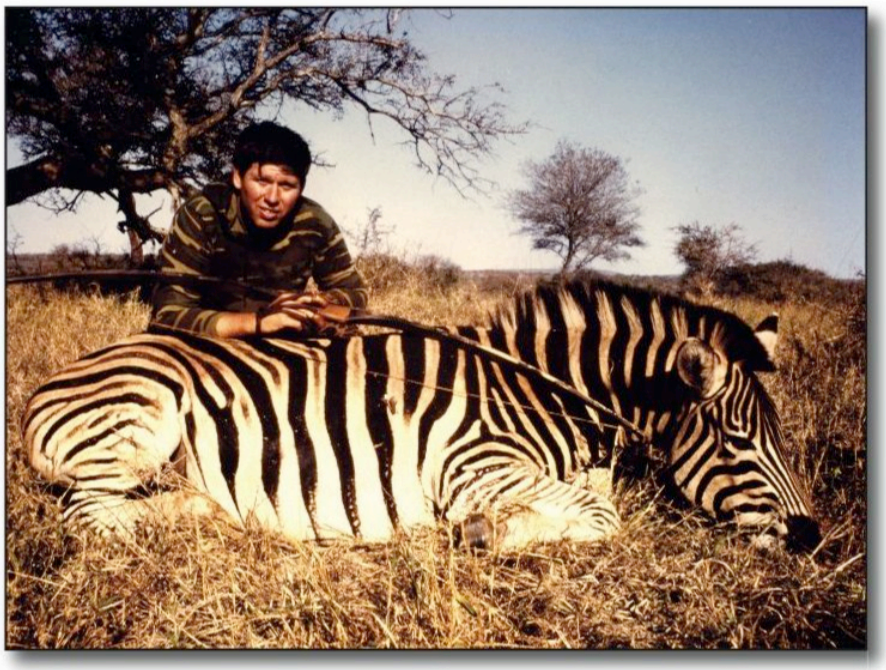


Getting an Edge on Success

By Dr. Ed Ashby with David Petersen

The objective of all ethical bowhunters is a lethal hit resulting in a quick recovery. Yet too few of us give sufficient consideration to the cutting capability of our broadheads' *cutting edges*, which so often make the difference between success and failure with "perfect" as well as "*Uh-oh!*" hits. Let's look at three essential facts that all bowhunters should know about how broadhead cutting edges work, or don't.

Edge Finish

When all else is equal there's no question which type of edge finish makes a cut that bleeds the longest and most freely; it's the cut made by the thinnest, sharpest, smoothest edge. That's a physiological fact that applies to double- as well as single-bevel heads. Why? Because the thinner, sharper, and smoother the cutting edge, the less disruption there is to the lining of the inner wall of each blood vessel cut. Disruption of this layer is what initiates the blood's clotting process, known as coagulation. Coagulation stops or retards the rate of hemorrhaging — exactly what the bowhunter does *not* want to happen.

The rougher a cutting edge, the more it mangles the tissues, tearing rather than slicing cleanly. The upshot here is the creation of "tissue tags," near-microscopic loose strands of tissue along the edges of the incision, facilitating faster clotting. A thin, smoothly honed, truly sharp broadhead cutting edge creates fewer tissue-tags along the course of the cut it makes.

The difference in clotting effect between different types of finishes on a "sharp" edge isn't highly significant when a major (large diameter) vessel is *severely* lacerated or severed. It does, however, become an important factor when a large vessel is merely nicked, or when only small-diameter vessels have been severed — such as with a marginal liver, kidney, or lung hit. The volume and duration of a freely flowing wound is especially important on a shot hitting only one lung, and is a huge factor on muscle-tissue or gut hits; that is, hits in areas where there are fewer major vessels to sever.

Another, often overlooked wound where the type of edge finish becomes significant is through the muscle tissues of the heart. The heart muscle, more than any other tissue, is designed to seal off wounds to reduce the loss of blood. An edge finish that promotes coagulation merely assists the heart muscle's innate tendency to seal the wound, stopping or retarding the bleeding. As with major blood vessels, edge finish on your broadhead will have little effect on a wound passing through multiple heart chambers. But with a wound that merely nicks a heart chamber, hits only one of the heart's chambers, or hits only the muscle of the heart wall, the edge finish can have significant impact on hemorrhage and recovery rates.

And here's yet another hemorrhaging factor to consider: There is overwhelming medical evidence that a shaft that remains in the wound channel contributes (applies) direct pressure on the wound, reducing the rate of blood loss. This is why first responders are cautioned not to remove a penetrating object from a wound until the patient is in a setting where the resulting increased blood loss can be dealt with.

