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**Human Weapon
Strength of the Hit**

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Introduction

During fight, the weapons people use, beside knives, sticks, stones and other stuffs, should be their body parts. Usually, the fist, elbow, knee and foot are the body parts that are used mostly. A study of seven Olympic boxers in weight classes ranging from flyweight to super heavyweight showed a range of 447 to 1,066 pounds of peak punching force. Energy transferred from punch to target varied widely depending on how heavy the boxers' hands and gloves were, how fast they punched, and how rigidly they held their wrists. (William 2016). Then what about with elbow, knee or feet?

Punching-Direct Attack

Punch is to use fist to give a strike. It is the most common way during a bare-handed fight. (Figure 1)

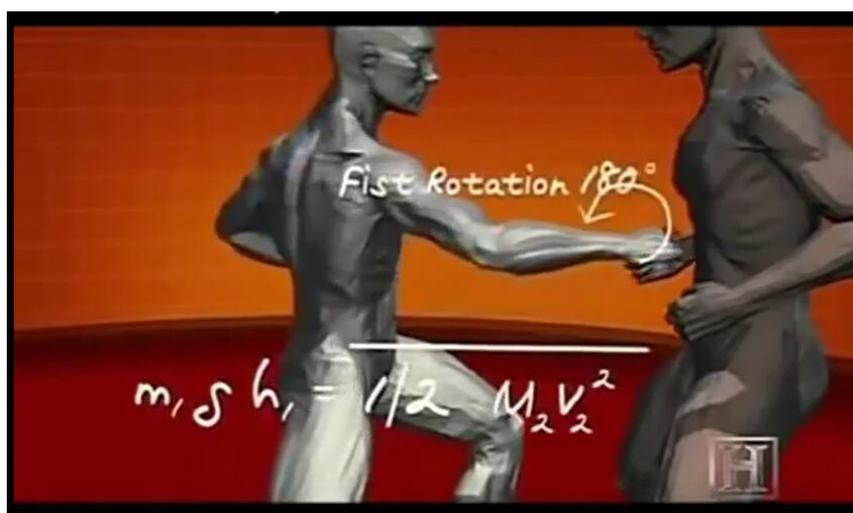


Figure 1 The Punching on the belly.

In the picture, the white model used the right fist to give a strike at the grey model's belly. Notably, the fist spins one round before hitting the object. As you execute the punch, the twisting movement allows the arm to remain non-tensed until impact. This increases speed while maintaining anatomical alignment throughout the technique. This process significantly increases the power delivered by the punch. Experiment: Hold the fist cocked in chamber, palm down, and straight punch without twisting. How much power can you generate? Immediately then re-execute the punch correctly. You will immediately notice a tremendous difference in (1) the lack of tension in the arm muscles (before and during execution), (2) the power generated by the technique, and (3) the stability of the arms and shoulder during the punch (Cox, 2012). In the movie Rocky IV, Ivan Drago registers a 2,150-psi punch. But that is not realistic at all! A study of 70 boxers found elite-level fighters could punch with an average of 776 pounds of force. Another study of 23 boxers showed elite fighters were able to punch more than twice as hard as novices, the hardest hitter generating almost 1,300 pounds of force. (Cecil, 2010) The strength is only able to cause bone fracture or soft issues damage.

Knee Hitting-Fatal attack

When lifting up and bend the leg, one has the most powerful weapon-the knee. (Figure 2)



Figure 2 The Knee strike

Unlike the fist strike, the knee strike gets its strength from the leverage: bending down the opponent's back while strike the belly hard with knee. The strike can cause 2.5 tons of force, which can move a car. (Human Weapon) Melchor Menor, a former two-time Muay Thai world champion, uses a simple technique to incapacitate his opponents: a knee to the chest at close quarters. Menor himself was surprised at how powerful this move can be. "I wasn't expecting to have the highest force. When he said the power of the knee [kick] was equal to the power of a 35-mile-an-hour [56.3-kilometer-an-hour] car crash, it was humbling." The displacement sensor in the dummy's chest measured nearly two inches (five centimeters) of chest compression from Menor's knee strike. (Hall, 2006)

Why is the force so strong? We all know the formula of energy is

$$E=1/2mv^2$$

When the mass is constant which is the knee, the speed decides the strength. When the performer pulls the back of the opponent down, it increases the relative speed of the knee and the belly, just like the crashing of the two high-speed cars.

Elbow Strike

Unlike the two attacks before, the elbow strike goes straight to the head. (Figure 3)



Figure 3 Elbow Strike on the head

All the forces are magnified by concentrating on a small part of area.

According to the formula of the pressure, which is :

$$P=F/A$$

The elbow has such a small surface area that it can deal great damage on the head. It can be done by swing the elbow diagonally downward, normally in 45 degree angle (like a "slash" sign) to attack the target.

Unlike we normally cannot use the elbow slash to attack alone as we need to get close to opponent enough to attack. The elbow slash will be used effectively when we want to response to opponent's knee-kick.

