

THE SCIENTIFIC VALUE OF USING A 3D SURFACE SCANNER TO QUANTIFY ENTHESES

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INTRODUCTION

e.g. Peterson 1994 & 2000, Robb 1998, Stirland 1998,
Knüsel 2000, Weiss 2003 & 2004, Mariotti *et.al.* 2004,
Henderson & Gallant 2006, Villotte 2006,...

Hawkey & Merbs 1995

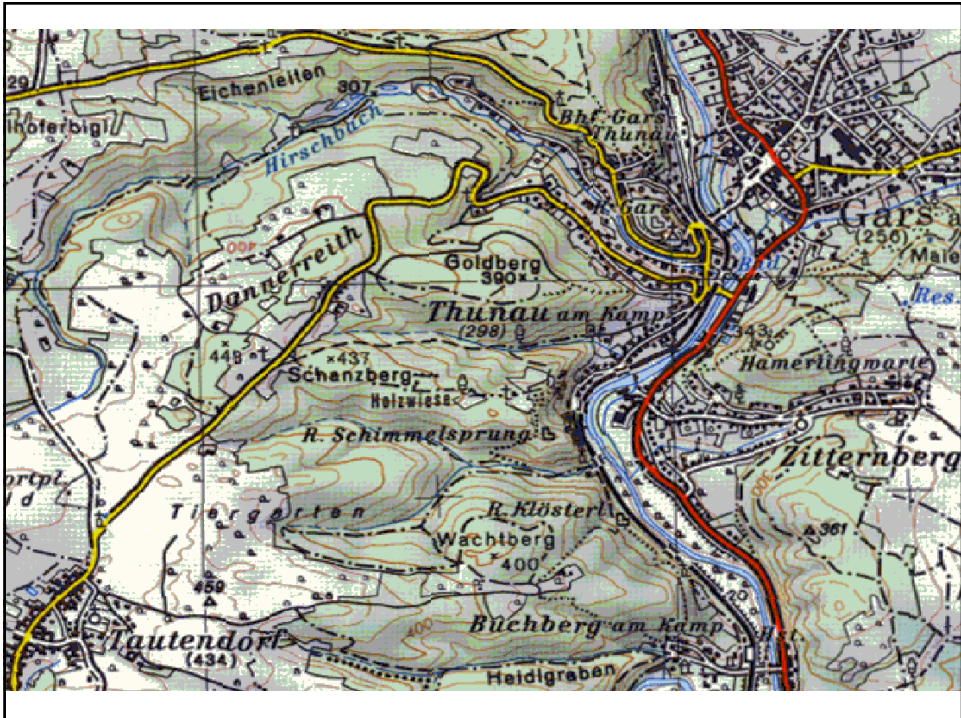
MATERIAL & METHODS

approach using a 3D method to quantify differences in enthesis size, surface roughness as well as surface “information content”

