



Dentine Without Borders: An improved dental macrowear scoring method with cross-cultural application



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Introduction

Teeth are the only aspect of the skeletal system to directly interact with the environment. Enamel, unlike bone, does not remodel over one's lifetime—once wear begins, it cannot be reversed. Therefore, the degree and extent of dental wear at the time of death is the cumulative result of varying processes acting on the intra-oral environment: attrition, abrasion, and erosion. Examination of dental wear pattern differences may elucidate lifestyle or behavior differences within and between populations [1,2,6,8].

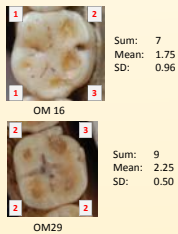
Old Problems

Theoretical:

Dental wear scoring techniques are often based on a target population (e.g. [4-8]). These resulting methodologies, particularly the visual aids, are inherently population specific.

Analytical:

Traditional methods attempt to characterize patterns of wear [4,5] or sum quadrants/tooth scores [7]. This provides an easy to compare metric, yet may mask individual differences.

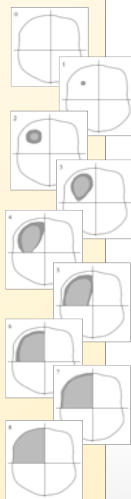


Reporting:

Most methods do not suggest a standard way of reporting information on dental wear. Often, it is presented in a tabular or list format that may be difficult to detect patterns or outliers.

New Solutions

To avoid bias introduced from a target population, Lagan 2017 [3] derived hypothetical wear stages based on progressive dentine exposure.



Under Lagan 2017, the mean and standard deviation of quadrants are calculated for each tooth. This two-part metric conveys more information without sacrificing speed.

MolWear provides a simple interface to create and manage projects, record data, and visualize results. Key information (Mean, SD) is summarized and reported graphically, allowing differences to be appreciated at a glance.

Materials & Methods

Left and Right mandibular molars of two populations were observed, and data collected using MolWear.

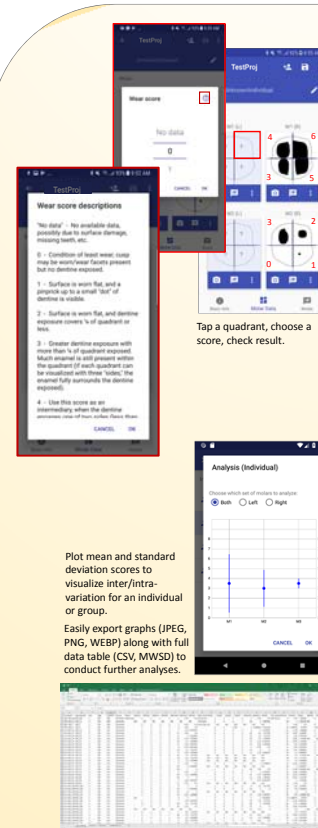
Lagan 2017 proposed a modification to the Scott 1979 method which addressed many of the above problems of scoring dental wear.

- 1. Native American remains (n=30) from the Fort Ancient culture (11th – 14th C.).
- 2. European remains (n=60) from 12th – 16th C. Denmark.

Score	Description	Dentine Exposed
0	No dentine exposure, cusp may be worn flat	< 0%
1	"Pinprick" to small dot	< 1%
2	Moderate dentine patch	1-24%
3	Large dentine patch, likely still surrounded on all sides by enamel	25-50%
4	Some inter-quadrant coalescence	35-65%
5	Extreme inter-quadrant coalescence	60-75%
6	Thick enamel ring	60-84%
7	Thin enamel ring	85-99%
8	Full dentine exposure	100%

Teeth are scored by quadrant based on the amount of dentine exposed. Visual aids provide an idea of how these grades might typically present.

Once each quadrant is scored, the mean and standard deviation for each tooth are calculated and used to assess overall wear, as well as differences in wear patterns.



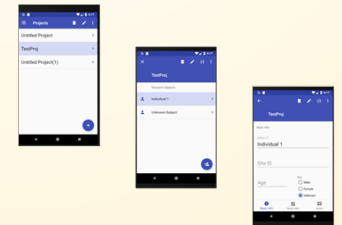
Tap a quadrant, choose a score, check result.

Plot mean and standard deviation scores to visualize inter/intra-variation for an individual or group. Easily export graphs (JPEG, PNG, WEBP) along with full data table (CSV, MWS/SD) to conduct further analyses.



MolWear

MolWear provides immediate visual feedback to help guide scoring; the tooth outline changes to reflect the assigned score. Full text written descriptions are easily available, if needed for reference.



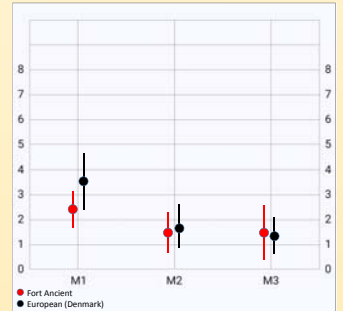
Results: Observer Error

Observer error was evaluated via t-Test and the non-parametric equivalent, Wilcoxon Rank Sum. Neither statistic found significant differences within or between observers.

Direct quadrant-by-quadrant comparison further support the utility of this method as no grade difference was found within or between observers for the majority of scores. Differences that did occur were random and infrequent.

	0	1	2
Inter-	85.3%	12.7%	2.0%
Intra-	86.5%	10.9%	2.5%

Mean(+SD) Wear Grade by Tooth

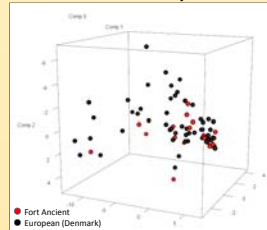


Results: Inter-Population

To compare populations, mean and standard deviation of wear grades were plotted by tooth. Univariate parametric and non-parametric testing was used to evaluate significance.

Multivariate Principle Components Analysis was then used to further explore and appreciate differences within and between groups.

PCA of Wear Grade by Individual



	t-Test	Wilcoxon
M1 AVG	0.02	0.09
M1 SD	N/S	N/S
M2 AVG	N/S	N/S
M2 SD	N/S	N/S
M3 AVG	N/S	N/S
M3 SD	N/S	N/S

In this study, only M1 Averages showed significant (and near significant) differences from univariate testing. Qualitative observations support the idea that both populations displayed similar wear.

PC 1 accounts for >70% of the variance and corresponds to overall degree of wear. Subsequent components relate to direction and asymmetry of wear.

Acknowledgements

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