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The Impact of the Macana: A Theoretical Exploration of the Combat Effectiveness of War Clubs in the Guianas and Beyond

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The macana or block war club of the Guianas is a weapon of unique appearance, with sharp edges and corners, and a 'waisted' or 'thinned' area serving as a handle about one-third between two squared ends. This design is no accident as each edge and corner provides a potential impact point for the weapon. Further, some examples of the club have a blade of stone or metal fitted into one face. Europeans seeing this weapon in action noted that it "scatters the brains" (Stedman 1796: 396-397). This paper explores the design of the macana, its use, and the injuries it could have caused in combat and shows the club to be a highly effective melee weapon capable of inflicting serious wounds to bone and soft tissue, including internal organs.

La macana o garrote de guerra en bloques de las Guayanas es un arma de apariencia única, con bordes y esquinas afilados, y un área "entallada" o "adelgazada" que sirve como mango de aproximadamente un tercio entre dos extremos cuadrados. Este diseño no es un accidente ya que cada borde y esquina proporciona un punto de impacto potencial para el arma. Además, algunos ejemplos del club tienen una hoja de piedra o metal encajada en una cara. Los europeos que vieron esta arma en acción notaron que "esparce los cerebros" (Stedman 1796: 396-397). Este artículo explora el diseño de la macana, su uso y las lesiones que podría haber causado en combate y muestra que el garrote es un arma cuerpo a cuerpo altamente efectiva capaz de infligir heridas graves a los huesos y tejidos blandos, incluidos los órganos internos.

Le macana ou block war club des Guyanes est une arme d'apparence unique, avec des arêtes et des coins tranchants, et une zone «cintrée» ou «amincie» servant de poignée environ un tiers entre deux extrémités carrées. Cette conception n'est pas un hasard car chaque bord et coin fournit un point d'impact potentiel pour l'arme. En outre, certains exemples du club ont une lame de pierre ou de métal insérée dans une face. Les Européens voyant cette arme en action ont noté qu'elle «disperse les cerveaux» (Stedman 1796: 396-397). Cet article explore la conception du macana, son utilisation et les blessures qu'il aurait pu causer au combat et montre que le club est une arme de mêlée très efficace capable d'infliger de graves blessures aux os et aux tissus mous, y compris aux organes internes.

Introduction

There is a rich tradition of impact weapons—wooden war clubs—in South America, Central America, and the Caribbean. Roth (1924) identified at least nine different types of war clubs in Guyana alone. This article uses one form of war club, the block or waisted variety found in the Guianas, as a case study to explore the use and effectiveness of impact weapons in Amerindian combat. While this variety of war club is most often found only in the Guianas, design elements flowed into the Caribbean. Loven (2010: 45; 153; 451-453) makes several mentions of the war clubs found in the Guianas and discusses the influence of such weapons on those of the Taíno. A transfer of design knowledge is reasonable given the evidence that other cultural items, such as pottery, were carried out of the Guianas to Trinidad and possibly beyond (Boomert 2013: 149). Keegan and Hofman (2017) note that the Carib moved into the Lesser Antilles before the arrival of Europeans, so it might be possible the design knowledge transferred at this time. Further,

the elements explored are transferrable to other club types regardless of where they are found due to shared characteristics of impact wounds and associated trauma.

The waisted or flared quadrilateral war clubs of the Guianas, often referred to by the Amerindian names of 'macana' or 'aputu', are in appearance unlike any other club or impact weapon seen in human history. In the Taíno language, if the terminal *a* in macana is accented, the word *macaná* is produced, which is the verb "to kill" (Highfield 1997: 159).

Schomburgk, based on his travels in the early 1840s, appears to be the first to note that the various Amerindian groups in South America each used a style of war club distinctive to that group. Roth (1924) categorized the diversity of the clubs used in the Guianas into four types. The weapon in question here, the macana, fell under what Roth called the "block or cubical type" and that clubs of this type have "square ends with sharp corners, thinned in the middle" (Roth 1924: 173). Bray (2001) notes that this type of club is a "distinctive form that is found nowhere else in Amazonia" (254). Im Thurn, who did some of the early work on the club (both the bladed and non-bladed versions) writes:

> One is four-sided; that part which is grasped in the hand is square, but from that point the sides gradually curve outward, the one end much more than the other, until they are abruptly cut off and end in both directions in flat surfaces at right angles" (Im Thurn 1883: 299).

