

Movement Analysis

Hammer Throw

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When I say that I throw the hammer competitively, what comes to mind? I will bet you anything that you get a picture of me picking up a craftsman hammer and, in some awkward motion, hurling it into a field. This is a common misconception; the hammer throw is actually a four kilogram iron, steel or brass ball that is attached to a wire that is about three feet long with a handle attached to the other end (7). The objective of the hammer throw is to spin around several times within a seven foot circle without leaving and get the hammer to go as far as possible while landing within the forty degree sector (for diagram of throwing arena see page 14).



The throw can simply be broken down into the winds, the turns and the release. A typical competition level throw will consist of two winds, three to four turns and obviously one release, but for the purpose of this analysis, we will only be discussing one wind, one turn and the one release. We will be discussing the movements of a right-handed athlete. As a right handed thrower, the hammer is held in the left hand and the turns are made counterclockwise; conversely a left handed thrower will hold the hammer in their right hand and turn clockwise.

Though the sport of the Hammer is almost unknown and slightly ignored by others in the track and field community often times being held in a different facility during meets, the experts in the sport have much to say on it. Most experts place extreme importance on posture. The thrower needs to have her head up in an attempt to lengthen her spine as much as possible (1,3, 2). By thinking about a long and tall spine, you reduce the chances of slouching

over and getting pulled over by the ball. Thinking tall also helps the thrower to sit back and relax into the throw.

Not only does the thrower need to think tall, but she needs to sit low. Although these are slightly contradicting thoughts, it is imperative to bend at the knees and not at the hips, and sit into the throw(6,1,5). The knees need to be behind the feet; this allows you to counter the force of the ball and optimize on the force exerted by creating speed.

Relaxing the shoulders and letting them run long is another emphasized point related to posture(1,5,3). By relaxing your shoulders, you let the ball take a natural orbit allowing it to pick up speed and fly better and further. Also, if you tense your arms, the likelihood of pulling on the release is much greater. Relaxing the shoulders also lengthens the radius of the hammer by inches, which lengthens the orbit of the hammer by feet, which allows the velocity of the hammer to increase, thereby dramatically increasing the release speed and total distance the ball will travel (5).

Obviously posture is a key point in the throw, but it is not every thing. A second major component mentioned by many of the experts was the need to counter the ball (1,3). As mentioned earlier, you counter the ball by sitting back against the pull of the ball. This is not one strong pull or jerk; this is a subtle movement that is learned after the thrower learns to trust to lean against the hammer(3). This is important because by countering the ball, it travels a smother orbit, and a smoother orbit will pick up speed more quickly ,and ultimately the ball will fly faster and further.

The third point that is emphasized by the experts is the need to extend the double support phase during the throw (4,5,3,1). During the turns there is a point where both feet are on the ground. The thrower needs to extend this period as much as possible because the only way to increase speed is to drive or push with your right foot, and the right foot is only on the ground during the double support phase, so this is truly your only time to create speed. So by lengthening the time that you are in double support phase, you lengthen the amount of time that you are able to push, increasing the speed of your feet thus increasing the speed of the ball, therefore increasing the length of the flight.

As you can see, the smallest changes in a thrower's technique can alter the throw in so many ways that the idea of the perfect throw seems impossible to achieve. The perfect throw starts with the thrower facing the center back of the ring, her back to the direction in which she will throw. This is termed "0 degrees" and everything is measured from this point. There are many acceptable ways in which to start the hammer (for reference on the degrees of a circle please see page 13). Many prefer the pendulum start, and others prefer the static start. Neither is right, but there are more problems associated with the static start. With the pendulum start the hammer is swung like a pendulum until it picks up enough speed for the thrower to easily start the wind.

The wind starts the whole throw and sets the rhythm of the rest of the throw. The hammer is swung and extended out behind the right hip, with both hands on the handle. Then the hammer is swung counter clock wise in front of the body, then up and over the head. The thrower should



think of parting her hair with her thumbs and look through the gap in her arms. When the ball gets to between 180 and 170 degrees, the thrower turns her shoulders to look at the ball; the hips stay looking at the back of the ring, and the left foot also turns medially on this movement. This is called the “catch.” Once you have caught the ball, you push through with the right side to the entry (5).



