

# *Comparative Study of the Force Generation Sequence between “Covering Hand Brachial Fist” and “Static Shot Put”*

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**Keywords:** Tai Chi Chuan, static shot put, Covering Hand Brachial Fist, force generation sequence

**Abstract:** This paper employs a literature review method and experimental comparative approach to examine the force generation sequences in modern sport, static shot put, consisting of five components: "pushing off, turning, extending, thrusting, and tossing," and the traditional Chinese martial art Tai Chi Chuan's "Covering Hand Brachial Fist" force generation sequence, described as "power originates from the feet, travels through the legs, is controlled by the waist, and is released at the extremities." Practical effects are considered in this study. "Covering Hand Brachial Fist" is a representative force generation technique in Chen-style Tai Chi Chuan, making it a suitable subject for comparative research with the force generation sequence in static shot put. This research aims to provide insights and references for improving performance in shot put sports.

Tai Chi Chuan, as a traditional Chinese martial art, is a national treasure and a world-class intangible cultural heritage. It represents a perfect fusion of Chinese dialectical thinking with aesthetics, philosophy, traditional Chinese medicine, and more. It combines various functions such as nurturing the mind and body, enhancing physical fitness, and self-defense.[1] It is a form of exercise that embodies the inclusive cultural concepts of the East. Practitioners focus on training the physical, mental, and energetic aspects of the body, aligning with the physiological and psychological requirements of individuals and promoting harmony within human society.

Shot put is one of the modern Olympic events with its origins in Europe, gradually evolving from stone-throwing competitions. Static shot put is a crucial component of shot put sports, and the quality of the technique directly affects the accuracy of shot put throws. The force generation sequence for static shot put comprises five components: pushing off, turning, extending, thrusting, and tossing. In contrast, Chen-style Tai Chi Chuan's "Covering Hand Brachial Fist" utilizes a force generation sequence described as "power originates from the feet, travels through the legs, is controlled by the waist, and is released at the extremities." [2] The concept of "waist control" in Tai Chi Chuan aligns closely with the modern concept of core strength in sports training. Both focus on similar training areas, but their methods and approaches differ.[3] Most modern sports training relies on external equipment to stretch muscle groups, whereas Tai Chi Chuan emphasizes relaxation and breath control, working from the inside out. Although the methods differ, they can yield similar results. After conducting a comparative study of the two training methods and their effects, it is believed that the

latter's method is more scientific, rational, and in harmony with human physiology and anatomy. Tai Chi Chuan emphasizes the holistic development of the body, offering not only comprehensive physical exercise but also health benefits that modern sports training may lack. In the practice of Tai Chi Chuan, "Covering Hand Brachial Fist" stands out as a representative force generation technique. Hence, this paper conducts a comparative study of the typical force generation movement "Covering Hand Brachial Fist" in Chen-style Tai Chi Chuan and the final force generation movement in static shot put.

## 1. Chen-style Tai Chi Chuan Covering Hand Brachial Fist Technique

Covering Hand Brachial Fist in Chen-style Tai Chi Chuan is one of the most significant techniques and serves as a representative method for generating power in this style. It underlines its importance and practicality.[4] When practicing the force generation for Covering Hand Brachial Fist, it demands the perfect fusion of one's physical, mental, and spiritual aspects to produce power. In Tai Chi Chuan, internal energy originates from breathing, flows through meridians, and circulates throughout the body, representing a natural physiological phenomenon.

When executing Covering Hand Brachial Fist, the force generation involves pushing off the ground beneath the feet, leveraging the reactive force of the ground. The legs spiral the force upwards, simultaneously relaxing the left hip and torso while making a slight leftward shift, transitioning the center of gravity into a left bow stance. Simultaneously, the left palm rotates inward, moving towards the left waist side, transforming into a fist situated at the waistline, with the fist's core facing upward. The right arm spirals towards the front-left direction, with the fist's core pointing downward. The right fist and left elbow work in tandem to create tension. Initiating force requires extreme relaxation and stretching of the body, preventing issues like losing the crown point and muscle tension, which can lead to the counteraction of the body's own power, disrupt the smooth flow of internal energy, cause an irregular sequence of power, and potentially result in power breaks. The goal is to release the maximum force more effectively and smoothly. The Covering Hand Brachial Fist movement is illustrated in Figure 1.

