Investigating Early Human and Neanderthal Tool Use: Edge Damage Distribution on Stone Tools Used for Piercing Tasks

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Introduction

Studying how stone tools were used in the past provides insight into technological adaptations, responses to changing environments, and behavioural differences between species and populations of the genus *Homo* (Hardy, 2004; Schoville et al., 2010, 2016; Schoville & Brown, 2010; Wilkins et al., 2012). One method developed by Bird et al. (2007) and expanded on by Schoville et al. (2010, 2016; Schoville & Brown, 2010; Wilkins et al., 2012) used to assess stone tool function is edge damage distribution analysis. Their method maps the location of wear along the edges of tools and quantitatively compares experimentally obtained distributions to distributions from archaeological assemblages. A critique that has been leveraged against the edge damage distribution approach (Rots & Plisson, 2014; Werner & Willoughby, 2018) is that previous experimental work has not explored tools used for drilling, piercing or perforating, despite their potential to exhibit similar damage traces as those documented in hunting weapons (spear tips) due to the functions having the impact concentrated on the tip of the point. Here, we carry out an experiment to test the hypothesis that stone tool functional use for piercing tasks and as spear tips result in similar edge damage distributions.

Methods

Pre-use: A total of 15 stone tools made from either Texas chert or heat-treated Keokuk chert were selected for use based on the presence of a point and a platform and labelled E1-E15. Each stone tool was photographed on a 10x10cm grid on both the ventral and dorsal sides and the tools were then examined, and any pre-use edge damage was noted and recorded on sketches.

Use experiments: The point of each stone tool (E1-E15) was used to pierce leather using indirect percussion with a pine baton (Figure 1). *Bos taurus* short rib (Figure 1) was placed behind the leather during perforation to serve as a punch board after Doyon et al. (2023). Each tool was sequentially implemented to produce punctures (Figure 1) until it became ineffective or the maximum of 30 perforations was reached.

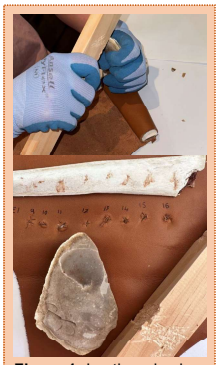

Figure 1: Leather piercing

Post-use: The stone tools were photographed again on a 10x10cm grid on both the ventral and dorsal sides with the platform oriented down and the point bisecting the vertical midline of the grid. The images were then used in ArcGIS version 10.6.1 to map the distribution of damage along the edges of each stone tool (Figure 2) following the protocol described by Schoville (2010; Schoville & Brown, 2010; Wilkins et al., 2012).

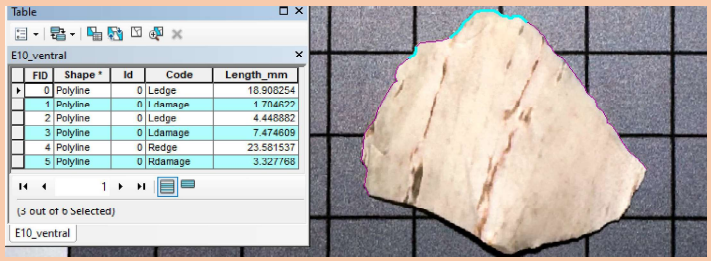

Figure 2: ArcGIS map and table of E10 ventral showing the areas of edge with damage in blue

The edge damage data from the table seen in Figure 2 was then exported, and statistical analyses were performed, including two-sample Kolmogorov-Smirnov tests (*D*, Kolmogorov-Smirnov statistic) in Excel and a Fisher's exact test in an online, open-access statistics program (quickcalcs.com).

Results

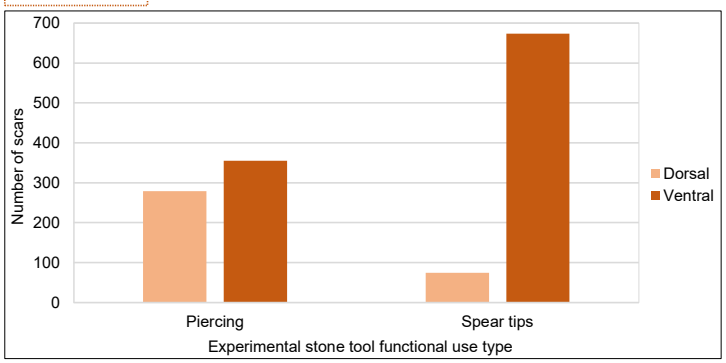

Figure 3: Comparison of the number of scars (amount of damage) on the ventral and dorsal surfaces for experimental tools used for piercing and as spear tips. Overall, experimental tools used for piercing and as spear tips (Wilkins et al., 2012) exhibit more damage on the ventral surface. However, a Fischer's Exact test determined that piercing tools and spear tips are extremely significantly different from one another with a $p < 0.0001$.