The entry is the time spent before the turn. The thrower needs to wait for the ball to pass in front of them and not pull at any point (7). As the ball passes in front of the thrower, the right knee and foot turns in pushing against the ground, the thrower sits back with the left toe off the ground, thumbs up tilting slightly left.

When the ball gets to 270 degrees, the thrower starts the step or turn. The thrower then pulls her knees together turning on their left heel, the weight is then shifted to ball of the left foot sinking into the knee. With the knees almost a flat foot on the right together, you step through quickly with almost a flat foot on the right at about 170 degrees (4). The hips need to be aligned with the feet and also facing 170 degrees. Here the ball is once again caught at 180 degrees and now you are in the double support phase.



In the double support phase, the thrower grinds her feet into the ground on the right toe and left heel, pushing the knees together all the while. The ball will sweep from 180 down through 0 to about 270; here the thrower makes one fast upward motion and releases the ball by 220 and finishes out over the ring (7).



The biomechanics of the throw is a little more in-depth, the best place to start is with the grip. Like mentioned earlier, for a right handed thrower the hammer is held in the right hand under a leather glove (7). The handle is held by the distal phalange and the flexor digitorum superficialis of the hand. The right hand is laid over the left using as few of the fingers as possible, in order to lengthen the radius as much as possible.



The wind is started by swinging the hammer behind the right hip. This is done by flexing the triceps, the deltoid and the biceps partially of the left arm to bring the arm across the body. Once the hammer is moving, the thrower lets the hammer swing fully out and back down by

the thrower's side. When the hammer again, the thrower swings the hammer by flexing the superior portion of the the medial portion of the deltoid of the medial portion of the trapezius on the left



starts raising over her head trapezius and right arm and side to get the

hammer over the head. At this point, the left humerus will be raised straight out at a 90 degree angle out from the body; the elbow will be at about 70- 75 degrees, and the left wrist will be at about a 120 degree angle. The wrist is brought to this angle by the concentric contraction of the flexor carpi radialis. The right humerus is flexed up to about 170 degrees by the flexion of the biceps long head and the anterior deltoid. The right elbow is flexed to about 90 degrees by the bicep brachii and the brachialis. The right wrist is slightly extended to about 145 degrees.

From here the thrower moves into the catch phase, the hammer is to swing naturally until it gets to about 180 then is caught at about 170 degrees (3). The catch is done by flexing the external oblique of the right side and the internal oblique of the left side and rotating the vertebral column to get full rotation, keeping the hips squared to the back of the ring. The lower trapezius and the latissimus flex to dip the right shoulder in the direction of the ball. Then the thrower turns her head to look at the ball with the splenius cervicis. The portion of the wind before the catch is the only point in the throw where the thrower ever loses sight of the ball.

Now the thrower moves into the entry phase of the throw. From the catch, the thrower starts to push the ball by flexing both the internal and external obliques, the latissimus and the trapezius to bring the ball squarely in front of the thrower. She needs to wait till the ball gets there to avoid pulling on the hammer (2).



The force in the throw does not come from the arms like throwers like to believe, it comes from the legs.

Until this point no real movement has occurred and the entry phase continues until the right foot leaves the ground. Extending out from the shoulders everything needs to be limp and relaxed in order to extend the radius as much as possible (1). The only muscles in the arms that need to be used is the flexor group in order to hold on to the handle; this will allow the thrower to move with the orbit. The rest of the push is done by the right leg. The thrower should think of grinding into the ground with the foot, primarily standing on the phalanxes and the

metatarsals. This is done by the plantar flexion of the soleus, tibialis posterior and the gastrocnemius. The ankle will be at about a 175 degree angle. The thrower, while thinking of pushing, thinks of driving the knee into the ground. This helps the thrower get the idea of bending at the knees and not at the hips. This strategy also helps the thrower counter the ball. The flexion necessary is achieved by the concentric contraction of the gastrocnemius, the semimembranosus, semitendinosus, and the bicep femoris. This flexion is also achieved by the eccentric contraction of the Sartorius and the quadriceps. The knee should be at approximately a 100-110 degree angle.