To practice the elbow slash, you have to bend the elbow closely against the arm, as if they are together. Then, twist the shoulder, send your body into the opposite direction, aiming to strike the elbow against the upper targets. In case the opponent counters with a punch, you should parry that punch away with your fist, and swing the elbow against the desired target. Do not use this techniques often or else the opponent will prepare for it.

(Muay Thai)

Leg Strike

Just move the muscle on the thigh will give a powerful movement on the leg. This is called a swipe and it has the longest range during the fight.

(Figure 4)

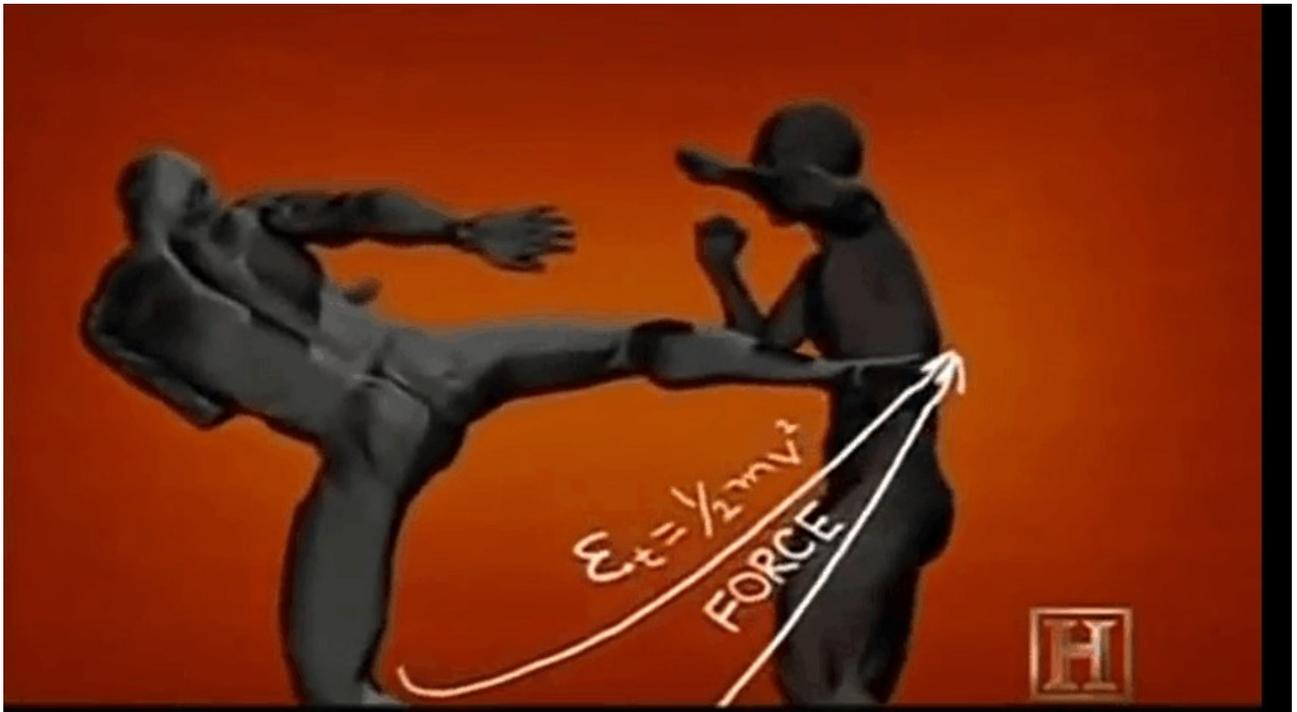


Figure 4 The strike of the leg

If you see the hip as a point, moving along the hip can generate a torque that acts on the leg. The torque

$$\tau = \mathbf{r} * \mathbf{F}$$

shows that the torque is dependable with the distance from the pivot.

Thus, the longer the leg, the stronger the force will be exerted. The strength is also related to speed, as

$$E = 1/2 mv^2$$

The strength is almost equal to a flying baseball. (Human Weapon)

Then why people spin before a kick? The physics of a spin-kick follows the general rules of uniform circular motion. The foot, which is the object at the edge of the circle, is trying to move in a tangential manner to the circle, but a force is exerted inwards towards the body (center of rotation) that is keeping the foot in circular motion.

Keeping in mind Newton's third law, every action has a reaction, so for the force moving inwards towards the body that is keeping the foot in circular motion, there is a force exerted by the body against the leg, thereby canceling out the two forces. This then makes it so that the mass of the foot, with the force of gravity acting upon it, has to be overcome for the kick to be kept in a spin. This is when we try to do spin-kicks, we tend to fall forwards before completing a full spin. (Sandra, 2011)

Conclusion

The four kinds of strikes have distinct advantages and are all powerful. Overall they utilize the laws of kinetic energy, thus, the faster the strike, the heavier the body part, the more the opponent will suffer. Also with the law of the pressure, people are always trying to minimize the hitting area to make to strength to concentrate.

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