American Antiquity (2025), **90**, 379–386
doi:10.1017/aaq.2024.83

Society for American Archaeology

REPORT

Differentiating Chipped Stone Perforators from Gravers

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(Received 5 June 2024; revised 3 September 2024; accepted 31 October 2024)

Abstract

Chipped stone tools termed perforators and gravers are characterized by projections. Although the implied function of these tool types differs, there are no guidelines for classifying perforators and gravers based on their morphology. Consequently, researchers classify these tools differently, which precludes meaningful comparisons of the frequencies of these types between assemblages. A use-wear study confirmed the hypothesis that specimens with a thin projection and a sharp distal angle often had perforation use wear. Specimens with graver use wear were characterized by a range of projection perimeters and distal angles. We recommend that specimens with a projection perimeter of 20 mm or less and a distal angle of 40 degrees or less be classified as perforators and those with greater dimensions as gravers. This will achieve a consistent classification system for perforators and gravers, although it must be recognized that these type names may not be indicative of the function of individual specimens.

Resumen

Las herramientas de piedra tallada denominadas perforadores y buriles se caracterizan por proyecciones. Aunque la función implícita de este tipo de herramientas es diferente, no hay pautas para la clasificación de perforadores y buriles de acuerdo a su morfología. Por consiguiente, los investigadores difieren en su modo de clasificar estas herramientas, lo cual impide realizar comparaciones significativas de las frecuencias de estos tipos entre conjuntos entre ensamblajes. Realizamos un estudio de desgaste por uso en una muestra de treinta ejemplares que contiene una diversidad de formas y tamaños de proyección. Las muestras con desgaste por uso de perforación se caracterizaban por una proyección delgada y un ángulo distal agudo. Sin embargo, las muestras con desgaste por uso de buril tenían una gama de formas y tamaños, incluidas las similares a los perforadores. A efectos taxonómicos, recomendamos que se utilice el término perforador para las muestras que exhiben un ángulo distal de cuarenta grados o menos y un perímetro de veinte milímetros o menos mientras que las que tengan dimensiones mayores se denominen buriles teniendo en cuenta que esta taxonomía no es indicativa de la función.

Keywords: gravers; perforators; use wear; stone tool typology

Palabras clave: buriles; perforadores; desgaste por uso; taxonomía de herramientas de piedra

This report seeks to clarify current stone tool typology by establishing criteria to differentiate chipped stone perforators from gravers. Augers, awls, becs, bodkins, borers, burins, drills, gimlets, gravers, perforators, piercers, and micro-piercers are all type names applied to specimens that imply their use in perforating, engraving, or drilling (Ahler and McMillan 1976:179; Ballin 2021:46; Bates at al. 2022; Miller and Redmond 2016:165). As Tomášková (2005) observed, lack of consistency in the use of stone tool typology precludes systematic comparison of different assemblages and creates the impression of greater variability in the archaeological record than actually existed.

Although the functions of perforating and engraving differ, there are no widely accepted criteria for distinguishing perforators and gravers, two understudied tool types. Almost 50 years ago, Lynott (1975:123) observed that what is called a perforator in Eurasia and Africa is typically referred to as a graver in the Americas, and this confusion still exists. Both perforators and gravers are characterized by a projection, either in the form of a distal tip or from removal of material along a lateral edge. The projection on gravers is often referred to as a spur or beak (Boen and Williams 2022:16; Maika 2012:4). Because the projection is the portion of the tool involved in perforating and engraving, we discuss the likely morphology of projections for performing these functions. We then examine specimens for use wear to determine whether there is concordance between the expected morphology of projections for perforating or engraving and the actual use of specimens.

