

The Biomechanics of the Sanchin Arm Thrust

In the past three newsletters, I have analyzed the key elements of Sanchin including the stance, legs, torso, arms, and hands. In this section we will look at the entirety of the movements from a biomechanical perspective as they work together to optimize the impact force of the Sanchin arm thrust. In this discussion, I will be using the reverse straight punch instead of the Sanchin arm thrust as the example to explain the biomechanics of this action. This is because we do not actually hit a target (e.g. bag) with the Sanchin arm thrust, although we utilize our antagonist muscles to stop the forward motion of the thrust. Even though there are physics involved with that action, it is more practical to discuss a reverse punch so that the physics involved with the impact can be explained as well. For simplicity, I will use reverse punch to mean reverse straight punch.

Many athletic trainers of top athletes, martial arts included, use an understanding of the science of motion to help develop training programs that will lead to optimized performance. Most of you, like me, pursue Uechi-ryu for self-improvement and enjoyment, we do not need to hire a trainer to develop a program to prepare us for participating in combat sports. Understanding the biomechanics involved with our Uechi-ryu can provide valuable insights into optimizing technique by changing our practice and supplement with training methods. I will not hit you with a bunch of formulas but instead describe the scientific concepts involved with the motions involved with a reverse punch (and Sanchin arm thrust).

Recently while watching a seminar on YouTube by a very impressive Shotokan Master, the techniques he had the group working on were out of deep stances with big stepping movements to cover distance and delivering very high impact strikes. There was significant rear leg drive, hip rotation, shoulder movement, and body behind the punch. This is in stark contrast to how we move in Sanchin and Uechi-ryu in general. However, it “hit” me (no pun intended), that the dynamics of the movements are the same, whether an “exaggerated” delivery of a reverse punch by the Shotokan master, or the Sanchin arm thrust delivered in a contained space while in Sanchin stance. Energy needs to come up from the ground, travel through the body, accelerate the arm motion to kime with high impact on the target. We must develop the same kinetic actions as the Shotokan master demonstrated, but in an in-close scenario, which

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is more practical for a self-defense. The ability to generate power with proper biomechanics is what we learn from Sanchin kata, but it takes understanding, time, and practice.

The reverse punch is a coordinated sequence of movements involving the entire kinetic chain of the body. The legs generate the initial force downward to gain kinetic energy that works back up through the legs, through the core muscles to facilitate rotational force and connection to the upper body. The shoulder and arm muscles, such as the deltoids and triceps, contribute to the extension and impact of the punch. Biomechanics also play a role in achieving precision and accuracy. Proper alignment of joints, along with coordination and timing, is essential to landing a punch accurately on the target. Improper technique, such as over-rotation or hyperextension of joints, can lead to injuries. Teachers need to emphasize proper form and gradually increase intensity to minimize the risk of injuries.

Executing a reverse punch is a complex and dynamic movement that involves the intricate interplay of various biomechanical principles including Newton's laws of motion and the transfer of energy. Ultimately, a high impact punch is a blending of these principles, where force, kinetic energy, acceleration, momentum, and impulse come together in an organized sequence of movements.

It begins with "force". In physics, "force" generally refers to a push or pull applied to an object. Force is the driving factor behind any punch, acting as the catalyst for motion. When it comes to understanding the force behind a punch, Newton's three laws of motion provide a framework for analyzing the dynamics involved. By applying these principles, we gain insight into the interplay of mass, acceleration, and reaction forces, ultimately enhancing our understanding of the dynamics involved in the physical act of punching. However, there are many variables involved and it isn't as simple as plugging numbers into a formula.

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Newton's First Law: Law of Inertia

- The first law states that an object at rest will remain at rest, and an object in motion will remain in motion unless acted upon by an external force.
- The muscles of the arm, chest, shoulders, and core, provide the "force" to initiate the motion of the body into chambered position.
- Once the punch is initiated, the law of inertia explains why the fist continues moving until another force, such as muscular contraction or contact with another object, halts its motion.

