A Study of Ancient Resharpening

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The goal of this section on resharpening is for the reader to move on to the next chapter with a complete understanding of ancient resharpening and the visible traits left behind by the reduction of the blade edges. As I was working on taking the digital photos of the ancient knives pictured in this section, I decided to attempt to make a digital illustration that would somehow re-create the step-by-step process of ancient resharpening. After several failed attempts and many frustrating hours of sitting at the computer, it dawned on me that in order to have an accurate set of images showing the reduction process, I first needed to remove all of the guesswork and rely on accurate data. The problem was, I could not locate any recorded data on blade-edge reduction. Therefore, I contacted a good friend of mine and fellow AACA board member Jim Fisher from upstate New York who is an artifact authenticator who has gained the respect of many collectors, including myself, over the years for his artifact knowledge as well as for his devotion to fighting artifact fraud. Jim has a Bachelors degree in Anthropology with a specialization in Archaeology from the University at Buffalo. In his efforts to learn all he could about the ancient manufacture of flint relics, Jim has studied and become well-versed in the ancient art of flintknapping.

After explaining what I was attempting to do, a plan was devised to do a joint study in which a reproduction knife would be made that closely resembles a known knife style, and then that flint knife would be resharpened, dulled, and resharpened until it reached the point of exhaustion. Between each resharpening, measurements would be recorded and the knife would be photographed at each stage of resharpening.

The first step in beginning the study was to locate an honest flint knapper to make the study knife and to assist in the blade-edge reductions, a person who had the ability to reproduce known knife styles true to their ancient form using the tools ancient man would have used long ago. After contacting several trusted collector friends from around the country, it was apparent the person I was looking for was a flintknapper named Dan Long of Ontario, Canada. I learned that Dan is well-known, not only for his ability at his craft, but also for his honesty and integrity as well as his love for the study of ancient lithic techniques. When I contacted Dan he was excited to participate in the project, and he graciously created and donated the Dovetail knife pictured on the following pages.

The study knife was reduced at the blade edges using a pressure flaking tool in a manner identical to the way we understand it would have been used in prehistoric times. While Dan mastered the reduction process, Jim managed the task of collecting and analyzing all of the associated metric data. The following pages of photographs recount visually the step-by-step process of resharpening and the resulting reduction of the blade edges.

Initially, the purpose of this study was simply to illustrate the effect of multiple series of resharpening on a knife form. Since completing the first study pictured on the following pages, however, we decided to expand the study to other archaic bevel lithic knife forms (Dovetail and Thebes Clusters) as well as non-beveled forms. When these additional studies are completed, the data and photographs will be published in a separate

book.

About Morphology

Morphology is the study of form and structure, in this case that of an Archaic Bevel knife form. Morphometric studies define the changes in form and structure utilizing precise measurement. The study team hopes that additional studies similar to the one described here will assist in furthering the identification and understanding of morphometric "markers" that may prove to validate suppositions about the amount of resharpening seen on authentic ancient knife forms.

Objectives

Two objectives were achieved during this study. The first was the determination of the number of successive resharpenings that could be completed before the knife reached the point of exhaustion. The second objective was identifying morphometric markers that may indicate limits of lithic knife resharpening when using a unifacial, beveling technique.

Resharpening Methods

Two methods can be used when resharpening the edge of a flint blade; bifacial and unifacial (beveling). Both are accomplished by pressure flaking. Bifacial resharpening was the preferred technique used during the Paleo period. The use of this technique continued until the Late Paleo/Early Archaic transition at about the time of the Dalton culture. It is at this point that resharpening via unifacial beveling first began appearing. Bifacial resharpening requires a series of flakes to be removed from both faces of each blade edge. A total of four flaking "passes" are necessary to complete one bifacial resharpening, as opposed to only two passes needed for the unifacial beveled approach. Both techniques result in a narrowing of the blade itself, but when resharpening using the bifacial method, it will also cause the blade to become thinner at the mid-section with each reduction of the blade edges. As the knife becomes thinner, it will also become weaker and can handle less stress at the mid-section. Pressure flakes that are removed during bifacial resharpening are longer and usually reach to at least the mid-point of the blade. Resharpening that is done by unifacial beveling, however, involves the removal of relatively shorter pressure flakes and this does not affect the original thickness of the knife. When viewed in cross section, a bifacially resharpened blade retains its regular, lenticular profile with the blade edges in line at the centerline of the blade. A beveled blade is rhomboidal in cross section. The blade edges of the unifacially beveled knife are off center and diagonally opposed to each other. The discovery of the unifacial method of resharpening allowed the knife to remain more consistent in thickness and thus stronger, while reducing the time it took to complete the resharpening process. It is common to find both types of resharpening used throughout all time periods that evolved after the Paleo period. Although most repairs to projectile points were made using the bifacial method, I have seen a number of examples of lateral impact fractures repaired using the unifacial method.

Data Produced by this Study

The data set that Jim recorded during this study included measures of point width and length, blade curvature, shoulder angle, and blade torsion. Additional calculations based on the primary data included point width reduction and point length reduction. Point

width reduction demonstrates the percentage of the point width lost as a result of each series of resharpening. The measure of point length reduction relates the percentage of the original point length lost as a result of resharpening.