The use of tools can be considered a separate question from that of typology (Andrefsky 1998; Odell 1981). Modern ice picks and chisels may be used to perform functions other than those for which they were designed, yet we still refer to them as ice picks and chisels based on the morphology of their tips. However, the morphological difference between chipped stone perforators and gravers as tool types remains undefined. Previous use-wear studies of specimens with chipped stone projections have revealed multiple functions, including engraving with tools classified as perforators and perforation use wear on tools termed gravers (Bates et al. 2022; Kay 2014; Kay and Solecki 2000; Nowak and Wolski 2015; Sørensen 2017; Tomášková 2005; Tomenchuk and Storck 1997; Venditti et al. 2016). Use-wear studies of drills have revealed their frequent function as perforators, but drills typically have a rod-like distal tip that is diamond shaped or bi-convex in cross section, unlike the perforators and gravers in this study (Engelbrecht 2023; Engelbrecht et al. 2023; Miller and Redmond 2016; Smallwood et al. 2020).

The Sample

Excavations at the Eaton site in western New York State yielded 116 chipped stone tools tentatively identified as perforators and gravers. In turning to the literature, we were unable to find a discussion of the difference between these two tool types. When we sought to compare these specimens with others from sites in the Northeast, we found that systematic data were lacking. These deficiencies in the archaeological database prompted the research presented here.

Eaton is a multicomponent site now owned by the Archaeological Conservancy (Figure 1). Its major component is an Iroquoian village dating to the mid-sixteenth century. A total of 257 2 m^2 units were excavated by 17 summer archaeological field schools between 1975 and 2000. All soil was screened using quarter-inch hardware cloth, except for samples from features that were subject to flotation. Hundreds of chipped stone tools, including 81 drills and 115 drill fragments (Engelbrecht 2023; Engelbrecht et al. 2023), and 335,433 pieces of lithic debris were recovered during these excavations. Most of the lithic tools and debris were of Onondaga chert.

The site was plowed from the latter part of the nineteenth century through the mid-twentieth century, and most artifacts were recovered from the plow zone. Post molds delineate the major portions of three Iroquoian longhouses and a portion of a palisade. It is assumed that most stone tools with projections were used during the Iroquoian occupation because the bulk of diagnostic material is Iroquoian.

Of the 116 specimens in this study, 50 were unifacial flakes, six were unifacial blades, 45 were bifaces, and 15 were cores or core fragments. Thirty-three of the bifaces in the sample were damaged or whole projectile points or projectile point preforms that were reworked. Of the 116 specimens, 24 were also morphological scrapers, knives, or both. Five additional specimens that were likely perforators or gravers had a projection or tip snapped off and were not considered in this study. An Access table (available at https://core.tdar.org/dataset/497107/eaton-chipped-stone-perfortors-and-gravers) records the location of every specimen (unit, level, relationship to the longhouses) and various attributes, including maximum length, width, thickness, mass, cross-sectional shape, bit thickness, projection perimeter, and tip angle.

Projection Tip Morphology

The projections/tips in our sample were produced in a variety of ways, including unifacial or bifacial retouch on one or both margins or from a snap or break on one side. The projections on the unifacial specimens were created by the removal of one or two flakes. Chipped stone gravers are