It is important to highlight here that the club is not equally divided at the thinned handle area. Typically, this occurs at about the one-third point of the weapon's length. This configuration allows the larger end to serve as the club 'head' while the smaller end serves as a sort of pommel. The appearance of this thinned area could vary greatly, with some clubs having a straight taper and others have more of a curved taper, causing handles to range anywhere from thin to very thick. The thinned handle area is often wrapped in cords (Roth 1924:173). Figure 1 identifies the parts of the macana.

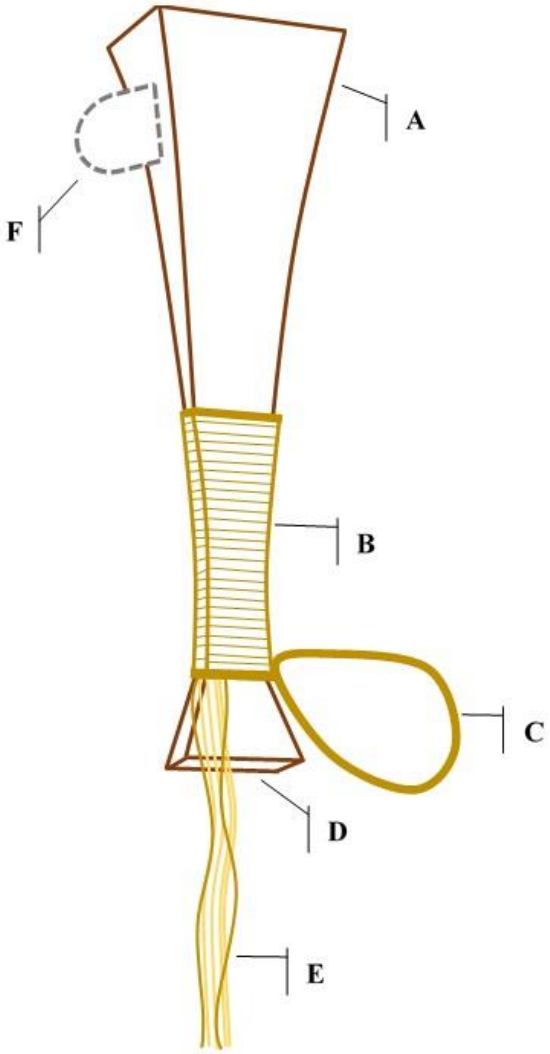

Figure 1. The Parts of the Macana. A: Head. B: Handle (often woven with cord). C: Wrist loop. D: Pommel. E: Tassels. F: Stone or metal blade.

Quality wood was critical to macana construction and use. Stedman (1796) notes that the macana was made of the "heaviest wood in the forest" (396-397). Roth (1924) makes a similar observation, writing that the club was made of "the hardest and heaviest woods procurable" (173). Such woods included ironwood, purpleheart, snakewood, amara, brown ebony, bowwood, and black cinnamon.

In addition to hard wood, some macana were made more vicious and had blades of stone or metal mounted in carved sockets and affixed with a resin compound. The blades were inserted only in the head of the club at the center of the narrow face. A macana never had more than one blade inserted and some macana never had a blade inserted at all. Over time, blades became rarer. While Stedman (1796) notes the existence of bladed macana "frequently" (Stedman 1796:397), by the time Im Thurn writes about his fieldwork in 1883, he found bladed examples "occasionally" (Im Thurn 1883: 300). By the time Saville wrote *The Bladed Warclubs From British Guiana* in 1921, there was doubt the blade variety was made any longer as a contemporaneous University of Pennsylvania expedition failed to find one.

