

David and Goliath: Realistic Self-Defense Techniques

Dawn Newton

Introduction

Many combative martial arts have been brought to the United States in the form of sports, which translate easily into American culture. The structural confines of competition have given arts such as taekwondo, judo, and karate a way to measure and compare the skill of practitioners and have forced competitors to strive towards a goal of perfect form, timing, and execution. In particular, weight classes allow practitioners to narrow their training spectrum because they can anticipate the size of their opponents. With such an arrangement, a very large or very small person would not benefit significantly from training with someone of a vastly different body type or fighting style.

Hapkido is not such an art. In the United States, the philosophy of hapkido is based upon the idea of self-defense from many different kinds of threats. As a self-defense martial art, hapkido aims to meet two goals. First, instruction in hapkido should teach the martial art in its most whole form—if possible, to a level of mastery. But second, and perhaps more importantly, it should teach the students skills that they can use to defend themselves from harm before they have reached a level of mastery. In this way, hapkido can be considered a *practical* martial art. People who are concerned with crime and personal

safety are often drawn to hapkido for this reason.

The scenarios with which hapkido is primarily concerned are felonious attacks. These include battery, rape, robbery, and murder; each is an instance in which there is a high probability or a requirement for physical harm. In most cases, the attacker has breached the social and emotional prohibitions against the crime before beginning the encounter and is therefore unlikely to stop unless physically overpowered.¹ Additionally, most attackers choose victims who are much smaller than they are, making it even less likely for the victims to be able to stop the attack.

In this context, a smaller individual can be anyone who is at a disadvantage because of height, weight, or musculature. A *good* victim probably shares all three traits, being short, small and weak. In a determined assault, many techniques common to the practice of hapkido, such as front kicks and soft blocks, are rendered all but useless by the large size disparity between the fighters and the relentless nature of the attack. An effective but realistic response to an attack will take into account the ramifications of the size difference on the defender and will maximize the defender's application of power against the attacker.

The Criminal Mind

To respond appropriately to any typical social or business situation, it is important to understand the motivation of the people involved. This is also true of a violent attack. Studies of criminal psychology paint a portrait of a typical offender's thought process that can be used to shape a plan of defense. While the

portrait is certainly not true to every offender, it is a safe baseline assessment in the absence of other information.

One of the more common traits exhibited by criminals is a lack of self-control. In general, people with low self-control are extremely susceptible to passing temptations and act to maximize their immediate gratification. While the original proponents of this theory, Gottfredson and Hirschi, in their book *A General Theory of Crime*, have come under attack for proposing low self-control as an unsubstantiated primary or individual-level cause of crime, empirical data has subsequently indicated that low self-control is quite dominant in offenders' psychological profiles. People with low self-control are typically self-centered, and exhibit impulsiveness, lack of persistence, and risk-seeking behaviors. They also tend to be interested in physical activity rather than conversation and show a lack of empathy, manifested as indifference to the needs of others.² They are particularly sensitive to frustration and seek, in Gottfredson's words, "money without work, sex without courtship, revenge without court delays."³ These beliefs fuel a basic tenet that criminals use to justify their behavior: that something is owed to them.

A recent study of sexual offenders examines the results of some of these dysfunctional beliefs as a way of understanding the psychology of child molesters. It corroborates the assessment that offenders use confirmatory biases and selective exposure to support their pretenses and reinforce their own maladaptive behaviors, both before committing the act and as a way to justify the aftermath. According to Ward et al., "The most commonly endorsed beliefs involved victim

enjoyment, absence of victim harm, or 'extenuating' circumstances such as alcohol."⁴ Extenuating circumstances also included the perpetrator's need for sex and the lack of conventional sex available.