While the right leg is pushing, the left leg is in a flexed position as well, and the same muscles are tensed, but they are not pulling; they are resisting unwanted movement and creating an axis for the body mass and the ball to turn around. The main difference here is that while the right leg is in plantar flexion and every thing is pushed through the toe, the left foot rocks from the heel to the toe and back to the toe (2). So after the catch, the thrower sits back and pushes with the right, and dorsi flexes the left.

At this point in the throw, the thrower needs to have patience, a lot needs to happen before the turn even starts. This is the double support phase that needs to be lengthened in order to create force (3). She needs to wait until the ball passes in front of her. When the ball passes to 270, the thrower turns on the posterior lateral portion lift the of the heel. As the body rotates, the quadriceps right leg and slightly extends at the knee to step through. While stepping through, the thrower



needs to think about touching the knees together to create better centrifugal force, making the thrower turn faster (3). The thrower accomplishes this by flexing the adductor magnus, longus



and brevis and the gracilis. When the thrower takes this step, she must be conscious of the possibility of catching her right toe on her left heel. Catching the toe on the heel will cause the hammer to fly in unsafe directions and will cause the thrower to

go flying in some odd direction as well, more than likely obtaining scratches, sprains or bruises, not to mention damaged pride.

As the thrower steps through, she will glide along the lateral edge of the 5th metatarsal of the inverted foot, to the ball of the slightly plantar flexed foot.

The thrower also needs to remember that she must always counter ball, so this step is taken with the legs forward and sitting back against the pull of the ball (4). The step is taken as the ball



The
the

reaches 180, but the step is taken through to 160 degrees. Here the ball is once again caught



and the thrower is back in double support phase. The thrower counters the pull of the ball by sitting back on the dorsi flexed left heel and starts to push again.

After the ball is caught the thrower moves into the release phase. The ball is caught at 180, and is pushed through 0, and at about 315 the thrower extends the knee in one quick movement using the quadriceps and also the extension of the leg at the hip using the gluteal muscles (6). In this motion it is very possible to pull the hamstrings if the thrower jerks and is

unable to relax the muscles on knee extension. In this motion, the thrower needs to release the hammer as high as possible at about 45 degrees to the ground, so the thrower will flex the trapezius and the medial deltoid in order to raise the arms quickly and straight above the head. The thrower also needs to plantar flex the feet to aid in being as tall as possible; the thrower needs to flex the gastrocnemius, the soleus and the tibialis posterior.

The thrower needs to release the hammer by 230 degrees and finishes out after the hammer over the edge of the ring (7). By having the thrower finish over the ring, she is taking advantage of all possible space, even the space that the thrower doesn't have. This idea also stops the thrower from pulling back on the release and letting it optimize on the speed that the thrower has created.



The best test to see if someone knows material well is to have them teach someone else. For the practical application portion of this analysis, my friend Sarah was kind enough to volunteer. I started out by demonstrating the throw because Sarah had never seen it done before. I started Sarah off

problem with the pendulum when it got to the point in the ball, she didn't catch and



with the wind. She had no start and starting the wind, but wind where she had to catch the push on time and the hammer

fell out of orbit. To try to correct her I had her go through the motions without a hammer in hand. After going through the motions slowly, she started to wind better and better each time.

After the winds I had her try turning. This didn't go very well at all; she was so unfamiliar with the motion that she didn't know what to do. From here I had her do drills that would help her

find the steps. I had Sarah hold the hammer at arms length and turn circles counter clockwise.

This taught Sarah to feel the pull of the ball and to become comfortable with the pull it

presents. The main thing that Sarah had trouble

her arms run long. She bent at the elbows when

uncomfortable with the speed of the hammer.

try to mimic the step toward 180 in the turn. I



with was letting

ever she was

Next I had her

had Sarah

continue to turn like before and instructed her that when she thought she was at 180 to step

towards it. Sarah's biggest problem was finding 180; she was stepping almost everywhere but

180. After Sarah was able to step to 180, we went back to the turns. I had Sarah walk through

the motions slowly to get the foot work. After she had a feel for the foot work, I had her try it

with a hammer. When she took the hammer it looked like she forgot everything she had just

learned, but I was able to get her to release one in the right direction, so I was happy.