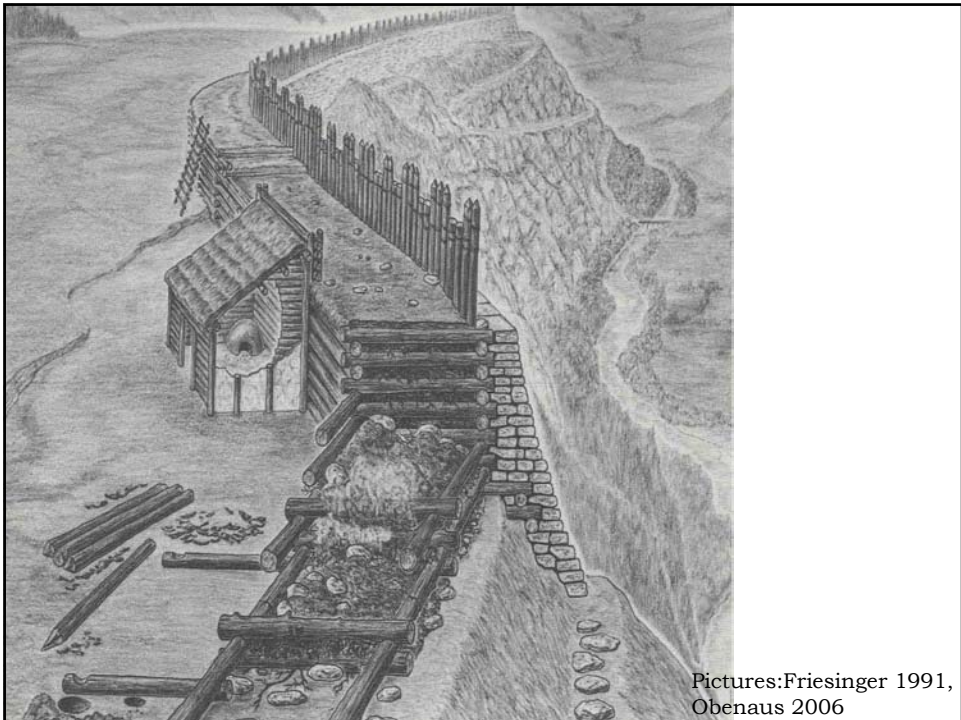
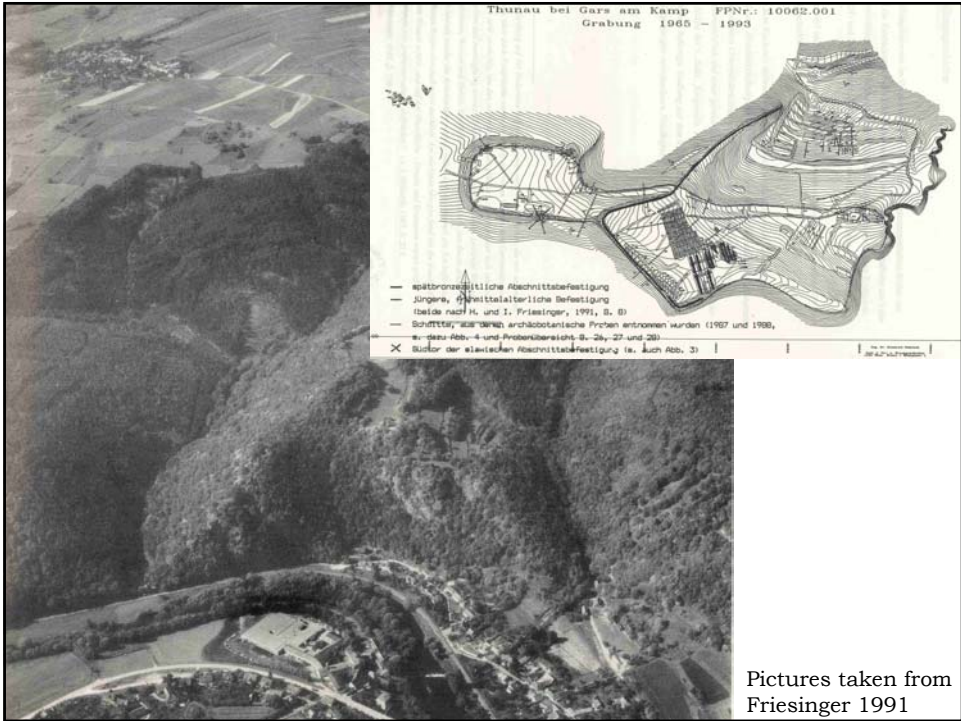
subsample of 21 individuals that span the variability of muscle mark development from faint to strong