In interviews with sexual offenders, researchers traced a chain of events for assaults. This chain started with background factors such as stress, feelings of loneliness or psychological trauma. A high-risk situation, such as interaction with a playful child, was the next step. A key fact about the high-risk situation is that the offender typically set up or manipulated the situation, either knowingly or not. The next stage was a lapse, or an experience of thoughts or ideas necessary to the commission of the act, such as fantasizing. Immediately following this stage was the relapse, the actual offense. Finally, the offender experienced post-relapse, or the self-evaluation of the act. This stage was typically an avenue of denial, allowing the offender to justify his or her actions; it also allowed the offender to maintain his or her behavior pattern in future instances.⁵ The interplay of frustration and need for instant gratification are apparent here, mirroring the psychological theories governing people with low self-control. The denial by the perpetrator in the aftermath of the act is also very significant.

The impact this information has on an individual interested in self-defense is dramatic. Although recent research suggests that violent crime instigated by a stranger is much less likely than that involving a perpetrator who is acquainted with the victim, this paper will assume rhetorically that the typical attacker is a large male who has no legitimate, discernable motive for his actions. These psychological profiles

indicate that the person cannot resist temptation, feels entitled to gain without traveling the associated, socially acceptable avenues, favors confrontation and physical activity, and is likely to deny that his actions are wrong. In such cases, there are no incentives for the attacker to stop the assault once it has begun, unless the victim responds with enough physical force to overcome the attack. Conventional social controls such as guilt, shame, social pressure or fear do not significantly impact the deviant mental processes of criminal attackers. This means that passive resistance and verbal entreaties are unlikely to end an attack.

Moreover, because the criminal attacker is typically lazy, and more interested in easily acquiring ill-gotten gain than in working hard for the loot, he is likely to choose a victim who appears to be an easy target rather than a challenging one. In other words, smaller people are at greater risk of being victimized than larger people in assaults that do not involve a weapon. This does not mean, however, that a single defensive kick or punch from the victim will present too much for the attacker to overcome. The attacker also enjoys confrontation and physical activity and has a low tolerance for losing or not getting a measurable benefit for every act. Furthermore, the attacker needs to be able to deny wrongdoing in the post-relapse stage. Completing the attack satisfactorily supplies the benefit necessary for the act to fall under the category of extenuating circumstances, e.g., "He wouldn't give me the briefcase, so I had to smash his face and take it." Being rebuffed in an attack is likely to induce feelings of failure and a frustration, thus, once engaged, the attacker will most continue the attack unless forced to stop.

Cruelty, Thy Name is Physics

Facing down a determined and socially deviant individual bent on physical abuse would be a daunting task for any individual. For someone greatly outsized by such a person, the task is even more difficult. This is because the Newtonian physics of the material world govern movement and stasis in a way that favors the larger individual in almost every aspect. A small body has difficulty moving a larger body, while the large body moves or injures the small one easily. In the same vein, a small defender may be unable to apply significant pressure to the control points of a larger attacker's body because of height or weight differences, whereas the larger person can apply any of the multiple advantages such as weight, strength or reach in an attack on the smaller victim.

Newton's first law of motion, the Law of Inertia, states that a body in motion tends to stay in motion, while one at rest tends to stay at rest. His second law of motion, the Law of Force, governs momentum and states that a force applied to an object will cause a change in momentum proportional to and in the direction of the applied force. Newton's third law, the Law of Reaction, states that when one body exerts a force on another body, that other body will exert an equal and opposite force on the first body. With regards to human bodies in motion, this means that in order to stop an approaching attack, the defender must be able to summon enough force to either counteract the force of the charge or to divert its vector.

Force is a product of an object's mass times its acceleration.⁶ Thus, in order for a 110-pound person

to stop the charge of a 220-pound person, the smaller individual would have to accelerate twice as fast as the larger person. Sadly, in a real-life scenario, such ability is outside the realm of the physically possible. Therefore, the smaller person must be content with only diverting the direction of the larger person's charge, a strategy which requires much less force to achieve success. This differential also means that even if the smaller defender gets a head start on a charge or thrusting motion, the larger attacker is likely to be able to summon sufficient force to counteract the defender's motion.