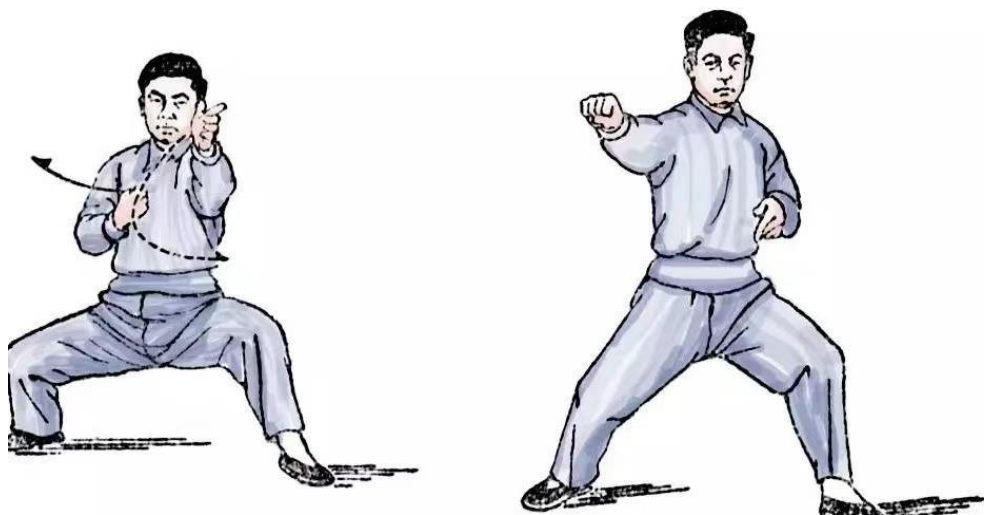


Figure 1: Covering Hand Brachial Fist action

The boxing manual states: "The body is like a bowstring, and the hand is like an arrow." "Power starts from the heels, flows through the legs, is controlled by the waist, and is released at the fingertips." When practicing Tai Chi Chuan, it is essential to constantly focus on using intention, not force. In the beginning, after numerous repetitions of training, the moment when you feel the body is

in perfect alignment, and the movements become more accurate and smooth, with the consciousness directing, internal energy flows continuously. Power is concentrated and, at the moment of exertion, gathers the full strength of the body to transmit it to the right fist. The culmination of power occurs at the very end.

Furthermore, Tai Chi Chuan emphasizes the use of unique force generation techniques, such as "rooting," "urging the 'dan tian' (lower abdomen)," and "spiraling throughout the body." Rooting involves pushing off from the ground beneath the feet, while urging the 'dan tian' is a training technique rarely seen in modern sports. Practicing Tai Chi Chuan can lead to a gradual understanding of these methods under the guidance of an experienced practitioner. Spiraling, or "chan si," is another characteristic of Tai Chi Chuan, akin to turning a screw. It generates not only substantial force but also exceptional speed. These techniques are gradually comprehended through practice.

Key points to note: During practice, execute movements slowly, smoothly, and continuously. Through countless repetitions, as the movements become precise and automatic, the force can be exerted smoothly. The goal is to achieve extreme precision and perfection in movements, eliminating unnecessary stiffness and dispersed muscle forces. Instead, focus the intention and energy of the body towards a single point, ensuring that the sequence of power flows cohesively from one segment to the next.

In ancient boxing manuals, it is said: "Move with the mind, move the body with energy; when the internal energy remains still, the external form remains still; when the internal energy moves, the external form follows the energy." Tai Chi Chuan is a system of movement where intention guides the flow of internal energy, and the body's limbs move in near-perfect synchronization. When one part moves, the entire body remains still, and when one part is still, the whole body is at rest. Finally, when exerting force, it should be rapid and powerful, reaching the extremities.

When performing the "Covering Hand Brachial Fist" movement, it is essential to ensure there is a rooted connection to the ground after exerting force. The body should not lean forward. Prior to exerting force, the entire body should be in an extremely relaxed state. At the moment of exertion, muscles spiral forward, and after releasing the force, the body immediately relaxes. The source of the body's strength returns to where it came from.