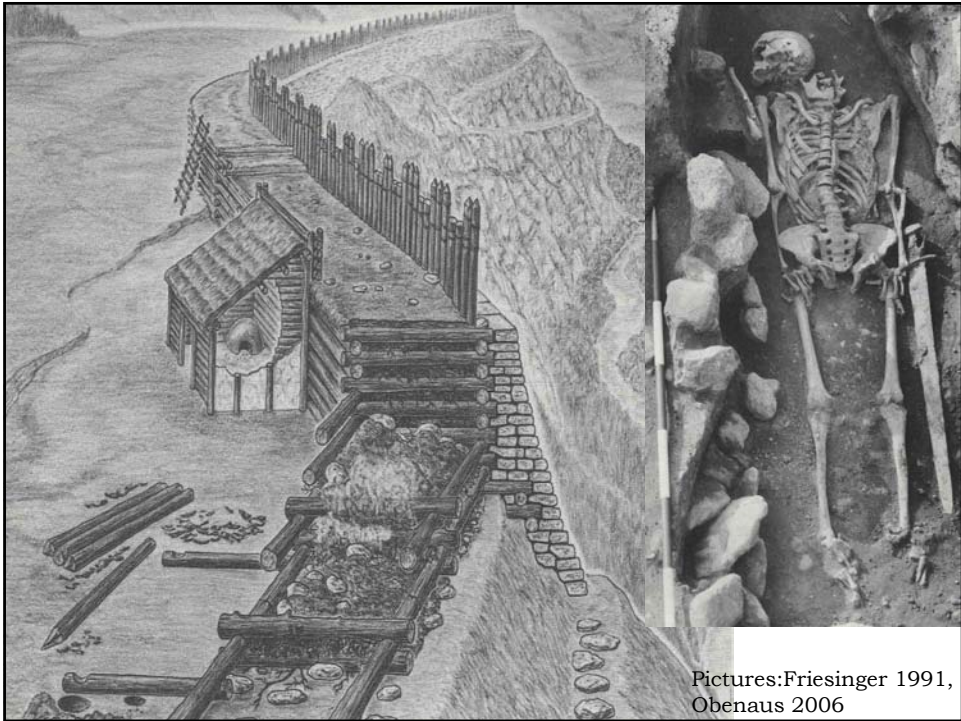
skeletons excavated in Thunau/Gars am Kamp, Lower Austria, a fortification with graveyard and settlement (early medieval)