Another important concept from physics is the so-called *center of mass*. Every object has a center of mass that is a balancing or central point where all of its mass seems to be concentrated. The stability of an object is determined in part by the distance from the object's center of mass to the ground.⁷ Shorter or heavier people usually have lower centers of mass than taller or thinner people and are therefore credited with being more stable. This sounds like a benefit to the smaller person, but as later discussion reveals, gravity may actually act as much as a bane for the smaller person as a benefit in physical conflicts with taller attackers.

Of course, Newton's laws can be quite awkward to apply to the complicated objects found in the real world. Rather than consisting of an ideal solid sphere, the human body exhibits variously shaped parts that can move somewhat independently. Different parts of the body offer different strengths of tissue and bone, with connective tissues, nerves, reflexes, individual susceptibility to pain, and other traits combining to complicate the task of calculating how a person will

respond to an applied force. Y.C. Fung writes on stress and injury in the body, “The safety of the structure is judged by the stress at every point relative to the strength of the material. The safety of the structure is determined by the weakest link.”⁸ In other words, a small force applied against a weak part of the body may do significant damage to a large person, whereas a much larger load on a more resilient part of the same body would have no effect. The weaker defender must maximize his or her chances by striking the most susceptible parts of the attacker’s body.

Application of power is another concept firmly based in Newtonian physics. Defined as the rate of change of energy over time, the martial artist has several means of increasing the power of a technique. Simplest, perhaps, is training to increase the speed with which the technique is delivered. Indeed, speed training is a hallmark of many martial arts for just this reason. Slightly more difficult is to increase the energy delivered to the target, defined by the product of the force and the distance over which it is delivered. Since a smaller person is naturally at a disadvantage in terms of increasing the force of their techniques (in comparison to a larger attacker), martial arts instructors will typically focus a student’s attention on increasing the application distance. “Kick through the target!” is a common exhortation. By following through on a kick, not only does the application of force extend over a larger distance, but the amount of force is necessarily greater as well, since retraction of the blow necessarily implies a reduction in the force being applied to the target. The net result of better follow-through is greater power delivery.

Naturally, the larger person owns a great advantage because of all of these factors. If a male attacker is able to summon speed in addition to force and to attack the victim's weak points, he stands to easily win the confrontation. The smaller person must anticipate this possibility and respond with protective maneuvers in addition to offensive techniques. Hapkido offers many such protective stances and behaviors, some of which have been widely adopted because of their efficacy, such as the front roll. *Bicycling* magazine describes a forward roll's motions and recommends that cyclists "do this tumbling drill three times a week until this collarbone-saving motion is automatic as you head over the bars," citing the high incidence of crash survivals by people who have practiced such maneuvers (and the high incidence of broken bones in those who don't!).⁹ Evidence such as this supports the idea that some martial arts techniques can be used to avert injury. Extrapolated, a small defender may survive the attack of a larger attacker if he or she utilizes good defensive techniques and does not take too many risks with questionable or weak counterattacks.

The Herculean Task

From the criminal portrait presented, there are two sets of circumstances that will be assumed to be true in a felony assault. First, it is assumed that:

- the attacker is not mentally well-balanced;
- having initiated an attack, the attacker is unlikely to give up easily;
- the attacker is in decent physical shape and is able to deal with a victim who fights back.

Second, based on the fact that the attacker chose a particular victim, it is very likely that, relative to the victim, the attacker is:

- physically stronger;
- as fast or faster on foot;
- more resilient to damaging blows.

The resulting image of a confrontation is quite frightening but is also very realistic. Unless an attacker has an equalizing or terrorizing tool such as a gun or knife, he or she is not likely to choose a victim who appears able to resist.

Physical laws of motion and body mechanics demonstrate that the small person will have no luck meeting force with like force. This is a major credo throughout the martial arts and particularly in hapkido. The smaller person will have more success controlling the situation by adding force in the direction the opponent is already traveling, or by subtly redirecting the opponent's direction of travel, thereby taking the opponent off balance. Unfortunately, accurate execution of many techniques designed to do these things can be quite difficult and may take decades of study to perfect. In a situation where the smaller opponent may be fighting for his or her life, techniques with a high probability of success are recommended over techniques with high injury probabilities but low probability of successful execution.