Im Thurn also identified an issue with the design of this version of the weapon. The stone blades had a narrow end that was inserted into the socket in the macana. In studying the blades found, Im Thurn noted that "in all examples, not few in number, that I have seen of this type, the narrow end—that which was undoubtedly attached to the handle—is peculiarly fractured" (1883: 424-425). So, while adding perhaps a harder impact point and possibly some cutting capacity, the stone blades were not durable elements of the club.

Use

Schomburgk noted that Amerindian warfare started with postures and gestures, then progressed to arrows and hand weapons as the distance between the sides closed. He wrote, "The combat starts only from a distance with poisoned arrows, of which each warrior takes seven to battle. When these are shot the fight continues with war-clubs and indeed man against man" (Schomburgk 1922-23, Vol.2: 255-256).

When distance closed and war clubs were deployed, it is likely the warriors had preferred targets. Burton (1884) contends that war clubs were used primarily to strike the head, regardless if the weapon was swung or thrown (Burton 1884: 20). This mirrors a primary account by John Stedman, a mercenary employed to recapture escaped slaves in what is now Suriname. He saw the macana in use because he regularly used Amerindians as trackers and guides. Stedman (1796: 396-397) wrote:

> I must not forget that every Indian carries a club, which they call Apootoo, for their defense. These clubs are made of the heaviest wood in the forest; they are about eighteen inches long, flat at both ends, and square, but heavier at one end than the other. In the middle they are thinner, and are wound about with strong cotton threads, so as to be grasped, having a loop to secure them round the wrist, as the sword-tassels are used by some cavalry. One blow with this club, in which is frequently fixed a sharp stone, scatters the brains. These are used by the Guiana Indians like the tomahawk by the Cherokees, on which, besides other hieroglyphical figures, they often carve the number of persons slain in battle.

The preference for targeting the head in combat is supported by archaeological evidence from North America. Steadman (2008), in studying evidence of skeletal trauma, found wound patterns matching the above methodology. Victims tended to first be wounded by an arrow, then were struck by an object such as a club or tomahawk, and were rendered unconscious or were killed. The strike was always to the skull (Steadman 2008: 53 and 56). Loven denotes an attack strategy used by the Taíno that is similar. In recounting a possible revenge attack on a medicine-man, he writes: "the relatives some day get together, hunt him up and beat him with clubs, smashing his arms, legs and head" (Loven 2010: 577). Loven also records in a footnote that the same method of attack was used to execute prisoners of war (Loven 2010: 577).

In regards to the macana, such strikes may have been delivered while the club was held in the hand or perhaps even thrown. Stone (1961:420) says the macana was thrown, but Stedman (1796), Saville (1921), Roth (1924), and Bray (2001) do not mention it. While Burton (1884) makes allowances for thrown clubs, which existed in several cultures on several continents, more definitive evidence is needed before the macana could be considered a missile weapon as well as a bludgeon.

An Escalation of Violence?

The non-bladed macana, with its heavy wooden construction and sharp edges and corners, was a formidable weapon without the addition of a stone or metal blade. What made the addition of the blade and the potentially increased wounding power that came with the modification worth the effort of carving a socket, formulating resin, and constructing a blade, especially when the blades often broke?

There are a few possible explanations. First, adding a blade may have allowed it to be used as a multi-function tool. The warrior could have both a war club and hatchet at his side and not have to carry two separate instruments. Second, addition of the blade may have been what Fox (1867) contended was a natural evolution in war club design. Burton (1884) made a similar conclusion, noting that elements were added to clubs via inspiration from nature (teeth, claws, stone blades, etc.) (1884:13). Burton's conclusion should be weighed carefully as he believed such additions supported his theory that the war club eventually evolved into the sword, which is somewhat hard to believe. Third, perhaps the addition was in response to escalated violence. Im Thurn noted that production of war clubs, bladed and non-bladed, greatly reduced as European forces quelled inter-tribal violence amongst the Amerindians. If reduced conflict resulted in a reduced number of clubs, could increase conflict have necessitated a war club capable of a higher level of violence and injury?