In summary, it is crucial to remember the principle of force generation in "Covering Hand Brachial Fist": "Power originates from the feet, flows through the legs, is controlled by the waist, and is released at the fingertips."

## 2. Static Shot Put Force Generation Technique

The final force generation in static shot put is the most crucial and core component of shot put sports.[5] It consists of five parts: "pushing off, turning, extending, thrusting, and tossing," and these five parts are executed seamlessly as a continuous motion. When pushing the shot, the left leg provides support while the right foot rapidly pushes off the ground, exerting force. This force is transmitted through hip extension, chest elevation, arm oscillation, wrist extension, and finger flick to propel the shot. The positioning of the two feet involves a specific distance and angle to ensure stability of the center of gravity after the turn.

The sequence for the final force generation in static shot put follows with the activation of the calf and thigh muscle groups. Force is transferred from the ground through the internal rotation of the knee joint, leading up to the hip joint, and subsequently driving the rotation of the hips. The static shot put force generation technique is illustrated in Figure 2.

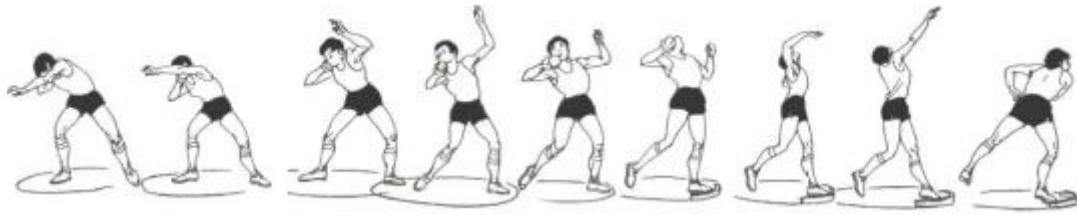


Figure 2: Schematic diagram of the sequential action of pushing the shot put in situ

**Push:** The right foot rapidly pushes off the ground, utilizing the ground's reactive force to initiate the exertion of force.

**Turn:** Hip rotation. The force transmitted through the leg initiates the rotation of the hips around the axis provided by the support of the left leg, engaging the core muscle groups of the body in force generation.

**Elevate:** Through the actions of pushing off and hip rotation, the hip joint surpasses the shoulder joint to create a counter-arch, while simultaneously the left arm actively swings to the left, providing greater acceleration for the shot put's release.

**Push:** Building on the initial force transmission achieved through pushing off and hip rotation, the right arm swiftly propels the shot put forward and upwards.

**Flick:** As the shot put is about to be released, the wrist slightly turns inward while simultaneously bending the wrist. A rapid and forceful flick of the shot put is executed, imparting additional acceleration to the rapidly flying shot put, allowing it to detach from the fingertips. Following the release of the shot put, the body maintains balance with the left leg as support. Due to the forward force applied by the body, there is forward momentum, necessitating a swift change in the support foot and a lowering of the center of gravity.

### 3. Major Factors Affecting Shot Put Distance

#### 3.1. Release Velocity

The release velocity is influenced by the sequence of force generation in the body, which accelerates from the moment the foot pushes off the ground to the final force exertion. It requires the convergence of the entire body's strength at a single point, resulting in an instantaneous burst of force. Through force transmission, it combines the reactive force from pushing off the ground with the body's own power, ultimately directing it to the fingertips and then onto the shot put.

#### 3.2. Shot Put Height and Angle

The distance of the shot put's flight is also influenced by the shot put's height and angle at the release. A higher release point results in a longer flight for the shot put. Due to the influence of Earth's gravity, the typical release angle is in the range of  $38^\circ$  to  $42^\circ$ . Shot put technique indicates that the appropriate release angle should fall within the range of  $38^\circ$  to  $42^\circ$ , which is slightly different from the theoretical optimal launch angle of  $45^\circ$  for projectile motion. This adjustment accounts for factors like air resistance, particularly in the case of headwinds or tailwinds. When there is a tailwind, the shot put's release angle should be slightly greater than 42 degrees, and in the case of a headwind, the release angle should be slightly less than 42 degrees to reduce wind resistance.