Throws

In combative situations, throws are highly prized because they give a clear advantage to the thrower by causing the opponent to hit the ground (a strike) and

be taken off his or her feet to the ground. They leave the thrower with a variety of options—from simply running away, to kicking or stomping on the opponent's head. And because they rely less on brute strength and more on redirecting an attacker's momentum, throws can be easier to execute than a significantly damaging defensive punch or kick. While throwing techniques may lie outside the skill set of some martial artists, many aspects of throwing involve techniques that are common to many martial arts maneuvers.

First, successfully manipulating another person's body and momentum requires taking the person off balance. This can be done in three major ways, all of which can be combined with one another. By applying force to the upper portions of the body, mostly the head and shoulders, and so bending the attacker either forwards or backwards, the attacker's center of mass is dislocated to an unstable position, causing a fall. This technique can also be used to make the person move his or her legs in an attempt to regain a stable base. Secondly, the attacker's legs can be swept out from underneath, either by force or finesse, causing him or her to fall or stumble. Finally, strong force can be applied to the center of the body, which will bowl the person over if he or she is unable to withstand the impact or caught unaware by it. For a small defender, this last approach is unlikely to succeed, and the finesse portion of the second method may require better timing skills than the defender possesses. This leaves the first technique, off balancing, as the most easily executable for a small defender.

The majority of a person's body strength can be

applied within a zone in front of the body roughly framed by the outline of the torso, extending outward to a distance of an arm or leg's length. In the horizontal plane, strength is best used at or below the level of the shoulders. The front of the abdomen, about the same location as the center of mass, is the strongest place in the body.¹⁰ Unfortunately, the control points for a taller person, located on the head, neck and shoulders, are located at or above the head of a smaller defender. To push or pull these points in order to off balance the attacker requires a high grasp in relation to one's own center of mass which makes it that much more difficult to apply the body's strength against the target points. Reaching upward to push or pull horizontally is not a stance where strength can easily be brought to bear. Additionally, pushing upward against target points above the shoulders creates a force that is opposed by gravity, resulting in a net overall force less than that intended by the defender.

Should the defender exert a pull instead of a push, the force of gravity will complement the effort, resulting in a net overall force that is larger than that generated by the defender's strength alone. This increases the chance that the pulling action will be successful in off balancing the attacker (as compared to using a push). Additionally, when the opponent begins to fall forward because of the pull, the smaller opponent has greater control over the speed and direction of that fall because the overall motion is towards him or her and thus closer to the zone of maximum strength.

Among the body throws (sometimes discussed as judo-style throws) that are fairly easy to execute and

use these principles are hip throw and spring-hip throw, shoulder throw, stomach throws, and forward body drop. Shoulder throw generally requires a great deal of strength to execute properly because it requires that the opponent be thrown over a higher point on the body than where a fighter has maximum strength. Proper form also prohibits most of the rest of the body from helping with the momentum, since the shoulder—the primary point of contact between the defender and the target—should be relatively high compared to the defender's center of mass. In contrast, the various hip throws allow for most of the opponent's weight to be supported on the hips and legs, resulting in a stronger, more stable throw. For more experienced fighters, spring-hip allows the defender to quite literally throw his or her entire body into the technique, thereby maximizing the force and acceleration that can be mustered. The downside to this particular technique is that the defender is likely to fall and land on top of the attacker, and so must be ready to carry on the attack in the ensuing phase of ground fighting.

The forward body drop is a good technique to use against a charging opponent, as it maximizes the deflection of the attacker's momentum, but there is an important caveat to relying on this throw. A lesson that lower rank students continually teach other practitioners is that people who are not familiar with martial arts are generally unwilling to take flipping falls unless forced to do so. In the case of the forward body drop, the defender must be willing to exert enough strength with the hand pull to counteract the last minute pullback that an inexperienced opponent will exercise to avoid the fall. Unless the defender is

willing to spike the head of the attacker into the ground very hard and very fast, it is likely that an unwilling attacker will be able to resist this technique.