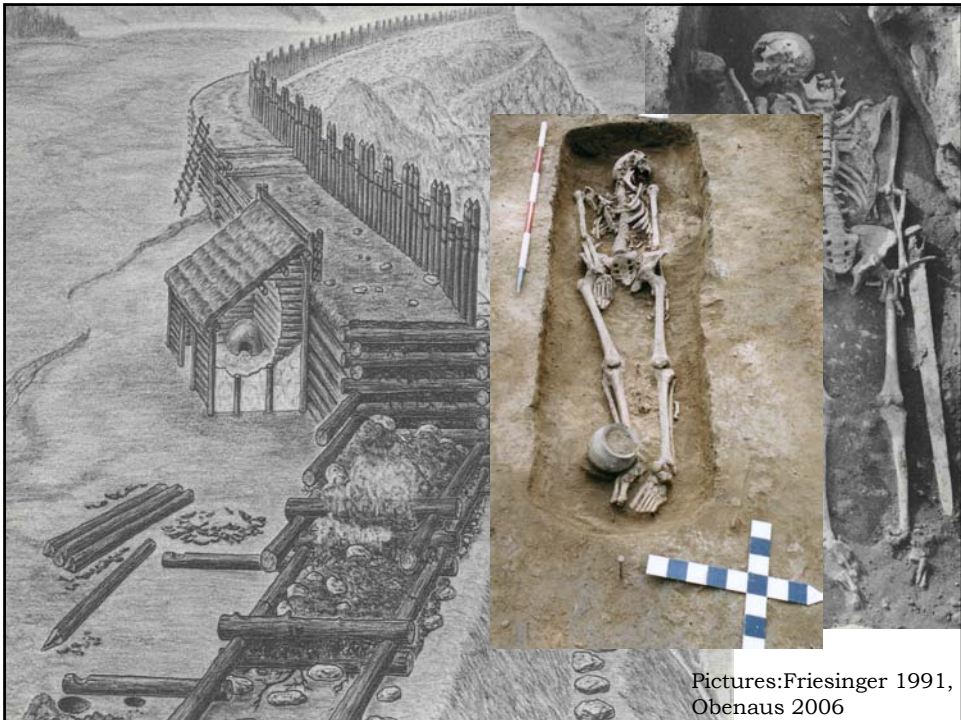


Pictures taken from Friesinger 1991





Pictures:Friesinger 1991,
Obenaus 2006



Pictures:Friesinger 1991,
Obenaus 2006

M. pectoralis major



PROCEDURE



Breuckmann
optotopometric
scanner

Breuckmann TriTOS
Sensor L39/060

<http://www.breuckmann.com/>



PROCEDURE

different views of muscle marks scanned

scanning takes about 1h for each muscle mark

resolution of composite model is better than 20μ ,
consisting of about 1.5 and 3 million points

models converted into .stl file

data exported into Rapidform 2006 (Inus Technology Inc., 2006)

