Experimental determinations of butcher experience using cutmark patterning

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INTRODUCTION

The evolution of hominin brain and body size is often associated with the increasingly carnivorous diet of early *Homo*. Cutmarks are a direct link to this behavior and have been emphasized in interpretations of the FLK 22 *Zinjanthropus* site (Pante et al., 2012; Dominguez-Rodrigo, 1997). However, the potential for linking cutmarks to the behavior and ecology of carcass consumption is currently limited due to our poor understanding of cutmark patterning, specifically the frequencies and distributions of cutmarks over larger mammal skeletons.

This study employs controlled experiments to investigate the effect of butcher skill, as measured by experience, on the frequency and distribution of cutmarks across cervid limb bones. Cutmark patterns were analyzed using the Density and Analyzing Patterns toolsets within ArcGIS following the protocol established by Parkinson (2013). The results have implications for researcher's choices of analogous participants in simulations of early hominin butchery and may assist in identifying the evolution of controlled and refined tool use through the archaeological record.

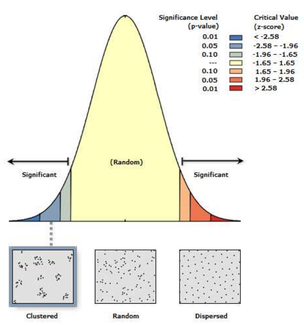
METHODS

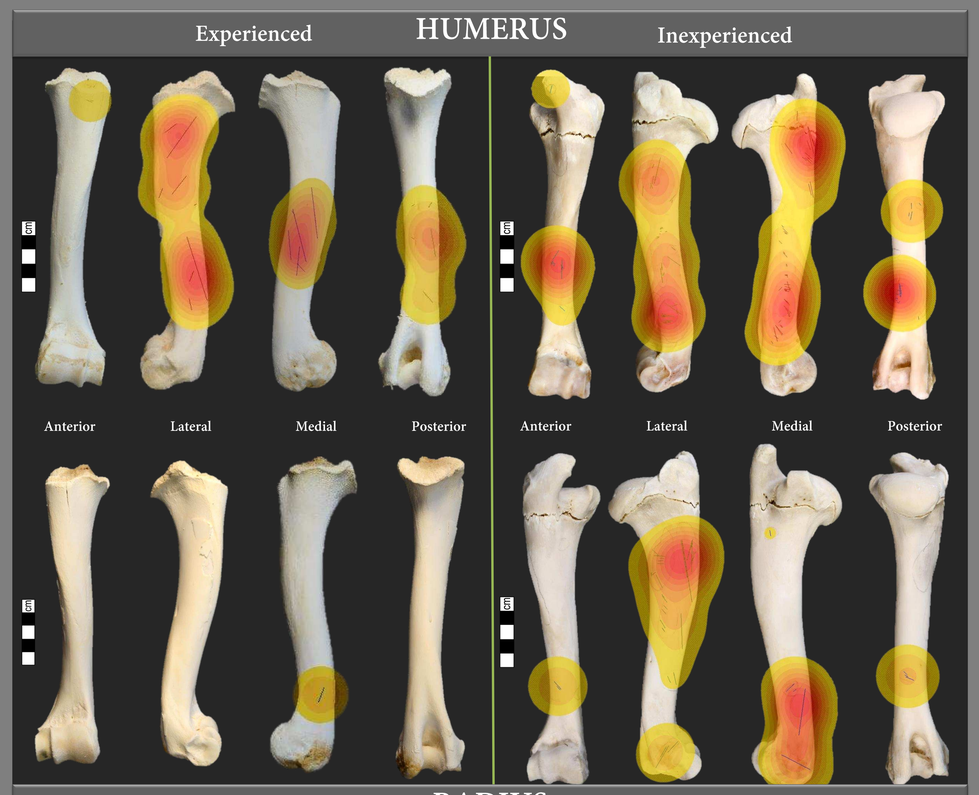
Experimental butchery:

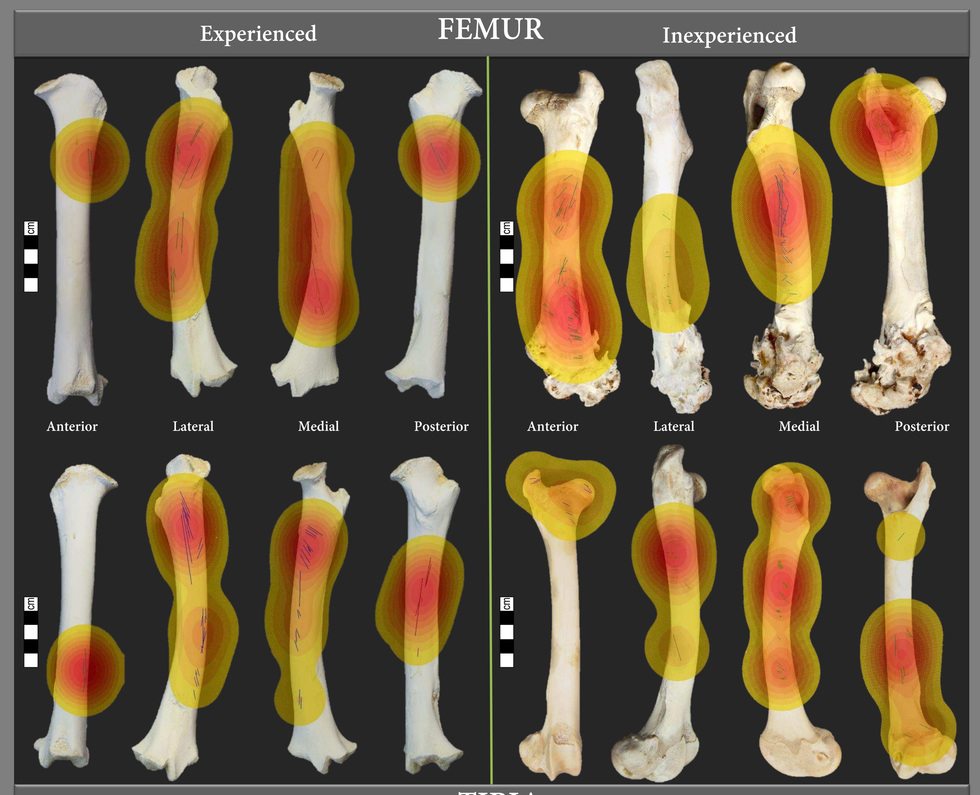
- Two controlled butchery experiments were conducted, for which forelimbs and hind limbs from complete mule deer (*Odocoileus hemionus)* were processed.
- Prior to the experiments, limbs were disarticulated from the thorax and skinned using a metal knife taking care to not leave cutmarks.
- The butcher for the first butchery experiment was an experienced game hunter that regularly processes his kills for consumption. The butchers for the second experiment had never butchered a carcass.
- Each individual was provided with a collection of obsidian and chert stone flakes that could be discarded, replaced, and/or reused at any time.
- Participants were not provided instructions on how to butcher or when to stop.
- KRW removed remaining soft tissue following the protocol of Mairs et al. (2004).

*Cutmark identification and analysis (*All analyses carried out by KRW):

- Cutmarks were identified with the aid of a strong oblique light source and 10x magnification (as described by Blumenschine et al., 1996).
- Each segment of the bones was photographed and cutmarks were traced within Adobe Photoshop CS6.
- Images were imported to ArcGIS(10.2) and the outline of the bones and individual cutmarks were converted to vectors.
- The Average Nearest Neighbor and Kernel Density tools within ArcGIS were used to identify cutmark cluster patterns following Parkinson's (2013) use of the same tools for tooth mark patterning.