Finally, stomach throws are very quick techniques which almost everyone falls for because human reflex causes people to jump backwards with their hips and feet, leaving their upper body pitched forward when something comes toward their lower body. Two problems commonly happen with this throw. First, the defender is not strong enough or is unprepared to support the weight of the attacker falling forward onto him or her, and so ends up sandwiched beneath the larger body. Improvement comes with practice, particularly in learning to use the legs to push the attacker's lower body or legs away, so that the opponent flips heels over head and onto their back instead of toppling forward stomach-first. Second, application of this technique means that the defender has placed him- or herself on the ground into the same immobile position that is a disadvantage for the attacker in other throws. The defender must be ready to jump up and run or roll up into a continued attack in order to avoid being grabbed and held on the ground by the attacker.

Hand throws are also practiced in hapkido, where the force of attack against a wrist or other joint causes the opponent to take a fall in order to avoid suffering the pain of the joint lock and the imminent threat of broken bones. Unfortunately, the chance of successfully executing such a throw on the street against an inexperienced opponent is slim to none. Moreover, the amount of muscle that a large attacker can use to resist such a move is quite impressive. Combining the rapid exertion of strength with the

mass of a muscular arm results in a frighteningly large force—a force likely to be great enough to simply remove the hand or wrist from the defender's grip if the hand-throwing technique is not delivered absolutely perfectly.

Strikes

Punches and kicks might seem intuitively to be the wisest self-defense choice because they maintain the most distance between the attacker and the defender. There is also nothing complicated about applying these techniques, unlike throws or joint locks where achieving the desired result can rely on a fair amount of specific body manipulation. However, a small person cannot generate easily the same amount of force that a larger person can, while a larger person's bone and muscle mass make him or her more resilient to injury.

When resorting to strikes, a good rule of thumb is to apply more of you against less of them. That is to say, a small defender must attack obviously weak points with very powerful techniques, using as much body weight and force as possible. The classic example is a knee lift kick to the groin. Although a small person risks being grabbed when he or she comes in close enough to throw knee or elbow strikes, the scary reality is that being in very close to the opponent is required for a successful strike against *most* sensitive targets. Though painful, a vicious kick to the knee is unlikely to cause much more than temporary discomfort when the opponent is twice as heavy as the defender. Moreover, blows are often softened by the tendency of fighters to cushion and

ride strikes. This means that the opponent will not only block the technique if possible with an arm or a leg but will also move the part that is being hit to minimize the shock from a static blow. Experiments with crash test dummies and side impact accidents have shown that these natural blocking techniques dramatically reduce the impact and the severity of the injuries sustained by the target.¹¹

In order to inflict the maximum force and disable an opponent, a small fighter must hit with the strongest techniques, which include: knee, elbow, and palm heel strikes; blows to the groin or floating ribs; and particularly, strikes to the head. Though many people are flexible enough to kick to the head, this strategy is ill advised unless the defender can summon enough power to do significant damage once their foot connects with the head. Also, while less powerful, hand strikes are much faster than kicks, and so are less likely to be blocked before impacting their targets.

For small fighters who wish to kick, the two-step side kick is the strongest long-range kick in their arsenal. It combines linear momentum, which is easy to control, with a very solid stance. This allows the defender to put a large percentage of his or her body weight into delivering a strong technique. Fancier kicks like the turning side kick and axe kick mirror the strong suits of the normal side kick and are also powerful kicks, though they are more difficult to execute with precise targeting. Other kicks are less suitable for self-defense. The roundhouse kick is typically slow, easy to see coming, and lacks good target possibilities unless the defender is able to kick to the head. Similarly, while the rear-leg front kick is

better than the front snap kick for generating power, both suffer from the same dearth of sensitive targets as the roundhouse. These kicks might be great for bruising an opponent in a sparring match, but they are less effective in a life-or-death situation.