METHOD

*3D/2D surface areas and perimeters

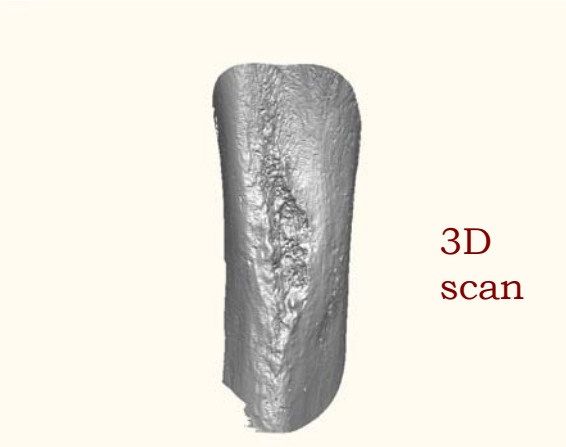
*Surface complexity measures

*Planarity statistics

3D SURFACE AREAS



Right humerus, site of *M. pectoralis major*



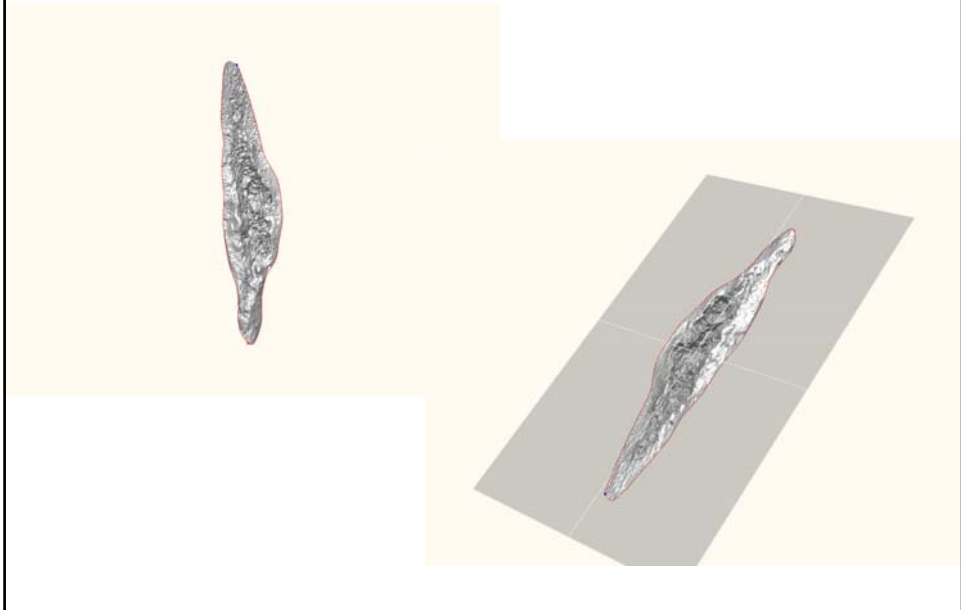
3D
scan

3D SURFACE AREAS & PERIMETERS

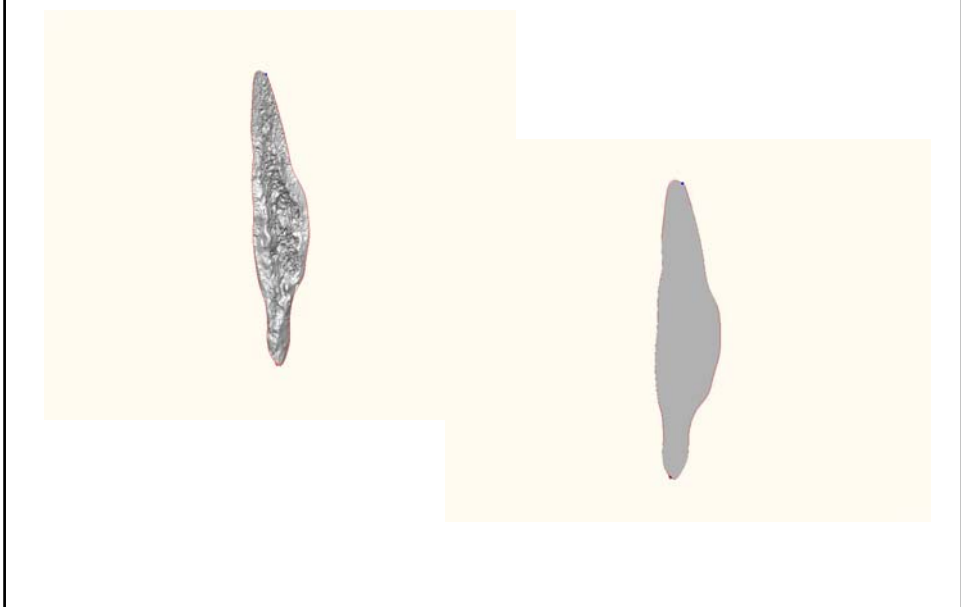
delimitation of *M. pectoralis major* area



2 D SURFACE AREAS & PERIMETERS



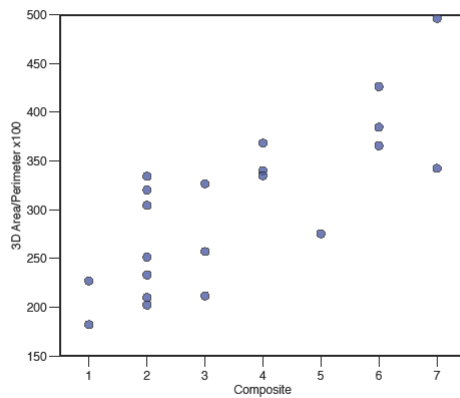
2 D SURFACE AREAS & PERIMETERS



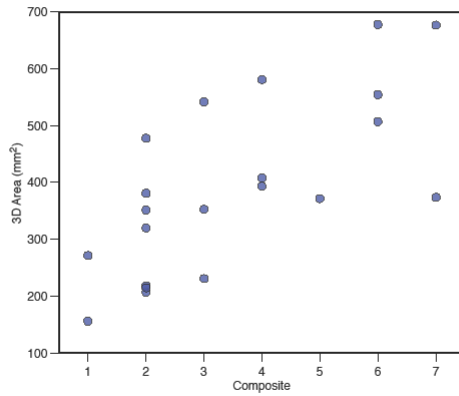
SURFACE AREAS & PERIMETERS

- * three dimensional surface area of the enthesis
- * two dimensional area of the enthesis
- * length of the 3D nurbs curve enclosing the enthesis (3D perimeter)
- * length of the projected curve (2D perimeter)