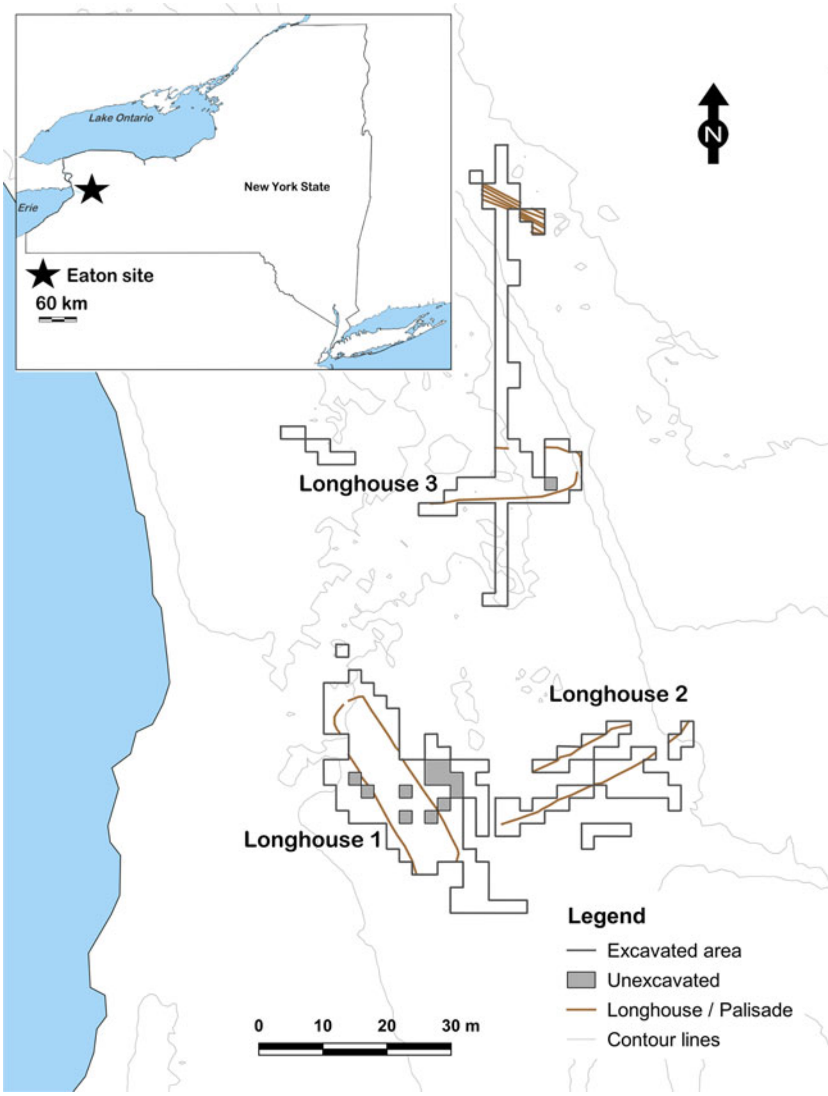

Figure 1. Location of the Eaton site.

assumed to incise, slot, groove, or carve the surface of material, especially medium-hard to hard materials like wood, bone, antler, or stone (Ballin 2021:62; Boen and Williams 2022; Morrow 2016). They need to be sturdy to withstand the pressure of being used on medium-hard to hard materials. Our expectation is that tools with a thick projection and a wide distal angle would be gravers. Perforators are defined functionally as tools used to create holes by pushing or twisting through soft to medium-hard material. Awls and needles made of bone, antler, or even thorns can also be used to perforate soft material. A sharp point is needed to perforate hides because they tend to stretch, rather than break (Hughes 1998:353). As Friis-Hansen (1990:497) observes, the narrower the front angle of a projectile point, the more likely it is to penetrate a hide, and we would expect the same for perforators. We expect chipped stone perforators to have a thin projection with a sharp distal angle.

Quinn and colleagues (2008) developed a sharpness index for el-Khiam projectile points from the Near East by dividing the tip into two right triangles and then using trigonometry to determine the distal angle. Taking a series of measurements from the tip, and then averaging them, gives an approximation of

https://doi.org/10.1017/aaq.2024.83 Published online by Cambridge University Press

the front distal angle. However, projections in our study appear to be both narrower and shorter than those of el-Khiam points, making this methodology less suitable. We decided instead to use a goniometer to measure the angle. A common problem with goniometer measurements relates to the physical interaction between the goniometer, object, and individual (Yezzi-Woodley et al. 2020). We placed the specimen on top of the instrument, with the tip of the projection at the fulcrum and the stationary and moving arms of the goniometer aligned with the first 4 mm of the lateral edges of the tip. If the lateral edges of the projection were less than 4 mm, we measured the angle of the shorter projection. This ensured that the goniometer arms were on a flat surface. The distal tips were angular, so curvature was not a problem, and the sizes of the specimen and the instrument were compatible.