Newton's Third Law - Action and Reaction:

- The third law of motion states that *when one object exerts a force on another object, that object exerts an equal and opposite force on the first object.*
- As the shoulders and hips draw back to chamber, the weight shifts to the rear leg.
- A downward force is exerted to the ground using the levers and muscles of the legs, ankles, and feet.
- A corresponding force from the ground initiates the kinetic chain motion from the ground.

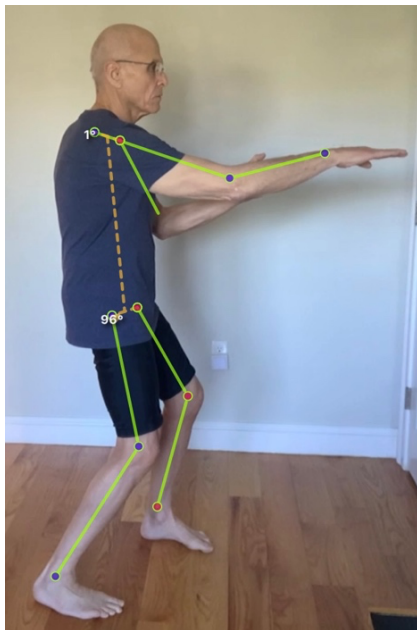
Kinetic Energy: The energy of motion:

- The legs generate the initial force downward to gain kinetic energy that works back up the legs, and through the core to facilitate rotational force and connection to the upper body.
- The body gains speed and momentum in the direction the force is applied.

Momentum: The product of an object's mass and velocity (speed & direction):

- The force from the ground also moves the body forward with momentum.
- The forward foot stops the momentum of the lower body and contributes to the acceleration and velocity of the arm.

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Newton's Second Law - Law of Acceleration:

- Acceleration of an object is related to the net force acting on the object and the mass of the object.
- To increase the force of a punch, one can either increase the effective mass of the fist, accelerate it more quickly, or both.

Effective Mass: what the mass of the fist seems to have at contact with the target:

- The effective mass of the punch is more than just the fist and arm.
- The effective mass of the fist can be increased with well-timed kime at the point of impact, accurate technique, and by putting more body into the punch.

Momentum: The product of an object's mass and velocity (speed & direction):

- Acceleration of the fist increases the velocity which in turn increases momentum.
- A punch with higher momentum delivers a more powerful impact force
- Momentum is the driving force behind a punch's penetrative power.

Kime: focused energy and tension at impact:

- Achieving kime involves tightening the muscles at the point of contact.
- Kime not only enhances the impact force but also contributes to control and effectiveness.

Impact Force: The force exerted during the moment of impact:

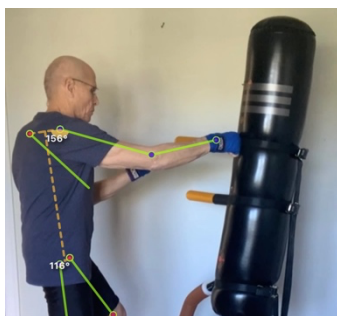
- When a punch connects with a target, the kinetic energy from the moving fist is transferred to the target.
- Impact force is what causes a change in the motion or state of the target.
- A punch with a high impact force may still have a limited effect if the time of contact is very short.

Impulse: The total force over time of contact.

- While impact force focuses on the strength or intensity of the force at the moment of contact, impulse includes both force and the duration of that force on the target.
- Impulse causes a change in the momentum of the target, causing it to move or react to the punch.



High Momentum Short-Range Punch: Increasing effective mass by stepping into the bag.



High (Kinetic) Energy Punch: Emphasizing speed and effective mass resulting in high impact at contact and impulse during the duration of contact.