Additionally, since the release point is at a certain height and the shot put experiences air resistance during its flight, and the release point for throwing events is relatively elevated, there is an angle formed between the line connecting the release point and the landing point and the horizontal ground. This angle is known as the ground angle. Due to the presence of this ground angle, the optimal release

angle for shot put, taking all these factors into consideration, should be less than 45 degrees, as illustrated in Figure 3.

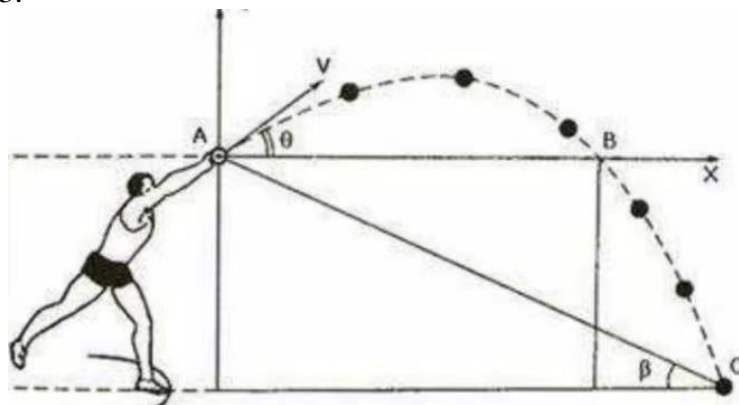


Figure 3: Schematic diagram of the final shot

#### 4. Comparison of Two Force Generation Techniques

The force generation sequence for static shot put comprises five components: pushing off, turning, elevating, thrusting, and flicking, while the force generation sequence for Tai Chi Chuan's "Covering Hand Brachial Fist" consists of four components: power starts from the feet, flows through the legs, is controlled by the waist, and is released at the fingertips.

##### 4.1. Common Aspects

(1) Both techniques initiate force by rapidly pushing off from the ground, utilizing the ground's reactive force. Precise and error-free execution is achieved through countless repetitions of practice.

(2) They both rely on the transmission of force through the leg, with Tai Chi Chuan emphasizing spiraling upward while static shot put requires a rapid push-off and turn.

(3) Both techniques make extensive use of the body's core muscle groups, with Tai Chi Chuan emphasizing control by the waist. Contemporary sports training has only recently introduced core muscle group training, utilizing different equipment. Tai Chi Chuan, from its inception, has emphasized control by the waist, providing a more comprehensive and nuanced approach.

(4) Both techniques involve the body turning to the left and using the left side as the pivot for support and rotation. Force is directed outward by the right arm.

(5) In the final stage, both techniques require maintaining balance. In Tai Chi Chuan, it is emphasized that the energy returns to its source. After exerting force, the body must immediately relax the hip area. In static shot put, balance is maintained by changing the supporting foot to lower the center of gravity.

##### 4.2. Differences

(1) In Tai Chi Chuan, force generation requires "gen mui shao ling" (rooting and urging the 'dan tian') and emphasizes spiraling throughout the body. In static shot put, the sequence involves pushing off, turning, elevating, thrusting, and flicking, creating a sequential acceleration of the shot put.

(2) Tai Chi Chuan emphasizes a posture where the whole body forms a "wubei" (five bows), with core muscle regions forming a bow shape. In static shot put, the technique aims for a counter-arch in the torso to better propel the shot put.

(3) In Tai Chi Chuan, the center of gravity must remain stable, and the foot should not leave the ground during force generation. In contrast, static shot put involves a full leg extension, which



elevates the body's center of gravity, and after executing the technique, the emphasis is on relaxing the hips. For static shot put, changing the supporting foot is necessary to maintain balance and lower the center of gravity.