According to research by the Royal Academy of Veterinary Surgeons, when an arrow shaft remains in the wound *and* the animal continues to move, the pressure between shaft and wound is further increased, additionally retarding blood loss. In addition to collapsing both lungs for a quick death and easy recovery, pass-through shots also increase bleeding and enhance blood trails. At best, an arrow that remains in the body means a longer and thinner blood trail. At worst it means an animal

With all big game, scalpel-sharp broadheads are essential for a clean kill.

mortally wounded and not recovered.

Cut Efficiency

Now let's go back to the beginning: *"When all else is equal, there's no question which type of edge finish makes a cut that bleeds the longest and most freely; it's the one made by the thinnest, sharpest, smoothest edge."* There are those, of course, who contend that "all else" is *not* equal; that a ragged, serrated or scalloped edge cuts more tissue than a straight, smooth, sharp edge. The theory is that the irregular edge "grabs" the tissue, ripping and tearing at it, whereas a smooth edge allows the tissue to move along the edge without being cut. Aside from the coagulation factors discussed above, there are several flaws to this reasoning.

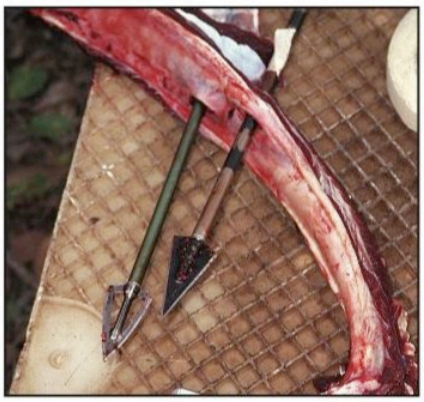
No one who's ever shaved with one would disagree that a rough-edged razor grabs at both whiskers and skin — but it certainly doesn't *cut* whiskers as effectively as a sharp, smoothly honed razor. The rough-edged razor is also going to rip many small chunks of tissue from the face, but all those lacerations together will not shed the volume of blood that comes from a single nick with a truly sharp razor.

Whenever fibrous tissues, such as skin, tendons, ligaments, and fascia are penetrated, testing shows that the irregularities along a roughly finished broadhead edge quickly become clogged with strands of tissue fiber. This clogging is present not only with "Hill type" serrations, but also with the marks left by file-sharpening and micro-serrations left by final sharpening with anything short of an extremely fine-grit steel or stone. In severe cases this "clogging" of broadhead edges becomes so extensive that the head is rendered incapable of cutting tissue, even when considerable pressure is applied.

Consequently, as test results consistently demonstrate, a smoothly sharpened, honed, and stropped edge, free of all serrations and burrs, penetrates tissue easier than a head having a rough edge. On all except pass-through shots this means a *longer wound channel* for the smooth edge. A longer wound channel means more vessels and capillaries cut by the broadhead, increasing bleeding.

An often cited example of a scalloped edge working better than a smooth, non-scalloped edge is serrated vs. non-serrated steak knives. There are several reasons why serrated-edge steak knives are widely used, and often *seem* to cut our mealtime steak with more ease than straight-edged knives. The chief reason is that not many folks have steak knives with high quality steel, and even the few who do (at least among those I've encountered) don't keep them well sharpened.

The other factors all revolve around the steak on our plate already being skinned, dead, aged, butchered, and cooked, rendering the meat conducive to "sawing." Our dinner steak doesn't have a covering of fibrous skin, and the fibrous connective tissue remaining in the steak has been modified by cooking.



Sharp broadheads are essential to lethal penetration through hair, hide, muscle and especially, bone.

As our early ancestors knew, cooking connective tissue — skin, sinew, tendon, ligament, horn, or hoof — softens it.

Slicing tissue requires a sharp edge. If a smooth edge is not sharp it has great difficulty cutting through even soft tissue; it has to tear rather than slice through. Even when dull, a scalloped, rough, or serrated edge has an irregular, abrasive surface. When the edge is dull, this makes it easier for the edge to saw the tissue, but not easier for it to *slice* tissue.

And significantly, arrows can't neatly carve around bones, as we do when eating a steak. Bone is the most difficult tissue your hunting arrow will be called upon to deal with, and bone contact of some sort occurs with a majority of hits. Bone doesn't *cut* well with anything short of an offset-tooth saw blade. The thin projections of a scalloped broadhead edge are fragile and easily damaged on hard bone impact. Once damaged, they greatly reduce cut effectiveness and markedly increase arrow drag, reducing penetration and cutting while promoting coagulation.

