

Conclusions

- Mesowear develops slowly, it is probably more of a lifetime signal
- Surprisingly, no grit-effect for GRS. It could be washed off in the rumen
- Feedback mechanism counters crown wear by inducing root growth

References and additional information

Clinic of Zoo Animals, Exotic Pets and Wildlife
vetsuisse-fakultät
FNSNF Swiss National Science Foundation
University of Zurich[UZH]

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