This third theory is not unheard of; an example from the Maya illustrates its potential. Gallenkamp (1987) notes that the Classic-period Maya soldier's kit included short spears, shield, flint knife, and wooden club (1987: 121). This kit was soon to change, with Gallenkamp writing that, "When warfare assumed an increasingly important role, a number of innovations entered the Maya arsenal" (1987: 121). The Maya developed projectile weapons, such as slingshots, atlatls, and arrows. Further, they dropped the flint knife and wooden club and replaced them with a "two-handed wooden swords edged with obsidian blades", a weapon that would carry on in various Central American civilizations (Gallenkamp 1987: 121).

While it is unlikely that an evidenced answer to why Amerindians added stone or metal blades to the macana will be found, the effort it took had to offer a potential return on the effort investment to build the bladed club.

It is possible that the blades were added to achieve both the multi-function tool noted above and provide the weapon with a smaller impact surface. That said, breakage was clearly an issue. As trade hatchets and axes came into ready availability, the macana no longer needed a blade as these tools were more durable and functional. Further, as inter-tribal violence subsided, the non-blade version served its purpose as Amerindians worked as guides and trackers looking for escaped slaves.

The Physics of Trauma

The macana is well designed and built to be a weapon capable of inflicting serious wounds. From the wood, its weight, the narrow edges, and possible blade, each element lends itself to a calculus of serious soft tissue and bone injury.

The macana, like all war clubs, caused tissue damage through what is called blunt force trauma, with Madea et al. (2014: 258). noting that, "The term itself is used to describe physical damage due to mechanical force applied either by the impact of a moving blunt object or by the movement of the body against a hard surface" They further note "the transfer of kinetic energy with consecutive tissue deformation and injury." Causing injury with blunt force trauma relies on transferring the most energy from the striker to the victim.

Blunt force trauma is not a mechanism of death, which is "defined by what physiologic function failed and caused death" (Bucholtz 2014: 123). Most often, death from blunt force trauma involves "shock, usually from blood loss or brain-spinal cord disruption" (Bucholtz 2014: 123).

According to DiMaio and DiMaio (2001:91), "The severity, extent, and appearance of blunt trauma injuries depend on" several factors. These factors work together, as an equation of sorts, to explain the attributes of the injury. The most severe injuries occur when force is high, the time to deliver the energy is short, the impact point of both the weapon and the body have a small surface area, and the weapon is durable (DiMaio and DiMaio 2001: 91). If the force is low or the energy delivery takes a long time, the severity is lower. If the force is dissipated over a large surface area, the injury severity is lower. If the weapon "deforms or breaks on impact, less energy is delivered" because some of that energy is used to make the actual deformation and/or break (DiMaio and DiMaio 2001: 91).

Given that the macana was made with the hardest woods available, they clearly lost little energy due to deformation. Also important to understanding the wounding ability of the macana is the role of impact points with small surface areas. The macana's narrow edges and sharp corners focus the energy on a small area, thus increasing damage.

Another element to injury is increasing the amount of force exerted on a surface area, especially a reduced surface area (DiMaio and DiMaio 2001: 91). Adding a stone blade increases the weight and thus the force of impact. Further, the blades have an even narrower edge than the carved edges of the club. Even with a blunt edge, this impact would cut and lacerate. The metal blades would have cause similar injuries, but would not have had as much force as they were much lighter than their stone counterparts.

Injuries

I turn next to general injuries caused by the macana with a specific focus on the non-bladed variety of the club because these appear to have been more common, although stone and metal blades are mentioned.

Bucholtz (2014) identifies four injuries caused by blunt force trauma: abrasions, contusions, lacerations, and

fractures (123). Prahlow (2010) adds a fifth injury to this list: avulsion.

Soft Tissue: Abrasions, Contusions, Lacerations

Damage to soft tissues is often responsible for death by blunt force trauma. Not all soft tissue injuries are life threatening, but some do lead to significant complications. While it is important to understand the role of soft tissue injuries in assessing the macana as a weapon, it is doubtful evidence of such wounds will be found in the archaeological record, as would be the case with skeletal injuries. Therefore, this examination of soft tissue injuries will be brief.