(4) The training methods differ. In shot put training, equipment is commonly used, and individuals are subjected to heavy loads and overloads. Training primarily involves mimicking the appearance of the movements.[6] In Tai Chi Chuan training, slow and gentle movements are the primary focus, performed in a relaxed state. The whole body is integrated, emphasizing the perfect combination of form, spirit, intention, and energy. It requires the concentration of all the body's strength at a single point. It is challenging for ordinary individuals to understand how absolute strength increases while in a relaxed and slow state. In reality, the size of bodily strength is derived from energy, which is sourced from the blood, and the energy in the blood is obtained from food, oxygen, and water. When the body is in an extremely relaxed state, blood naturally flows through the vessels. Arteries deliver blood rapidly, and veins return it slowly. All capillaries in the body, including those in various organs, open up, and cells relax and open. As blood energy enters the cells, it accumulates over time, gradually strengthening the body. This is the traditional Chinese training method that is distinctively effective. Over time, individuals will become progressively stronger, their movements will become smoother and perfect, and their strength will increase.

## 5. Recommendations

This paper provides an effective comparison of two different forms of sports in terms of force generation techniques. By considering the sequencing and characteristics of force generation in both sports, the aim is to explore how the scientific and reasonable training methods of Tai Chi Chuan can be integrated into the force generation technique of static shot put, with the intention of improving individual performance and technique in the sport. As an experiment, based on the structural characteristics of shot put movement and force generation sequence, in combination with the techniques and training methods of Tai Chi Chuan's "Covering Hand Brachial Fist," points of integration are identified to aid in enhancing performance in shot put. The training methods and means employed in Tai Chi Chuan, first and foremost, require numerous repetitions with complete relaxation of the whole body to attain the utmost perfection in the execution of movements. The sequence of force application is explicitly detailed, and these techniques closely resemble those required for the final forceful action in static shot put. Effective and scientific training methods can promote the coordinated development of static shot put technique and strength. It is widely acknowledged that the development and refinement of sports techniques can provide strong assurance for the stability and improvement of sports performance.

Tai Chi Chuan is an elastic exercise in which the body extends infinitely outward. When practicing "Covering Hand Brachial Fist," the whole body is relaxed, concentrating to mobilize the body's strength before releasing it. In this elastic exercise, the posture extends infinitely, and there is a significant increase in hand displacement. When released under extreme relaxation, the acceleration of hand movement is faster. This can influence static shot put as well, as a fully relaxed body, not meaning slack but rather an enhanced relaxation of the muscles, allows for a better concentration of the body's strength applied to the equipment. Simultaneously, the elastic exercise can increase the height and speed of the release point.

Discussion Points: How to effectively apply the concepts of spiraling power throughout the body and "gen mui shao ling" from Tai Chi Chuan to the final forceful action in static shot put.

Tai Chi Chuan, known as internal martial art, involves a perfect fusion of the body's "form" (physical movements), "spirit" (mental attitude), "intention" (conscious thought), and "qi" (breath). When generating force, it is based on the foundation of perfect movements, utilizing conscious

thought and breath. The consciousness guides the breath, and the breath influences the form. Thought and breath work together, with movement guiding the breath. When thoughts align with breath, it synchronizes with the body's actions. It requires a close coordination of breathing with movement. Regardless of the movement, it must align with breath. In Tai Chi Chuan, every movement is synchronized with breathing, and "one motion makes the whole body as if nothing remains still." It allows for the instantaneous, cohesive release of the body's maximum force. In shot put training, these principles can be fully utilized to ensure the perfect sequence of force application, further improving athletic performance.

These findings offer a new perspective on training for static shot put by incorporating techniques from Tai Chi Chuan. It suggests that the integration of Tai Chi Chuan's training methods, emphasizing relaxation, spiraling, and core strength, can provide valuable insights and methods for improving the force generation technique in static shot put. By applying the principles of Tai Chi Chuan, athletes may enhance their understanding of the sequence of force generation, optimize their technique, and potentially improve their performance in static shot put. Further research and practical experimentation may be conducted to validate these recommendations.

## 6. Conclusion

Tai Chi Chuan is a traditional Chinese sport, while shot put is an important track and field event in modern Olympic games. Understanding the final force generation technique in static shot put from a fundamental perspective and employing scientific and efficient training methods and techniques is a subject worthy of exploration and research. Tai Chi Chuan is a traditional Chinese martial art, and its application in competitive sports requires a scientific understanding of its theoretical system and training methods. It demands extensive exploration, practice, and in-depth research of its theoretical framework and training methods. By fully utilizing the training methods and techniques of Tai Chi Chuan to serve modern sports, we can provide effective assistance for further improving sports performance.

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