In addition to the distal angle, we wanted to consider the perimeter of the tip, which we see as relevant to the functions of perforating and engraving. We considered using the cross-sectional perimeter metric for the projection tip, rather than the midsection of a projectile point; we decided, however, that at this smaller scale a direct measurement was more accurate than one based on an idealized geometric form. The perimeter of the projection was measured 4 mm from its tip unless the projection was shorter, in which case we measured the circumference at the base of the tip. To do so, we wrapped dental floss around the specimen: the floss was found to be easier to use than thread, string, or dental tape. One end of the floss was first affixed to a piece of clear tape and then taped to the face of the specimen, with the end of the floss lining up with a lateral edge. While securing the tape with a finger, the specimen was twisted, resulting in the floss being wrapped around the specimen. The floss was pulled taut by its container. We then used manicure scissors to snip the floss along the lateral edge where it met its taped end and then took a linear measurement in millimeters of the segment of dental floss. The perimeter of each projection was measured twice with the same result. This procedure has the advantage of being fast, easy, inexpensive, and accurate.

Use Wear

We chose 30 specimens for use-wear analysis. To ensure a representative sample of projection tip angles and perimeters, we added the angle (degrees) and perimeter (mm) for each specimen and then chose specimens with the following sums: 23, 27, 32, 35, 37, 38, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 56, 59, 61, 63, 65, 67, 69, 73, 76, 78. These represented the range of values, with 23 being a sharp-angled narrow projection and 78 being a wide-angled thick projection. To examine use wear, an AmScope trinocular microscope was fitted with WF 20/10× eyepieces, 2× objective lens, and 1.0×–4.5× zoom objective. Magnification varied between 40× and 180×. Thirteen specimens exhibited wear from perforation and 17 from engraving. However, all 30 specimens had wear suggesting multifunctional use: twisting/drilling, cutting, or scraping. Qualitative and quantitative aspects of the wear observed suggested a higher probability of either perforating or engraving. Recording of wear indicative of other functions—drilling, cutting, or scraping—was typically limited.

Specimens with perforation wear showed a higher incidence of edge serrations, whereas specimens with graver wear exhibited moderate to heavy micro-fracturing with continuous scalar scarring and more intense polish and edge rounding. In general, specimens with perforation wear showed less variable wear on the distal tip and less morphological change than gravers (Figures 2 and 3). Detailed use-wear descriptions of each specimen may be found on tDAR (https://core.tdar.org/collection/71221/eaton-chipped-stone-tool-use-wear).

Results

Figure 4 is a scatterplot, with the tip angle plotted on the *y* axis and the projection perimeter on the *x* axis. Specimens with perforator wear are marked with a triangle, those with graver wear are marked with a square, and specimens whose use wear we did not determine are marked with a circle. As expected, those with perforator wear had a small perimeter (20 mm or less) and a relatively sharp angle (40 degrees or less). However, specimens with graver wear did not conform to expectations: the dimensions of their projections overlapped with specimens with perforator wear. Specimens with perforator and graver wear are represented by roughly the same proportion of flakes, blades, bifaces, and core fragments. Figure 5 shows perforators and gravers with a range of distal angles and perimeters.

https://doi.org/10.1017/aaq.2024.83 Published online by Cambridge University Press