Abrasions, contusions, lacerations, and avulsions are all the types of soft tissue injury caused by blunt force trauma. DiMaio and DiMaio describe an abrasion as the "removal of the superficial epithelial layer of the skin" or the destruction thereof by friction or compression (2001: 92). Such wounds are rarely serious.

Contusions are "an area of hemorrhage into soft tissue due to rupture of blood vessels" (DiMaio and DiMaio 2001: 98). Contusions, often resulting in bruising and pockets of blood, can be far more life threatening than an abrasion and can cause death by shock and even blood loss. A blow delivered to the chest can cause cardiac arrest (DiMaio and DiMaio 2001: 119). In addition, unlike abrasions, contusions can occur in both the skin and the internal organs.

Lacerations represent the most destructive wound and, like contusions, can involve the skin and internal organs. Lacerations are "a tear in tissue caused by either a shearing or a crushing force" (DiMaio and DiMaio 2001: 104). Such wounds are more common "over bony prominences, such as in the head" (DiMaio and DiMaio 2001: 104). An avulsion can be considered a type of laceration. Prahlow defines avulsion as "a blunt force injury in which a portion of a body part (or tissue/organ) substantially separates from or totally separates from the body (or tissue/organ)" (Prahlow 2010: 310). An amputation caused by blunt force trauma is considered an avulsion.

It is also important to note that internal organs, depending on location, could be subject to lacerations and contusions. Injuries could be caused by the direct transfer of energy through soft tissue or by broken bones, especially a rib, contacting organ tissues.

While a glancing strike from the macana could possibly cause an abrasion, the club is more likely to cause contusions and lacerations, with the severity of the wounds determined by the factors noted in the previous section. The macana, with its edges and corners, in addition to the hardness and weight of the wood, was designed to cause wounds such as contusions and lacerations no matter in which direction it was swung. While the head of the club perhaps offered a more versatile catalog of strikes, the pommel could be used to deliver crushing hammer-style blows. Figure 2 details the various potential strikes possible to the head using the macana. Impacts to the head could cause fractures (discussed below) and serious injuries to the brain, including hematomas and aneurysms.