Have you ever tried field dressing or caping a big game animal with a scalloped-edge knife? Have you also field dressed or caped a similar animal with a knife with a truly sharp, smoothly honed and stropped edge? If so, you won't need any convincing which edge type cuts more efficiently. If your broadhead isn't truly sharp, then you're probably better off with a scalloped or serrated edge, but it's a poor, poor substitute for a sharp, smooth edge.

About here someone is likely to say: "But the knapped edge of a flint broadhead is a scalloped edge, and has fine serrations all along it, and everyone agrees flints cut better than steel broadheads." Few edges cut more efficiently than the *ultra-thin* edge obtained by removing a flake from flint or obsidian. Yet one that does is a *smoothly polished* obsidian scalpel blade, which, in pre-laser days, was often used during delicate eye surgery. An obsidian scalpel cuts more cleanly than any steel blade, and cleaner than the finest knapped obsidian edge. Why? Because its highly polished edge, as thin as that of the finest obsidian flake, has absolutely *no serrations*. Its cut is fully as smooth and flawless as that of a surgical laser.

Broadhead and Edge Design

There are also many features of your broadhead's design that affect the quality of the cut it makes as it passes through tissue — features few bowhunters think about but should. Foremost is the *quality of the steel* in the blade. Good steel prevents a thin, smoothly honed and stropped edge from losing its sharpness before it has finished penetrating tissue. If a broadhead is truly sharp at impact but no longer truly sharp when it exits, then the steel is not strong enough to support the existing edge bevel.

Softer steels are easier to sharpen, but are not strong enough to resist damage when the edge is thin. At any sharpening angle the cutting edge on softer steel will dull more quickly than on harder steel. To compensate for this, folks often sharpen softer-steel broadheads at a more abrupt angle. This helps with the edge retention but sacrifices the cutting and penetration advantages of a thin edge. But as long as the edge is truly sharp and smooth, why does this matter?

Because at equal levels of sharpness, the mechanical advantage of a broadhead's edge bevel affects the *quantity* of the cut achieved as well as the quality. The lower (or thinner) an edge's sharpened angle, the higher its mechanical advantage (MA). Think of the edge bevel as a simple wedge (if double-beveled) or simple inclined plane (if single-beveled). The longer the bevel's slope in relation to its rise (the blade's thickness), the higher the bevel's MA. At the same level of tension between tissue and the cutting edge, a higher MA edge will slice deeper.

While much discussion has been directed toward (overall) broadhead mechanical advantage and the increased penetration potential offered by long, narrow heads, such broadheads offer yet another advantage worth consideration. The longer a broadhead's cutting edge, the greater the distance impacted tissues travel along that edge as the arrow passes through an animal's body. This in turn increases edge-to-tissue contact time, offering the blade greater opportunity to cut.

Having the broadhead rotate as it penetrates, as with well-designed single-bevels, not only enhances the slicing effect; it also cuts more of the vessels encountered on a bias. A vessel of given diameter, cut on a bias as opposed to a right angle, will have a larger opening in the vessel wall. This makes it more difficult for coagulation alone to seal the cut, promoting faster and freer bleeding. Yes, blood vessels do travel in all directions and every broadhead will

cut many of the vessels encountered at a bias, but a rotating broadhead greatly increases the mathematical probability of cutting each contacted vessel at a bias — even when initial edge contact with the vessel is perpendicular.

In Review

So there you have it: the bowhunter's edge on success — a broadhead edge that works the best. Good quality steel in the broadhead's blade, while requiring more effort to sharpen, allows you to use a thinner edge with higher mechanical advantage while retaining blade sharpness throughout the entire course of penetration. The high MA of the low-angle edge cuts more efficiently at any given level of sharpness and tissue tension. A longer cutting edge (long, narrow broadhead) increases tissue-to-edge contact time, increasing the slicing effect. A single-bevel edge induces rotation, increasing the degree of tissue tension, dragging tissue forcefully across the edge at an angle to the cutting edge's direction of forward motion and cutting more vessels on a bias, thereby inhibiting coagulation and promoting freer bleeding. And last — but really first and foremost — on any given hit, a thin, smoothly finished, truly sharp edge creates a cut that bleeds longer and more freely.

Nothing does more to promote recovery success than fast collapse time for the wounded animal. And except for a double-lung pass-through that starves the brain of oxygen, or nerve-disabling (spinal) hits, collapse time depends on the rate of blood loss. Giving your broadhead an edge on success not only yields faster collapse, better blood trails, and shorter recoveries on "perfect" hits, it gives an enormous advantage when a hit is less than perfect. Finally, a sharp, high-MA broadhead also enhances the penetration potential of your arrow, improving odds for a total pass-through.

Optometrist and frequent contributor Dr. Ed Ashby is well known throughout the bowhunting community for his arrow lethality studies.