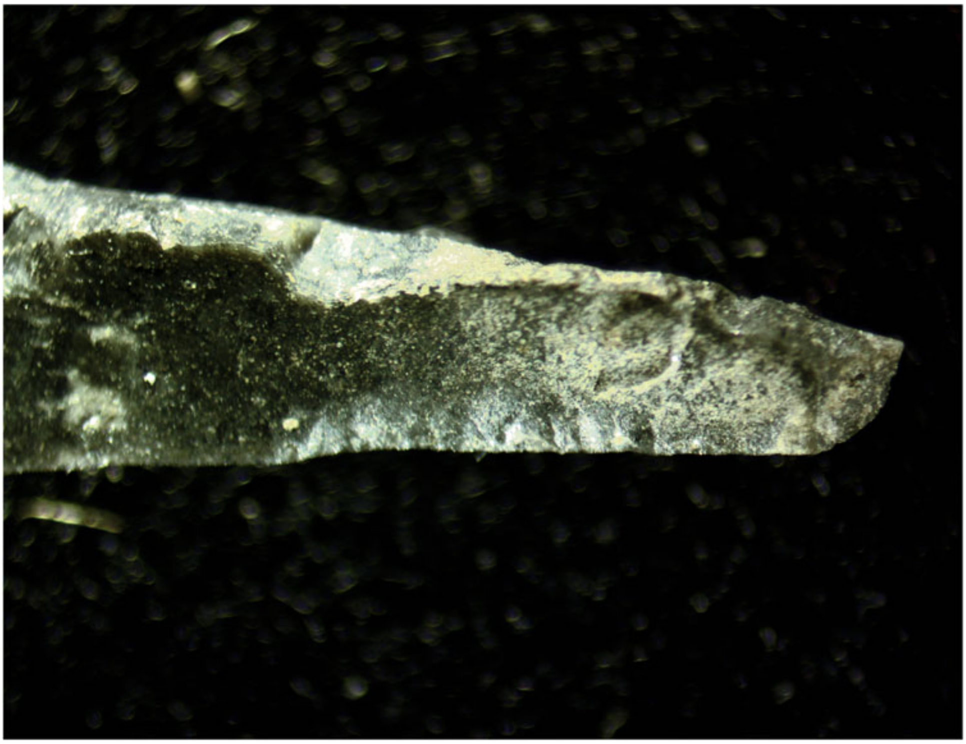

Figure 2. Perforator #1609: Use wear includes edge seriation, minor edge rounding, and fracturing; 40× magnification. (Color online)

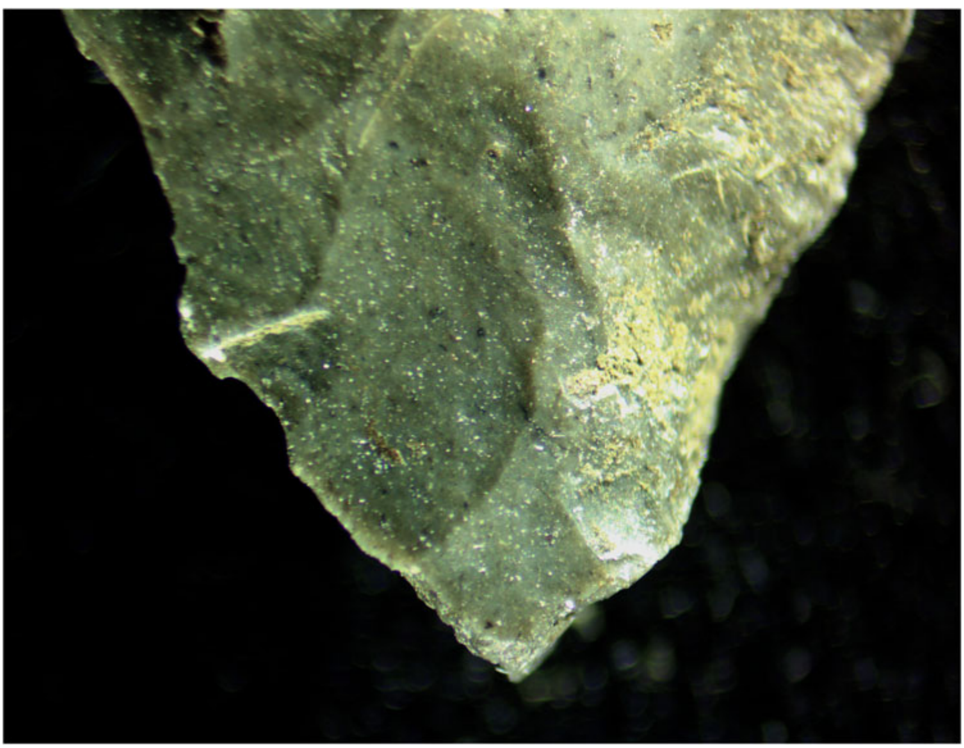

Figure 3. Graver #1565: Use wear includes moderate to heavy micro-fracturing along with scalar scarring, edge rounding, step fracturing, and distal edge crushing; 40× magnification. (Color online)

https://doi.org/10.1017/aaq.2024.83 Published online by Cambridge University Press