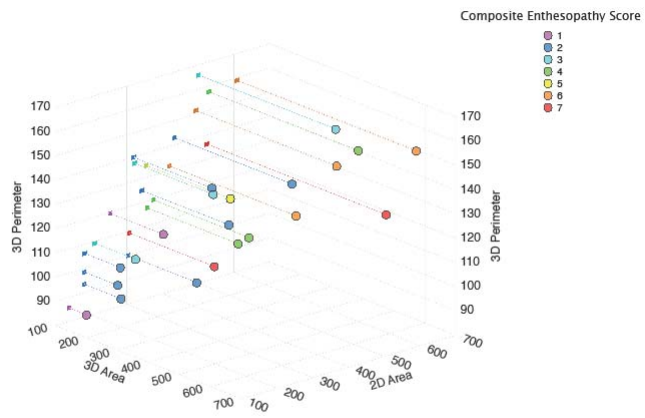
3 D AREAS & PERIMETERS



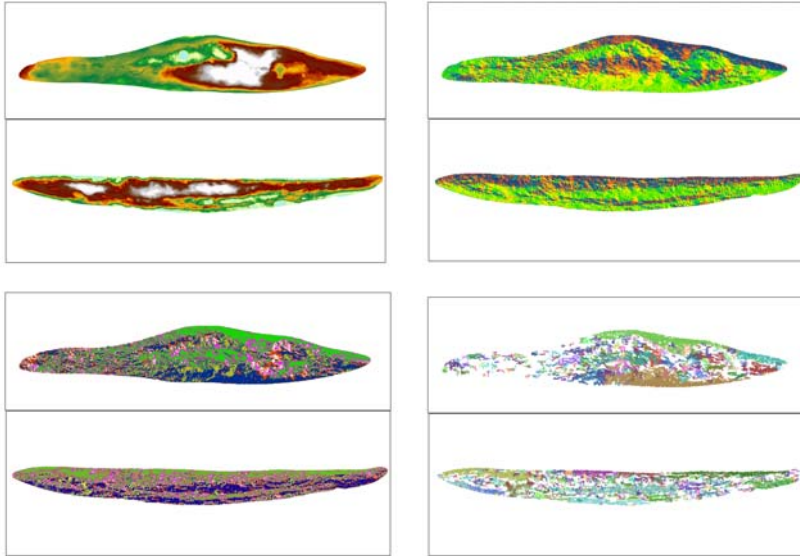
SURFACE AREAS & PERIMETERS



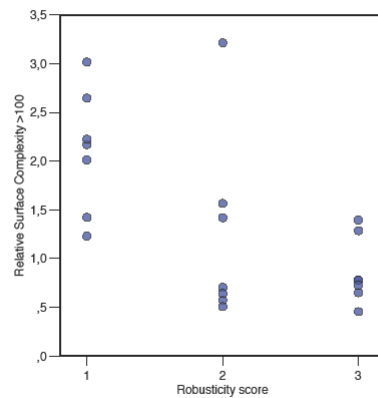
3D PERIMETER & AREAS



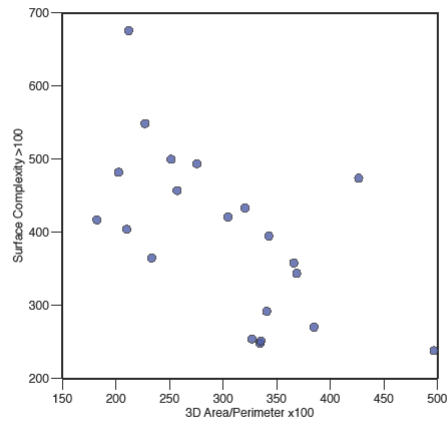
SURFACE COMPLEXITY MEASURES



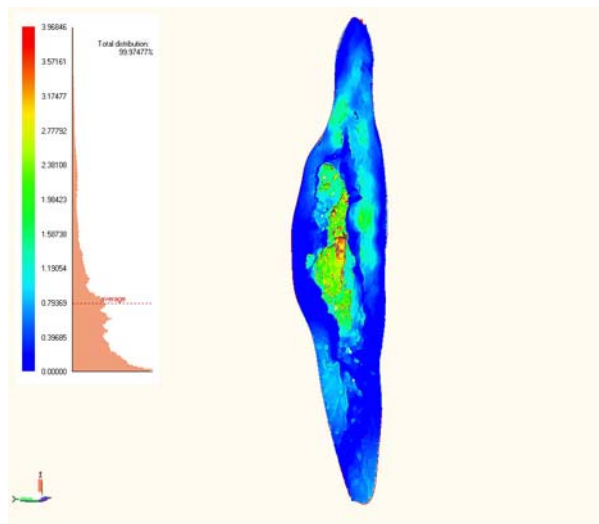
SURFACE COMPLEXITY MEASURES



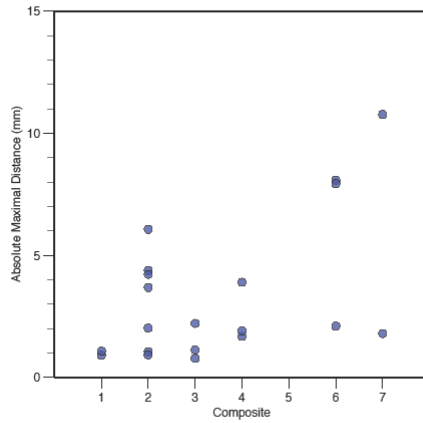
SURFACE AREAS & PERIMETERS



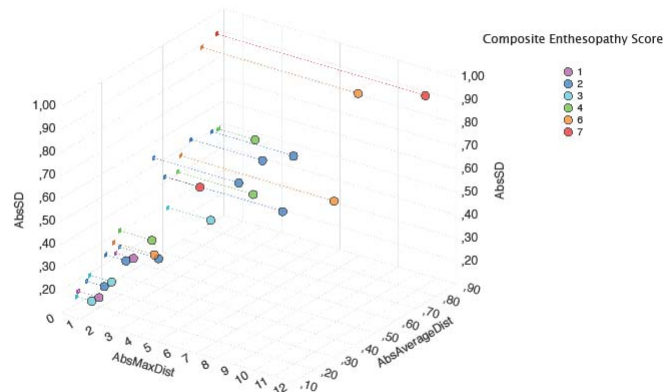
PLANARITY STATISTICS



SURFACE AREAS & DISTANCES



PLANARITY STATISTICS



SUMMARY & CONCLUSION

more expressed entheses have higher 2D & 3D area

3D surface area is strongly correlated with composite enthesopathy score (CES)

RSC is negatively correlated with robusticity & CES due to measuring small scale changes in surface orientation

max. deviation from plane correlated with high CES

DISCUSSION & CONCLUSION

- scanners with good resolution still expensive
- relatively large data sets
- + resolution of more than 20μ
- + surface features of muscle insertions better visible than on original specimen
- + delimitation of insertions more easy
- + results reproducible, 3D data available in case of reburial of skeletons
- + possibly method can be used for creating standards for quantification in future

SELECTED LITERATURE

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ACKNOWLEDGEMENTS

The authors want to thank the University of Coimbra and especially AL Santos for organising this workshop and DP for the invitation and for covering travel costs inside Portugal. For data collection, DP was supported by the Austrian Academy of Sciences.

BV was financed by the grant GZ200.093/1-VI/2004 from the Austrian Council for Science and Technology (PI H. Seidler)

All authors want to thank F. Novotny, M. Spannagl, K. Wiltschke-Schrotta for providing biological information of the skeletons from Thunau/Gars am Kamp, and H. Friesinger, E. Szameit and M. Obenaus for providing archaeological information.

DP & BV would further like to thank M. Coquerelle, M. Kucera, P. Mitteröcker, T. Pfisterer, K. Schäfer, H. Seidler, A. Stadlmayr and L. Viola for discussions and general support.