RESULTS

Experienced

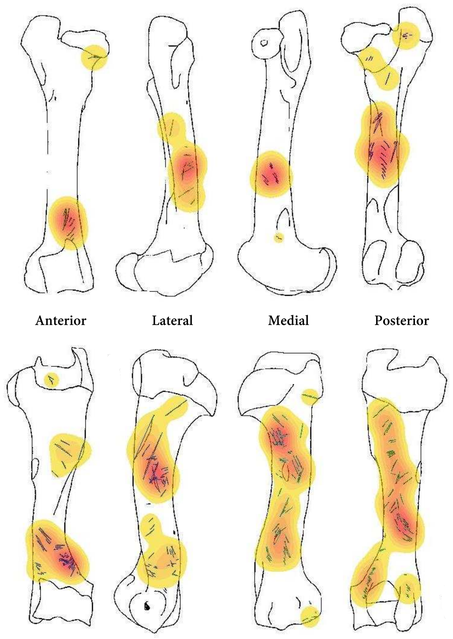
Side	Element	Aspect	NNI	p-value	# cm	Pattern
left	humerus	anterior	0.06	<.01	4	clustered
left	humerus	lateral	0.54	0.03	6	clustered
left	humerus	medial	0.78	0.24	8	random
left	humerus	posterior	0.94	0.8	5	random
right	humerus	anterior	n/a	n/a	0	n/a
right	humerus	lateral	n/a	n/a	0	n/a
right	humerus	medial	n/a	n/a	0	n/a
right	humerus	posterior	n/a	n/a	0	n/a
left	radius	anterior	0.05	0.01	2	clustered
left	radius	lateral	n/a	n/a	0	n/a
left	radius	medial	n/a	n/a	0	n/a
left	radius	posterior	n/a	n/a	0	n/a
right	radius	anterior	n/a	n/a	0	n/a
right	radius	lateral	n/a	n/a	0	n/a
right	radius	medial	n/a	n/a	0	n/a
right	radius	posterior	n/a	n/a	0	n/a
left	femur	anterior	0.14	0.02	2	clustered
left	femur	lateral	0.28	<.01	11	clustered
left	femur	medial	0.69	0.08	9	random
left	femur	posterior	0.18	0.01	3	clustered
right	femur	anterior	0.31	0.01	4	clustered
right	femur	lateral	0.43	<.01	24	clustered
right	femur	medial	0.36	<.01	19	clustered
right	femur	posterior	0.42	0.01	6	clustered
left	tibia	anterior	0.11	<.01	9	clustered
left	tibia	lateral	0.17	<.01	6	clustered
left	tibia	medial	n/a	n/a	0	n/a
left	tibia	posterior	0.28	<.01	25	clustered
right	tibia	anterior	0.1	<.01	9	clustered
right	tibia	lateral	0.05	<.01	4	clustered
right	tibia	medial	n/a	n/a	1	n/a
right	tibia	posterior	0.27	<.01	25	clustered

Inexperienced

Side	Element	Aspect	NNI	p-value	# cm	Pattern
left	humerus	anterior	1.25	0.14	9	random
left	humerus	lateral	0.34	<.01	37	clustered
left	humerus	medial	0.35	<.01	48	clustered
left	humerus	posterior	0.26	<.01	20	clustered
right	humerus	anterior	0.07	0.01	2	clustered
right	humerus	lateral	0.42	<.01	31	clustered
right	humerus	medial	1.63	0.01	5	dispersed
right	humerus	posterior	0.06	<.01	3	clustered
left	radius	anterior	0.59	<.01	13	clustered
left	radius	lateral	n/a	n/a	0	n/a
left	radius	medial	0.85	0.11	30	random
left	radius	posterior	0.68	0.29	3	random
right	radius	anterior	1.34	0.08	7	dispersed
right	radius	lateral	3.37	<.01	3	clustered
right	radius	medial	0.28	<.01	14	clustered
right	radius	posterior	0.27	<.01	6	clustered
left	femur	anterior	0.36	<.01	41	clustered
left	femur	lateral	0.35	<.01	11	clustered
left	femur	medial	0.37	<.01	34	clustered
left	femur	posterior	0.25	<.01	12	clustered
right	femur	anterior	0.29	<.01	10	clustered
right	femur	lateral	0.41	<.01	23	clustered
right	femur	medial	0.26	<.01	37	clustered
right	femur	posterior	0.95	0.78	11	random
left	tibia	anterior	2.54	<.01	4	dispersed
left	tibia	lateral	0.57	<.01	18	clustered
left	tibia	medial	0.46	<.01	34	clustered
left	tibia	posterior	0.13	<.01	9	clustered
right	tibia	anterior	n/a	n/a	1	n/a
right	tibia	lateral	0.78	0.04	24	clustered
right	tibia	medial	0.13	<.01	16	clustered
right	tibia	posterior	0.38	<.01	6	clustered

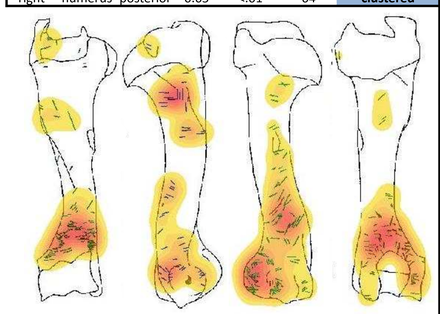
ARCHAEOLOGICAL APPLICATION: FLK 22 *Zinjanthropus* Level