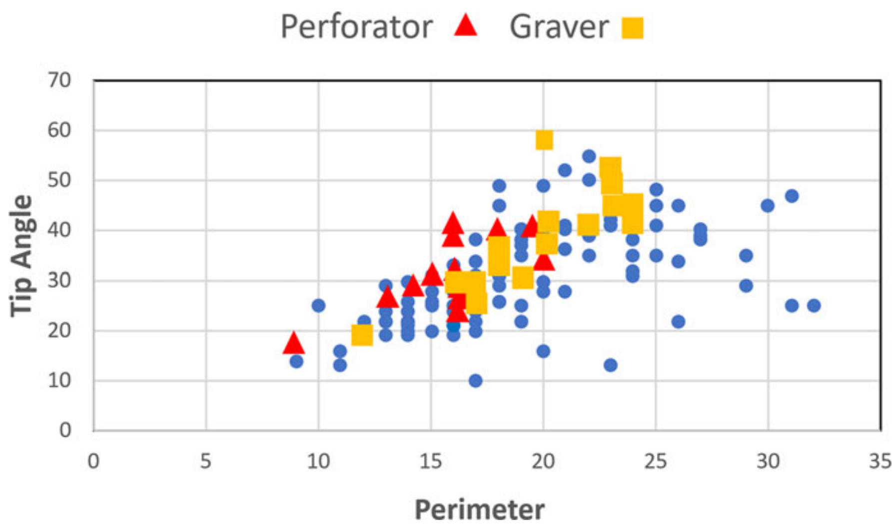

Figure 4. Projection tip angle plotted against perimeter. Specimens with perforator wear are represented by triangles, graver wear by squares, and specimens not studied for use wear are represented by circles. (Color online)

Figure 5. *Top row*: Specimens with perforation use wear (*left to right*; tool number): #1600, #1617, #1561, #1596; *bottom row*; specimens with graver use wear: #1386, #1587, #1013, #1053. (Color online)

Although these results preclude a clear-cut differentiation of perforators and gravers based on function, they do present a starting point for distinguishing these tools typologically. We propose that the term "perforator" be used for specimens with a projection perimeter of 20 mm or less and a projection angel of 40 degrees or less. We further propose that specimens with projections with wider angles and thicker projections be termed "gravers," with the understanding that the function of graving is not limited to wide-angled thick projections. Using this typological distinction, specimens classified as gravers were unlikely to have functioned as perforators.

Summary and Conclusion

Chipped stone tools with projections are found worldwide and are given various type names, including perforator and graver. However, one researcher's graver is another researcher's perforator, leading to noncomparable databases. This use-wear study indicates that specimens with perforation use wear have projections that are both thin and sharp, whereas graver use wear occurs on projections of variable perimeters and tip angles. For typological purposes, we advocate that specimens exhibiting a distal angle of 40 degrees or less and a projection perimeter of 20 mm or less be classified as perforators, and those with greater dimensions be termed gravers. We recognize that placing specimens in lithic tool types obscures the variability between them and may lead to false assumptions concerning function. However, the use of a typology does not prevent the investigation of intra-type variation. This is a separate research goal from the comparisons of large assemblages for which the description of individual specimens is not practical. Currently, the failure of archaeologists to use a uniform lithic tool typology for perforators and gravers renders inferences on the use of these tools over broad areas or time periods little more than speculation.

Acknowledgments. The late John Holland examined many of the specimens in this study with the corresponding author. Roderick Salisbury is responsible for Figure 1, and Mark Warford and Marko Miletich translated the abstract into Spanish. We also wish to thank three anonymous reviewers for their suggestions.

Funding Statement. The Eaton site was excavated by 17 summer field schools from Buffalo State University, SUNY Buffalo, or from both institutions in joint sponsorship. We gratefully acknowledge the support of both institutions.

Data Availability Statement. The specimens that form the basis of this study are curated in the Anthropology Department at Buffalo State University.

Competing Interests. The authors declare none.

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Cite this article: Engelbrecht, William, and Sean Hanrahan. 2025. Differentiating Chipped Stone Perforators from Gravers. *American Antiquity* **90**(2):379–386. https://doi.org/10.1017/aaq.2024.83.