Punches are best directed to the head where even less powerful impacts may disorient an opponent. Regardless of the size of the opponent, the brain is balanced in approximately the same way, and a solid hit will cause a momentary distraction. Many other targets in the head are also ideal. People get nervous and jumpy when things come near their eyes. The tongue and teeth are very sensitive and will cause a visceral reaction if rattled, cut, or otherwise impacted. Boxing the ears can cause momentary ringing or deafness, which will also distract an opponent. These are necessary results because the small defender will have the same reactions, or worse, to being hit by the attacker. Any strike must do the maximum amount of damage to allow the defender to escape.

Joint Locks and Pressure Points

Although hapkido teaches many joint locks, a great number of them require subtle finesse or some amount of strength or momentum to complete. If the defender is nervous or distracted, even carefully rehearsed techniques may fail to work under pressure. Certainly, as with most other techniques, reliance on strength is a mistake. The wrist techniques with the highest probability of working are the ones which generate a lot of momentum, which can work in lieu of force, and which do not require very subtle angles or pressures to work effectively. Two locks that fit this

description begin from the defender grasping the attacker's hand and slipping in one direction or the other under the attacker's arm to complete a full-circle turn. This twists the attacker's wrist without using very much strength. If there appears to be no discomfort, the defender can continue turning until the breaking point of the wrist is reached. These two counterattacks are depicted in the photo sequences shown below.¹²

Sequence 1: Turning to the Inside

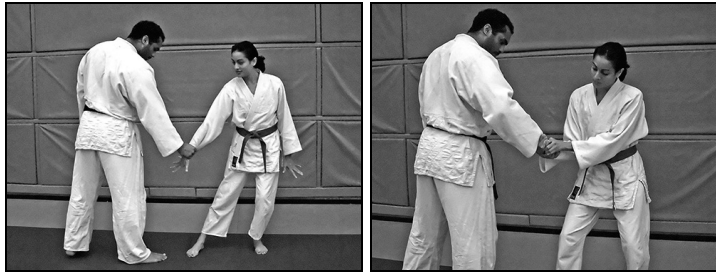


Figure 1: Live hand response to grab attack (left).

Figure 2: Covering the attackers hand (right).



Figure 3: Turning under the attackers arm (left).

Figure 4: Raising elbow and re-covering (right).



Figure 5: Applying wrist lock (left).

Figure 6: Wrist lock detail (right).



Figure 7: Applying elbow and shoulder locks to off-balance the attacker forward (left).

Figure 8: Maintaining wrist lock while applying downward pressure at the shoulder (right).



Figure 9: Bringing down the attacker (left).

Figure 10: Ready for a finish-off (right).

Sequence 2: Turning to the Outside

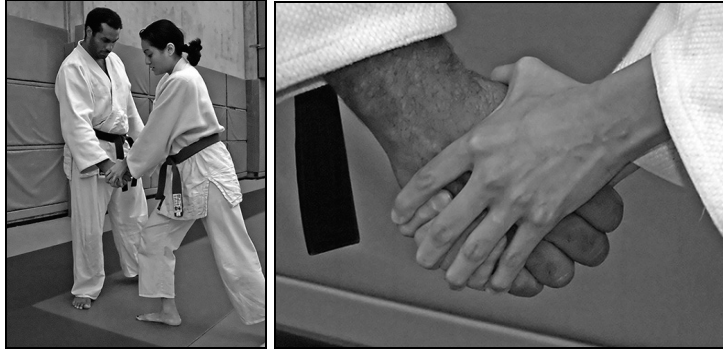


Figure 11: Covering the attacker's hand (left).

Figure 12: Detail of the counter-grab (right).