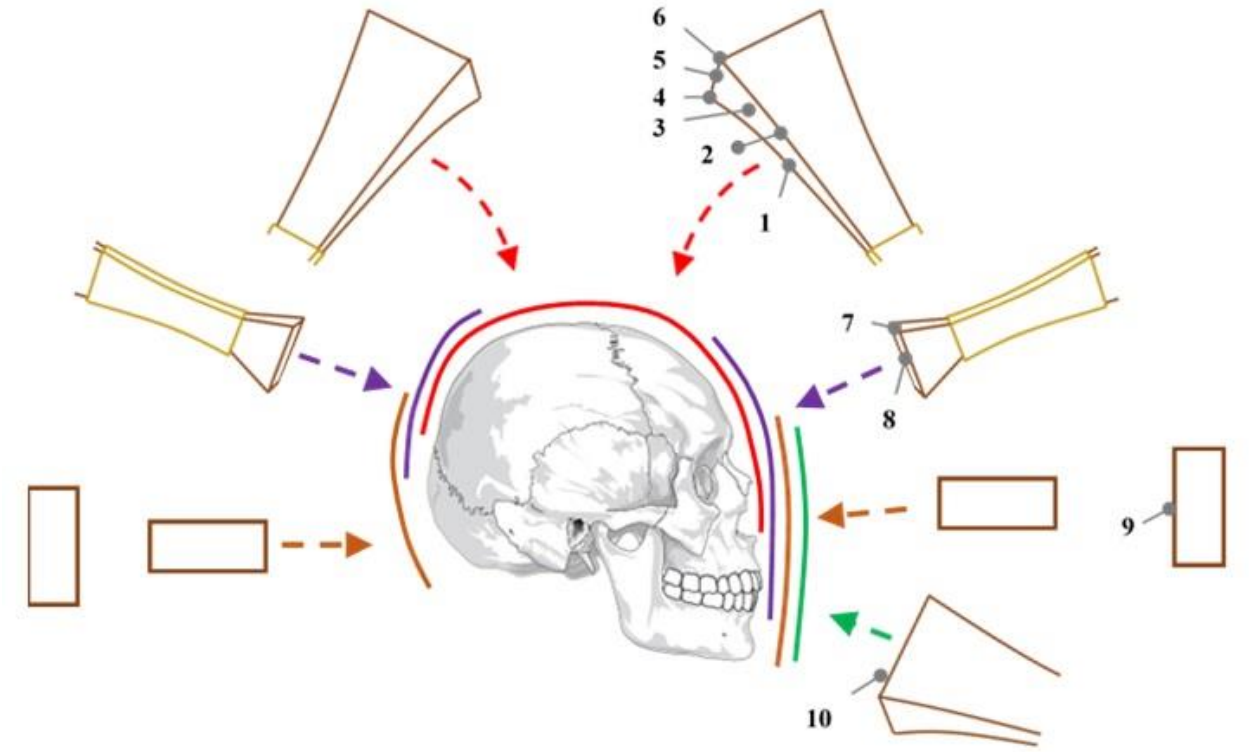

Figure 2. Potential Impacts of the Macana and the Skull.
Note: the impact areas shown front and back would continue onto the sides of the skull and mandible.

1: Outside front edge, wrap to end of head.
2: Inside front edge, wrap to end of head.
3: Front face
4: Outer corner
5: Bottom edge of head
6: Inside corner
7: Front edge of pommel
8: Bottom of pommel
9: Side face
10: End of head

Bones

Areas where the skeletal structure is near the surface of the skin make it susceptible to blunt force trauma. While no bone is truly safe from the impact of blunt force trauma, some require extreme force to reach, such as femur, while others, like the skull, require much less effort. As noted in the brief discussion above, lacerations are common "over bony prominences, such as in the head" (DiMaio and DiMaio 2001: 104). While a laceration is a soft tissue injury, the same location can experience a bone fracture, so a wound could have a soft tissue laceration and an underlying fracture. Further, fractures can cause additional damage. As Bucholtz (2014) notes, "The risk with fractures is the resulting tears of underlying tissues from the jagged bone margins. Life-threatening tears may occur in the heart, lungs, liver, spleen, large arteries or veins, brain, or spinal cord" (Bucholtz 2014: 130). Blunt force injuries to

the skeleton are most often found in the bones of the skull, arms, and chest. In addition, unlike soft tissue injuries, fractures could be found in the archaeological record.

Passalacqua and Fenton established a spectrum to explain what happens to bone when a force acts upon it: 1) force is applied; 2) bone bends, but not permanently; 3) bend is permanent; and 4) breakage (Passalacqua and Fenton 2015: 400). In their exploration of fracturing, Zephro and Galloway describe that stress in a fracture event is best understood by the following formula:

Stress=Force/Area

Herein force is measured as meganewtons per square meter, megapascals or pounds per square inch (Zephro and Galloway 2013: 34). Strain, which is the key factor in deformation, is called a "ration of change" (Zephro and Galloway 2013: 34) and is stated as:

Strain=Deformation/Dimension

The attainment of spectrum steps and breaking forces depends on some attributes of the bone. Bucholtz (2014) states that, "The amount of force needed to fracture a bone depends on the bone, the age of the person, and the presence or absence of underlying disease affecting the strength of the bone" (2014: 128 and 129).

The skull is perhaps the most bludgeoned area of the human body. The proximity of the bone to the skin surface makes both laceration and fractures very severe and with less effort than is needed by other areas of the body, like the pelvis and leg.