FLK *22* cutmark clustering (from Bunn 2001)



FLK *22* (Left and Below)

Side	Element	Aspect	NNI	p-value	#cm	Pattern
right	femur	anterior	0.21	<.01	11	clustered
right	femur	lateral	0.36	<.01	12	clustered
right	femur	medial	0.13	<.01	14	clustered
right	femur	posterior	0.43	<.01	28	clustered
left	humerus	anterior	0.38	<.01	48	clustered
left	humerus	lateral	0.56	<.01	48	clustered
left	humerus	medial	0.58	<.01	64	clustered
left	humerus	posterior	0.44	<.01	67	clustered
right	humerus	anterior	0.68	<.01	88	clustered
right	humerus	lateral	0.59	<.01	49	clustered
right	humerus	medial	0.51	<.01	93	clustered
right	humerus	posterior	0.65	<.01	64	clustered



DISCUSSION AND CONCLUSIONS

Experienced Butcher:

- Lower cutmark frequencies.
- More clustering.
- Cutmarks cluster near anatomical features associated with muscle attachments.

Inexperienced Butcher:

- Higher cutmark frequencies.
- Cutmarks are more often dispersed or random.
- Cutmark clusters are distributed randomly over larger areas and not limited to anatomical locations associated with muscle attachments.

Archaeological Application:

- Cutmark frequency for the FLK 22 assemblage (presented by Bunn, 2001) more closely resembles the experienced butcher; however, there are cutmark clusters distributed in areas only seen in the inexperienced sample. These marks may have been inflicted during skinning and/or disarticulation, which were not simulated by these experiments.
- A larger experimental sample is needed to draw more definitive conclusions from the archaeological samples, but the method holds potential to shed light on the skill of prehistoric butchers.

Acknowledgements

We'd like to thank the Colorado Division of Wildlife and Michael Brydge for the procurement of specimens. We are grateful to Sayat Temirbekov and Jennifer Parkinson for their help with ArcGIS. KRW's participation was made possible by funding through the Anthropology Graduate Student Society, Colorado State University. KRW is grateful to Josh Shaughnessy, Jonathan Fanning, Aaron Whittenburg, and Kaitlyn Simcox for their encouragement, friendship, and ideas throughout this research project. KRW would like to thank Leslie Welch for her unfailing support.

References Cited

- Blumenschine, Robert J., Curtis W. Marean, and Salvatore. D. Capaldo. "Blind Tests of Inter-analyst Correspondence and Accuracy in the Identification of Cut Marks, Percussion Marks, and Carnivore Tooth Marks on Bone Surfaces." *Journal of Archaeological Science* 23 (1996): 493-507.
- Bunn, H.T. 2001. Hunting, power scavenging, and butchering by Hadza foragers and by Plio-Pleistocene *Homo*. In *Meat-eating and Human Evolution*, edited by C. Stanford and H.T. Bunn, pp 199-218. Oxford University Press, Oxford.
- Dominguez-Rodrigo, Manuel. "Meat-eating by Early Hominids at the FLK 22 *Zinjanthropus* Site, Olduvai Gorge, Tanzania: An Experimental Approach Using Cut-mark Data." *Journal of Human Evolution* 33 (1997): 669-90.
- Mairs, S., Swift, B., Rutty, G.N. "Detergent: an alternative approach to traditional bone cleaning methods for forensic practice." *American Journal of Forensic Medicine & Pathology* 25 (2004) 276-284.
- Pante, Michael C., Robert J. Blumenschine, Salvatore D. Capaldo, and Robert S. Scott. "Validation of Bone Surface Modification Models for Inferring Hominin and Carnivore Feeding Interactions, with Reapplication to FLK 22, Olduvai Gorge, Tanzania." *Journal of Human Evolution* 63 (2012): 395-407.
- Parkinson, Jennifer A. "A GIS Image Analysis Approach to Documenting Oldowan Hominin Carcass Acquisition: Evidence from Kanjera South, FLK Zinj, and Neotaphonomic Models of Carnivore Bone Destruction." Diss. City University of New York, 2013.