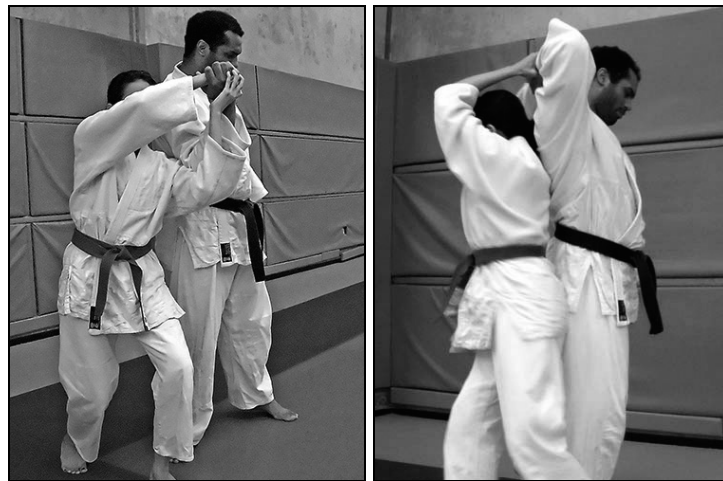


Figure 13: Raising the hand while turning to the outside (left).

Figure 14: Initiating the kuzushi (right).



Figure 15: Continuing the off-balancing action (left).

Figure 16: Bringing down the attacker (right).

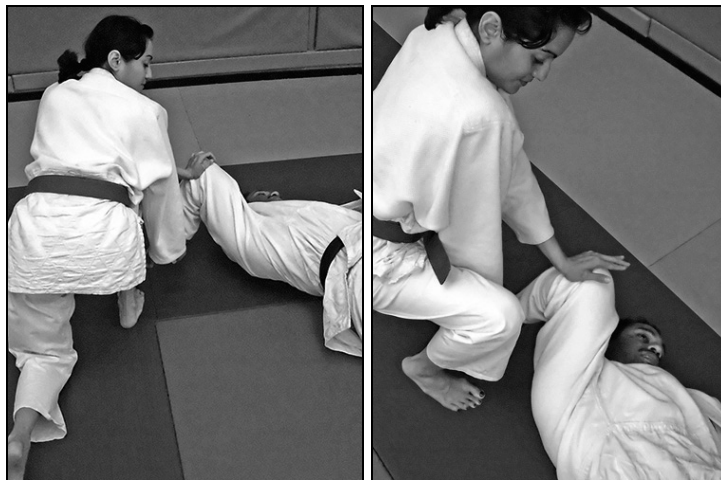


Figure 17: On the ground (left).

Figure 18: Ready for a finish-off (right).

Another plus to these techniques is that both can be used to take the defender's weight and force towards the attacker's backside. As these techniques both end with positioning of the arm outside of the

attacker's zone of strength, it reduces the attacker's ability to counterattack, while simultaneously providing the defender with some protection from blows delivered by the other arm and two legs.

Another set of useful hapkido techniques is the canon of pressure point attacks. Although most people are sensitive to some pressure points, the amount of force required to press through the muscle tissue to find and manipulate a pressure point increases as the person's muscles increase. Finding a buried pressure point in a very strong attacker is almost a hopeless task for a small defender who must move quickly to avoid being grabbed or struck. For a weaker individual in a life-threatening situation, the only pressure points easy enough to rely on are probably ones in the head and neck. These include points behind the jawbone at the top of the neck, under the nostrils in the nose, near the eyes, and in the hollow at the base of the throat.

Conclusion

The way of the world has always been that the more powerful forces lived off of the less powerful ones. Small fish are eaten by larger ones and big waves crush small structures. However, the human race makes an effort to be civilized and societal rules generally prohibit human beings from killing or hurting one another. Unfortunately, not everyone obeys these rules.

When a small person finds him or herself in a dangerous situation, confronted by a much larger person, the smaller individual fights a battle that is not frequently won. The best hope of the small person

is to utilize defensive fighting techniques that will make the best advantage of the situation. From a martial arts perspective, there are numerous techniques that might be of great use when executed flawlessly. However, most people who find themselves needing to use these skills do not have flawless technique. For them, the ability to summon power, precision and momentum and focus it on the weakest of their opponent's parts is their only hope. By carefully choosing techniques which concentrate much of their weight onto sensitive or fragile pieces of their opponent, they may equalize the struggle.