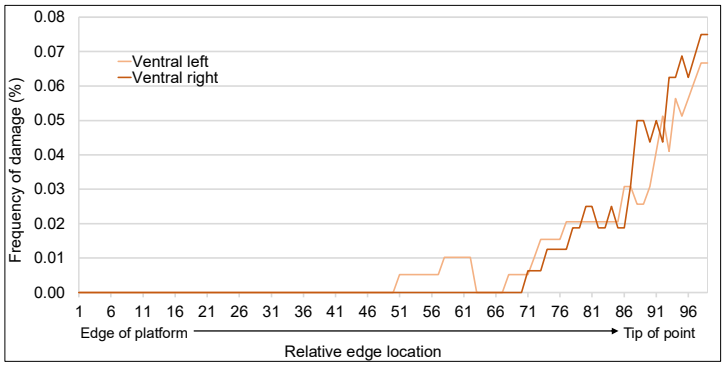

Figure 4: Comparison of left and right ventral edge damage distributions for experimental piercing tools. For experimental piercing tools the ventral left and right edges do not have statistically different damage distributions ($D_{max} = 0.145$, $D_{obs} = 0.139$, $p > 0.05$), which is consistent with spear distributions (Wilkins et al., 2012).

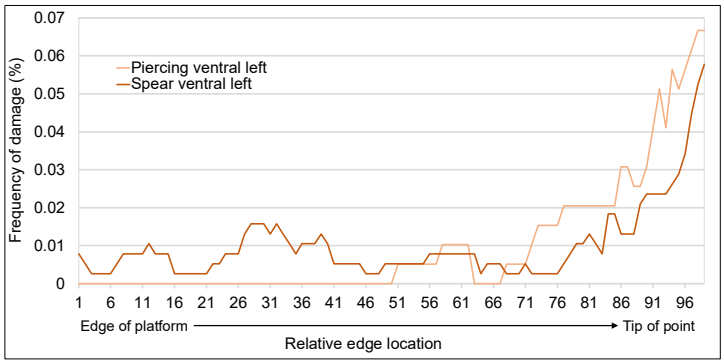

Figure 5: Comparison of left ventral edge damage distributions for experimental piercing tools and experimental spear tips. The left ventral edges of experimental piercing tools and experimental spear tips (Wilkins et al., 2012) have statistically different damage distributions ($D_{max} = 0.120$, $D_{obs} = 0.385$, $p < 0.05$).

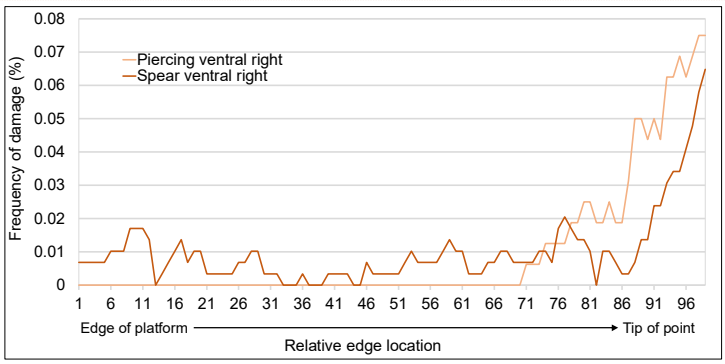

Figure 6: Comparison of right ventral edge damage distributions for experimental piercing tools and experimental spear tips. The right ventral edges of experimental piercing tools and experimental spear tips (Wilkins et al., 2012) have statistically different damage distributions ($D_{max} = 0.134$, $D_{obs} = 0.450$, $p < 0.05$).

Conclusion

The results do not support the hypothesis that stone tools used for piercing tasks have similar distributions to stone tools used as spear tips. While one characteristic of piercing tools resembles spear tips (ventral left and right distributions), other aspects differ. For piercing tools, damage is more equally distributed between the dorsal and ventral surfaces, and the tip damage extends more invasively down the edge of the tool. This distribution is significantly different from spear tips, based on a comparison with the published results of Wilkins et al. (2012). Here, we provide novel experimental distributions for piercing tools. The addition of experimental piercing tools to the collection of published stone tool edge damage distributions can contribute to inferences about early modern human and Neanderthal technology, behaviour and responses to environmental change. The limitations of this study include a small sample size, the indirect percussion being uncalibrated, and damage on the platform not being examined. Future research should expand the sample size and make comparisons to edge damage distributions from other experimental stone tool collections and archaeological assemblages. Other avenues to consider include examining ways to control or calibrate the indirect percussion, investigating how to methodologically incorporate damage on the platform, and exploring the implications of handedness and grip on the overall frequency and distribution of damage on stone tools used for piercing tasks.

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