When striking the head, targets can include the face, mandible, and cranium (DiMaio and DiMaio 2001: 109). The mandible, maxilla, zygoma, and zygomatic arch can easily be fractured with a single strike and cause a diverse set of fractures. For example, the maxilla fractures fall into five different types: Dentoalveolar includes some mandible breakage; LeFort I breaks through the nasal septum above the teeth; LeFort II breaks through the orbits low and across the bridge of the nose; LeFort III breaks higher across the orbits and the bridge of the nose; Sagittal follow the sagittal plane, (DiMaio an DiMaio 2001: 109). Such fractures would cause bleeding in the nose and throat an obscure vision.

For fractures to the skull itself, the type of fracture caused depends on the amount of energy transferred from the weapon to the bone. DiMaio and DiMaio (2001) state that it takes between 33.3 and 75 ft lb of energy to produce a simple linear fracture of the skull (149). Higher levels of force result in specialized fracture. Circular fractures and stellate fractures are possible with increase force (DiMaio and DiMaio 2001: 150).

The macana, with its sharp corners, is ideally designed to cause depressed skull fractures. Such fractures occur when a "large amount of kinetic energy" is delivered from "a small surface area" or such energy "impacts only a small area of the skull" (DiMaio and DiMaio 2001: 150). Such fractures are usually accompanied by significant lacerations to the scalp (DiMaio and DiMaio 2001: 151). Such fractures could also cause contusions and bleeding in the brain. DiMaio and DiMaio note such wounds as causing epileptic seizures, albeit rare (2001: 151). The macana could also cause basilar skull fractures or fractures at the base of the skull and ring fractures around the foramen magnum depending on where the club contacted the skull and the amount of energy delivered.

While decidedly less common in combat than strikes to the head, blows to the chest had the same potential for serious injury. A fractured rib can cut vessels, arteries, and organs. And death is not always

proximal to the injury. A fractured rib can cause damage that eventually leads to pneumonia or a wound may become infected (Bucholtz 2014: 130).

Another area of the body that was often injured in combat are the tissues and bones of the upper extremities. Such injuries "are seen in forearms when an individual has tried to ward off blows from such instruments" (DiMaio and DiMaio 2001: 111). As arms were raised to defend oneself from a strike or were the direct target of a strike, bones suffered direct impacts that caused significant damage. Often bones are damaged on the surface opposite the force impact as that is where bending and failure occur. However, a strong enough force can damage the impact area as well. For example, a forearm blocking a strike will most often experience a focal fracture, which is a "small force is applied to a small area" (DiMaio and DiMaio 2011: 111). Such fractures usually only break one of the two bones in the forearm.

Next Steps

Based on the above theoretical analysis of the macana and related impact weapons, field and collections work needs to be conducted to look for evidence of skeletal trauma that could be associated with such methods of combat. This research may not be definitive unless clear contextual evidence exists for combat given that the skeletal injuries associated with combat-related trauma could also be caused by non-combat events. Further, the volume of skeletal evidence in the Guianas, especially in Guyana itself, can be limited given environmental factors that adversely affect preservation, with Hammond (2005: 389) noting that most remains are found in "shell middens or rock outcrops" which provide a protection against soil acidity of the region. Using other forensic techniques, such as tool mark analysis, it might be possible to match a wound shape to a weapon style, but this greatly depends on the uniqueness of the weapon and the wound being examined.

Conclusion

The waisted or flared quadrilateral war club appears only in the Guianas. As compared not only to impact weapons of South America, but to the world over, its appearance is unique. The club could deliver at least 10 different strikes depending on the surface used and delivered these strikes as a hand-held bludgeon and even possibly a missile weapon. The design focused on delivering the maximum amount of energy from a small surface area to a small surface area, the ideal ratio for causing significant soft tissue and bone damage via blunt force trauma. Stedman's observation that a strike from the macana "scatters the brains" (Stedman 1796: 396-397) was correct in characterizing the club's capabilities. The club could cause abrasions, contusions, lacerations, and avulsions to soft tissue, while delivering force capable of damaging impact surfaces on bone leading to serious fractures of the skull, arms, and chest. On the battlefield, it could have caused both instant death or wounds that would eventually lead to death from infection or illnesses like pneumonia. Given its versatility and durability, the design is a masterpiece of weapons engineering.

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