Mechanically Sarah was able to hold her arms out correctly, but

she tensed up the shoulders, and didn't keep her head in line

with the hammer. Sarah's main complaint was that the motion

made her dizzy and she lost her bearings. When it came to her feet she wasn't stepping forward

with her legs and sitting back she was falling forward with the balls bull. I believe that given

more time than just our one session Sarah could get this over time.

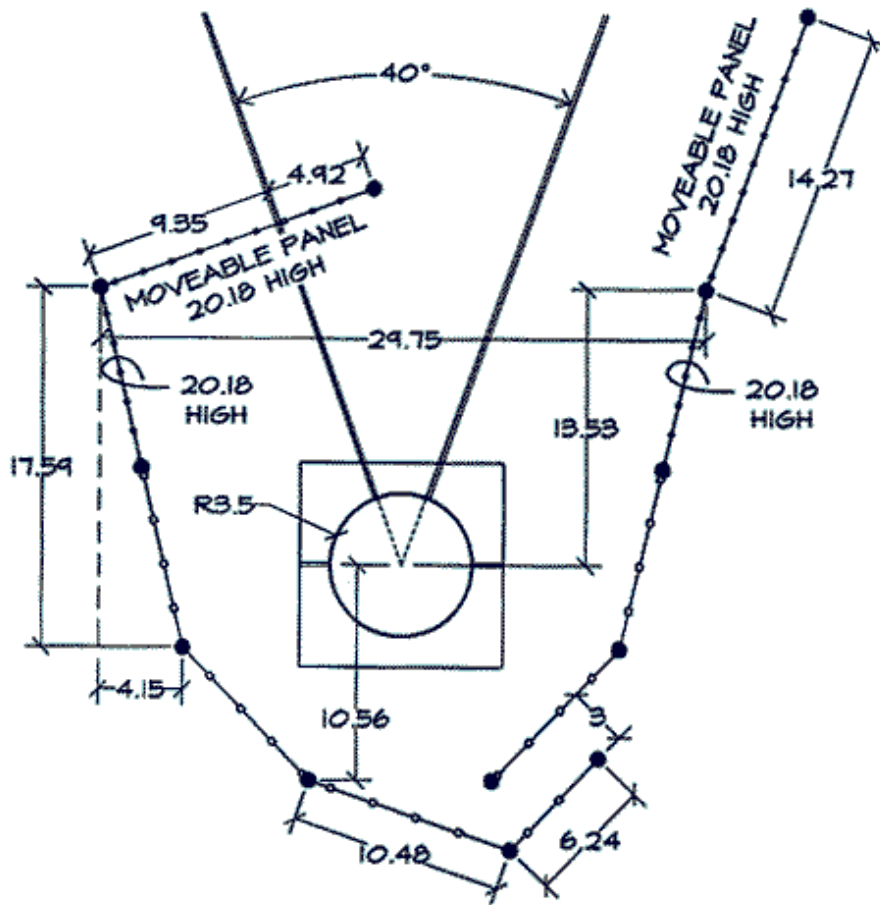
The challenge that the hammer presents to the thrower is both exciting and frustrating

even for the expert throwers being that it consist of many different aspects: the wind, the

turns, and the release. The hammer really is a whole body movement requiring the recruitment

of muscles from every part of the body. For someone unfamiliar with this movement the basic

fundamentals can be hard to identify and even harder to perform. The hammer is an event that is still evolving and finding its place in the world. It is something that I have enjoyed for the past three years and plan to for the rest of my life. The only thing that I can hope for the future is that more people will come to love it the way myself and my teammates do.



ALL DIMENSIONS ARE IN FEET

FENCE IS 16.4' HIGH
EXCEPT WHERE NOTED

FENCE POST ARE 9' O.C.
EXCEPT WHERE NOTED

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USATF level 1 certified
USATF/USOC Emerging Elite Coach
7 National Champions
31 All Americans
12 WIAC Conference Champions
3 qualifiers for US Nationals/Olympic Trials
Personal
4 Time All American (2 x hammer, 2x weight throw)
4 time academic all American
WIAC conference champion - weight throw