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Takeaways from these principles:

- The two key factors in executing a high impact punch are to accelerate movement to increase speed, and to utilize the full body and efficient technique to increase the effective mass of the punch on the target.
- The effectiveness of a punch depends on the acceleration of the fist. Acceleration is the rate at which speed changes over time. A faster punch generally delivers more force upon impact due to the increased acceleration.
- A punch with a high impact force may still have a limited effect if the time of contact is very short. Understanding and optimizing both impact force and impulse are important for delivering powerful and effective punches.
- A powerful punch results from a combination of force, kinetic energy, momentum, and well-timed impulse during contact with the target. The impulse of a punch is influenced by the duration of contact with the target. A longer contact time allows the force to be applied over a greater period, resulting in a larger change in momentum in the target and, consequently, a more effective punch. So, optimizing the duration of contact is one factor in delivering a powerful punch.
- Training to streamline movements and minimize inefficiencies ensures that a larger portion of the applied force contributes to the change in momentum.

Competitive boxers, MMA, kick boxers, etc. use an understanding of the science of motion to help develop training programs to develop those areas that have greatest contribution to a powerful punch. Programs might include resistance training to improve movement and strength; core development for stability, strength, and movement; plyometrics to improve speed and explosiveness; and mobility exercises for flexibility and reduced injury.

It would be great if we all had time to train like this, but most of us do not. However, there are things that we everyday martial artists can do to develop our body mechanics to perform our Uechi-ryu at a high level. Here are three supplemental training methods you can perform to develop the movement so that your arm thrusts and other movements “come from the floor”. I recommend these drills for karateka with a

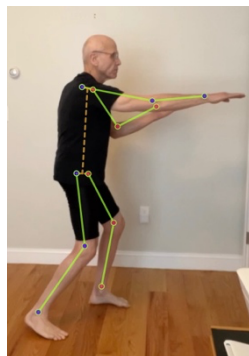
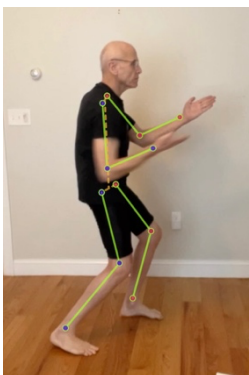
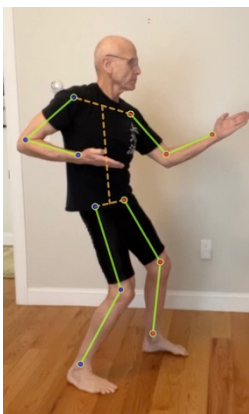
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minimum rank of Sankyū (brown belt). Before this rank, attention should be given to performing the movements with accuracy.

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Method #1: Exaggerated Sanchin kata

The following method of performing Sanchin kata is for the purpose of getting the feel of “chambering the body”, connecting to the ground, engaging the legs in the drive, and thrusting the body to execute the arm thrust. I am not suggesting you perform your Sanchin kata this way as standard practice, but to use this method to develop the feel of body movement and the connection of your arm movements to the body.



Practice exaggerated Sanchin kata as follows:

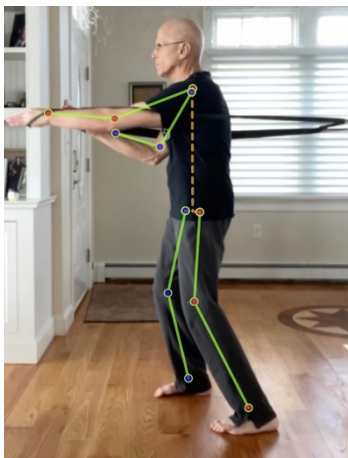
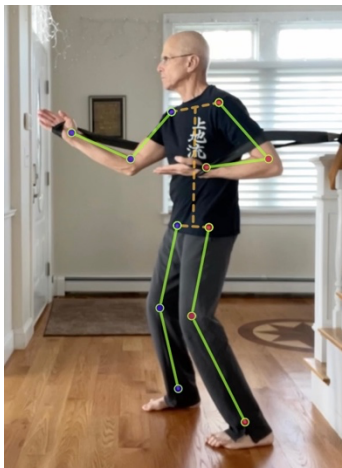
1. Perform the kata with no tension.
2. Keep it slow to start.
3. Accelerate the movements.
4. Exaggerate the motion of all movements.
5. Feel every movement originating from the ground. In fact, you should feel fatigue in the legs after performing this kata.
6. As you draw your arm back, rotate your shoulders past the guideline of “half of a hand”.
7. Keep the other arm in line with the shoulder as you normally would do. Don't let it swing around to follow your thrusting arm as it is drawn back.
8. As you draw the arm back for the thrust, shift weight to the back leg and bend your knee more. (Just exaggerate it)
9. Initiate the thrust first with a big push downward with the foot of your rear leg.
10. Drive through the leg, hip, back, and shoulders, all leading the arm out to the thrust. Feel every link of the kinetic chain engage.
11. Return to normal and step.
12. Continue the kata with all movements exaggerated.
13. When performing the double arm thrusts, exaggerate the body movement back and forth with the weight coming back as you draw the arms back, and then forward as you thrust out.
14. The stepping off movement should be exaggerated as well.
15. Get a strong push off with the rear foot.
16. Engage your core as you step.
17. Accelerate the wauke to chamber shifting your weight back; and then forward as you thrust out with the double boshikens.

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Method #2: Resistance band

Resistance bands are an excellent way of getting resistance training within the actual movements themselves. The type of band used doesn't matter, although I prefer the TheraBand CLX looped bands because you can use a Uechi hand formation while performing this drill vs. holding a handle or the band itself.

The height of the band needs to be around shoulder height and connected to something that will not move.



1. Practice body flow movement using the resistance band with one and/or two arm setups.
 - The two-arm setup provides good isometric resistance in the non-thrusting arm.
2. Create enough tension in the band so that there is no slack at your starting position, but not so much tension that you can't move without falling out of balance.
3. Start in a good stance.
4. This works for Sanchin stance and deep Sanchin Stance.
5. Practice from full chamber and from Sanchin guard position.
6. Make sure you feel your rear foot driving down to initiate the thrust and the energy through the legs.
 - Activate the core. (a great exercise to do while wearing the Core360 belt)
7. Thrust out using the body.
8. Alternate sets on each arm.
9. Practice this motion slowly, but with acceleration.
10. Breath correctly
11. Over time you can increase the resistance of the band and/or the speed of the thrust.
12. If you don't feel this in your legs, you are doing it incorrectly.

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Method #3: Makiwara and Heavy Bag:



The makiwara's effectiveness lies in its ability to provide immediate feedback and promote correct body mechanics during punching movements.

- When striking the makiwara, Karateka must engage their entire body, from the feet planted firmly on the ground to the rotation of the hips and shoulders, culminating in the extension of the arm and fist.
- Focus on the details of the technique, such as maintaining a straight wrist upon impact, proper hand positioning, and precise targeting.
- Since the makiwara offers what is called “persistent resistance” to the strikes, practitioners can gauge the effectiveness of their technique based on the feedback received upon contact.
- The heavy bag can provide similar benefits as the makiwara to the karateka.
- The swinging type heavy bag does not provide the same persistent resistance to the punch as the makiwara, as the impact force of the punch will result in the bag collapsing in and swinging back.
- The Dripex freestanding bag, however, does provide the same persistent feedback as a makiwara and is a good alternative for use in the home.

CAUTION: I HIGHLY RECOMMEND THAT WHEN PRACTICING WITH EITHER THE MAKIWARA OR HEAVY BAG THAT YOU WRAP YOUR HANDS AND WEAR BAG GLOVES.

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Mastering the reverse punch and Sanchin arm thrust requires understanding of the kinetic chain action of the body, that mass and velocity contribute to the overall force generated by a punch, and proper technique ensures that the impact force is effectively transferred to the target.