In this trial, 17 distinct unifacial resharpening series were required to exhaust the knife form. Resharpening series 18 effectively converted the exhausted knife into a drill. Some interesting data was collected along the way. The first five resharpening series resulted in only slight blade torsion. Blade torsion is best described as the measure of beveling or "twist" that the blade suffers due to unifacial resharpening. At the conclusion of resharpening series 5, the blade width had been reduced by 12 percent, but still maintained much of its original convexity. Following resharpening series 10, the original blade width had been reduced by 31 percent and the knife began to exhibit more moderate blade torsion. At the end of the knife's life cycle, following resharpening series 17, the original point width had been reduced by 65 percent while the length had suffered a reduction of only 14 percent. The measurement of blade torsion following resharpening series 17 is best defined as severe, and blade curvature is defined as straight. Once the knife had been converted to a drill form, its original width had been reduced by 71 percent. The bifacial pressure flaking strategy used to create the drill reduced blade torsion from severe to moderate as compared to that seen in the final stage of the knife form.

Morphometric Markers

In this study some important morphometric markers were clearly identified. The knife form was exhausted when blade torsion measured 5.75 mm (defined as severe) and an adjusted blade torsion angle of nearly 80 degrees had been achieved. The steep bevels made additional resharpening impractical. The ability to remove flakes from a biface or core, without producing hinge or step fractures, is dependent upon a variety of factors. These factors include the tensile strength (toughness) of the lithic material and the physical configuration of the piece in the area in which a flake is to be removed. The first factor is determined by geology, the second factor by the laws of physics and fracture mechanics. As a rule, the pressure flaking platform (the area against which the pressure flaking tool is applied) should be below the centerline of the piece. For effective results, the edge being pressure flaked must be of an angle considerably less than 90 degrees. Having appropriate pressure flaking platforms allow for the release of "clean" flakes that feather out to termination, rather than hinging or stepping abruptly. Given the adjusted blade torsion angle of approximately 80 degrees that was observed in the latter stages of resharpening, it became apparent why a series of step fractures began occur on the beveled edge. These step terminations occurred at about one-third the distance from the flaking platform (at the top of the bevel) to the intended point of termination, at the bottom of the bevel.

The measure of blade torsion angle provided the answer to a question that we had discussed before the experiment began: "How do we know when the blade has reached terminal utility as a knife form?" The blade torsion angle ultimately determined the degree to which resharpening via pressure flaking would achieve the intended result. The measure of blade torsion angle was recorded only at the conclusion of resharpening series 17, as the study team realized its significance. It proved to be an important morphometric marker. Additional trials such as the one described here will need to include the measure of blade torsion angle at each interval of resharpening.

Although this study does an excellent job of illustrating the life cycle of an Archaic Bevel flint knife form, the implications of the morphometric data are preliminary.

Additional trials will be necessary to validate the application of these morphometric markers in studies of authentic relics that have been subject to unifacial, beveled resharpening.

I would like to thank Jim Fisher for his willingness to oversee this project and for his contribution of writing this report. I also thank Dan Long for his participation in applying his craft to make this study as accurate as possible. Once the additional studies are completed and the morphometric data recorded and compiled into book form, we hope to be able to establish a mathematical equation that will allow for the measurements of a knife form to be extrapolated to determine the original size of a knife when it was first manufactured and the accurate number of resharpenings that reduced it to its present size.

Answers to the Questions After Completing the Study:

- How many resharpenings until the state of exhaustion was reached?
  Answer: 17 resharpenings as a knife, with reduction series l8 converting the knife into a drill form.

- What is the average loss of width for each reduction?
  Answer: Average loss of width is 1.7 mm per reduction.

- What is the average loss of length for each reduction?
  Answer: Average loss of length is .94 mm per reduction.

- At what point does beveling begin?
  Answer: We noticed a blade torsion measurement of 1 mm at the conclusion of resharpening series 4. This is the first point at which appreciable beveling becomes visually apparent.

- What is the reduction ratio of width to length?
  Answer: At the conclusion of reduction series 18 the drill form width at the midpoint of the bit was equal to 13.3 percent of its length (point ratio). Total width was reduced by 30.5 mm. Total length was reduced by 17 mm. The blade width was reduced approximately 1.8 times faster than the blade length was reduced (30.5/17 = 1.794). Rounded to the nearest whole number, the total reduction of width compared to total reduction of length would have occurred at a ratio of 2:1.

In addition to gaining the answers to these questions, some other interesting traits can be seen in the previous photo series that can assist when examining knife forms. Ancient artifact collectors by and large are not merely interested in the possession of artifacts, they are interested in studying them and learning all they can about ancient man and the tools he left behind. When handling a flint knife, a collector can't help but wonder how it was used, how long it was used, how it was hafted, and how it was lost. By becoming familiar with some of the traits seen in the previous photographs of the study knife, it can point to how long a knife was used before it was lost or discarded.

The indicators that became noticeable while doing this study can be very useful when trying to determine how many resharpenings a beveled knife form has had. By identifying these markers and using them in comparisons to authentic relics, they should

provide a good general idea of the number of resharpenings to which a lithic knife form was subject. When looking at relics that have the potential to be fake or modernly altered, it may also provide some guidelines for comparison. With this study continuing at the time of publication of this book, it will be interesting to see if the final data recorded as a result of the study will provide some solid markers that can be used to weed out potential bad relics. I hope that at the conclusion of the study some mathematical formulas and patterns will have developed that will allow the simple calculation of certain measurements to assist in determining if the size and style of a blades edges are representative of authentic resharpening or clearly an indication of reproductions. ●