In the Biblical story of David and Goliath, David slew the Philistine by slinging a small rock into the giant's head where it sank in like a third eye.¹³ In the same way, a person truly faced with a life or death struggle against an opponent who is much larger must look for brutal counter-attacks, the right moment of attack, and not hesitate to complete the attack. This is the lesson of true self-defense.

References

- Fung, Yuan-Cheng. "The Application of Biomechanics to the Understanding of Injury and Healing." Chapter One of the compilation *Accidental Injury: Biomechanics and Prevention*. Edited by Alan M. Nahum and John W. Melvin, New York, NY: Springer-Verlag, 1993, pp. 1-11, ASIN# 038797881X.
- Goldstein, Sam. "Attention-deficit/Hyperactivity Disorder: Implications for the Criminal Justice System", *FBI Law Enforcement Bulletin*, v. 66, no. 6, June, 1997, p. 11. This article was posted online on September 27, 2002 at <http://www.fbi.gov/publications/leb/1997/june973.htm>. Accessed July 24, 2004.
- Gottfredson, Michael R., and Travis Hirschi. *A General Theory of Crime*. Stanford, CA: Stanford University Press, 1990, ISBN# 0804717745.
- Longshore, Douglas, and Susan Turner. "Self-control and Criminal Opportunity: Cross-sectional Test of the General Theory of Crime", *Criminal Justice and Behavior*, v. 25, no. 1, March, 1998, pp 81-98. An abstract can be found on PubMed at <http://tinyurl.com/5qqcb>. Accessed July 24, 2004. Reprints may be ordered free, see <http://www.uclaisap.org/CJS/cats/cat4.html> for details.
- Mertz, Harold J. "Anthropomorphic Test Devices," Chapter Four of the compilation, *Accidental Injury: Biomechanics and Prevention*. Edited by Alan M. Nahum and John W. Melvin, New York, NY: Springer-Verlag, 1993, pp. 66-84, ASIN# 038797881X.
- Viano, David C. "Comparison of Arm Up and Down in Side Impacts with BioSID and Different Armrests", *Journal of Biomechanical Engineering*, v. 116, no. 3, August, 1994, pp 270-277. An abstract can be found on PubMed at <http://tinyurl.com/6zdqh>. Accessed July 24, 2004.

Ward, Tony, with Christina Fon et al. "A Descriptive Model of Dysfunctional Cognitions in Child Molesters." *Journal of Interpersonal Violence*, v. 13, no. 1, 1998, pp. 129-155.

Watanabe, Jichi and Lindy Avakian. *The Secrets of Judo: A Text for Instructors and Students*, Rutland, VT: Charles E. Tuttle Company, Inc., 1981, ASIN# 0804805164.

Endnotes

¹ Longshore, p 81.

² *Ibidem*, pp. 81-2.

³ Gottfredson, p. 89.

⁴ Ward, pp. 129-30.

⁵ *Ibidem*, pp. 136-8.

⁶ Clark, John E. *Matter and Energy: Physics in Action*. New York, NY: Oxford University Press, 1994, p.60, ASIN# 0195210859.

⁷ *Ibidem*, pp. 62-3.

⁸ Fung, p.1.

⁹ "Crash Test Dummies (Tumbling Techniques for Bike Accidents)." *Bicycling*, v. 39, no. 2, February, 1998, pp. 76-77.

¹⁰ Watanabe, pp.76-77.

¹¹ Viano, pp. 271-274.

¹² All photos by Randy Vogel, © 2004. Special thanks to photo subjects Adriana Espinosa and Gaidi Faraj! Large color photographs of these two sequences can be found at http://www.funfolks.net/UCMAP_M6/Newton.

¹³ The Holy Bible - New King James Version. I Samuel 17:49.