Qualitative biomechanical analysis on how to properly shoot a free throw research...

Engineering, Aviation

Introduction

The free throw shot is arguably the single most important shot in a game of basketball. Close to twenty percent of all the points in the National Collegiate Athletic Association division one basketball are scored by score throws. The free throw is especially more important late in a basketball game. This is because the free throw accounts for a significant percentage of the total point scored in the last five minutes and the first thirty five minutes of a basketball game. This applies for both the losing and winning teams. ‘ Theoretically, the free shot should be the easiest shot to make in a game of basketball. This owes to the fact the player stands fifteen feet away from the basket and without defense or close distractions’ (Knudson, 2007). However, theory and practice do not have congruence as far as the free throw is concerned. While a skilled collegiate team is expected to score over eighty percent of their free throws, most teams are not able to achieve this.

A good free throw requires good concentration among other things. But most importantly, a successful free throw requires good mechanics in the shot. This paper will qualitatively analyze the biomechanics of how to properly shoot a good free throw. In order to do this, the paper will compare the movement, skill and activity of three students. The subjects were required to shoot a number of free throws using the National Collegiate Athletic Association regulation size ball, free throw line dimensions ad basket. The subjects used were all male and they reported to play on a regular basis for recreational purposes. The subjects were filmed using a digital camera from the side. The ten shots were required to make and the results were all recorded. The video recording was done at thirty frames every second. From

the total shots attempted by each subject, five misses and five makes were chosen for qualitative analysis. The analysis was done on two dimension planes. The movements for seven points were taken. These include the wrist, fingertip, elbow, hip, toe, knee and shoulder.

The description of an ideal free throw

One of the most commonly used styles in attempting a free throw is the push style. The push style is usually a continuous motion. However, for the purposes of this paper, the push style will be subdivided into five basic phases. These include the preliminary movements, the backswing, and force producing movements, the critical instant and the follow through.

- Preliminary movements

These are very individuals and they vary from player to player. For most players, the preliminary movements help them visualize the mental picture of the shot they are about to attempt, relax and free the muscles of all tightness and tension. ‘ The player ideally moves up towards the free throw line and draws their right toe closer to the line. The left foot of the layer can be placed beside the right foot or a little behind the right food in a staggered stance. The staggered stance in which the from toe of the right foot is on the free throw line and the back toe aligning with the arch of the player’s right foot is the most universally recommended stance’ (Okubo & Hubbard, 2006). It is also noteworthy that some authors recommend the square stance where both feet are on the free throw line. The feet of the shooter are normally placed at shoulder width in readiness for the shot. However, depending on the preference of the player, the width can increase.

Foot placement that is too close together might cause balance problems for the shooter as the base of support at the feet is narrow. Conversely, foot placement that is too wide apart might introduce a sideways component to the push generated by the feet of the shooter. Some of the most common preliminary movements include dribbles with the execution hand while maintaining a loose wrist, and relaxed fingers and hand. After rehearsing the shot in his mind, the player picks up the ball with the two hands ready for the shot. In order to have a good control of the ball, the shooter should spread his fingers. The fingers of the shooter should also be behind the ball rather than on the sides. The wrist of the player should be bent to the rear in extension so as to offer support to the ball and also provide the propelling force for the shot.

- The backswing

The backswing phase consists of all the movements involved during the crouch by the shooter and preparation for the shot. At this point the ball is held immobile at the waist level and with the executing hand behind the ball. The shoulder of the executing arm is parallel to the shooter’s body. The upper arm of the shooter is held along the trunk. The knees of the shooter are flexed to nearly ninety degrees, ant the trunk flexed to nearly fifty degrees from the vertical point. Of importance at this point is the trunk flexion. ‘ Its subsequent extension loads the legs by increasing hip and knee flexion slightly before the extension for the shot. In order to maintain equilibrium, postural adjustments like hip and knee flexion occur as the shooter is standing’ (Knudson, 2013).

As the trunk positioning changes from flexion to extension, the upward

moving trunk presses down on the lumbar vertebra. This in town presses down on the sacroiliac joints that subsequently press down on the hip joints. The downward force generated is transmitted to the knee joints. This causes a greater knee flexion as a response to the downward moving force. This is very crucial to the shot as players who do not have proper trunk flexion may not be able to load the legs optimally via trunk extension thereby losing the full contribution the leg extension emanating from a profoundly flexed position has on the shot.

- Force producing movements

These are the movements that generate the upward and forward force required to project the ball towards the basket. These include the trunk and leg extension as well as the straightening of the executing arm. During this point of the shot, the ball is positioned in front of the body of the shooter. The right executing hand is positioned behind the ball with the fingers spaced and spread with the ball sitting square in the base and pads of the fingers. This phase begins when the trunk assumes a vertical position and the ball is slightly above shoulder level. This is the point when the knees are at maximal flexion and the vertical velocity of the ball equals zero.

The first force producing movement is the extension of the shooter’s knees an hips as well as the elevation of the ball due to the flexion of the shoulder. Ideally, the correct timing of these movements involves the extension of the knees and hips, after which the shoulder flexion follows, followed by the extension of the elbow and finally the flexion of the wrist. One of the errors that occur in this phase is the excessive elevation of the shoulder girdle. This causes tension on the trapezius of the neck thereby interfering with the

smooth motion of the ball. Another error occurs in the form of the hyperextension of the trunk in the lower back. This is due to a considerable curvature in the lumbar area of the spine.

During the shot, the upper arm is raised until it assumes a horizontal position. The elbow flexion of the shooter’s execution hand increases to about one hundred and thirty degrees of flexion. It is noteworthy that much of the power during the shot emanates from the elbow’s extension and the flexion of the shooter’s wrist during release.

- The critical instant

This is the instant of ball release during a free throw. After the release of the ball, there is nothing the shooter can do to affect the flight of the ball. After the release, some players leave the floor as an indication of a forceful push of the shooter off the floor. However, the feet should land in the same position as they were during takeoff if the player leaves the floor. A common mistake occurs here; where the player floats backwards or forwards therefore failing to land in the position of take off. In order to avoid this, the trunk should always maintain a vertical position rather than leaning backward or forward throughout the release and follow up phase.

The shoulder of the executing arm should be in between one hundred and forty and one hundred and fifty degrees of flexion. This ensures that optimal vertical velocity is imparted on the ball upon release. The elbow of the executing hand should approach full extension at release so that the joint makes a full contribution to the force of flight of the ball. The wrist of the executing hand should be mid flexion at the time of release. This is to make sure that the hand is at full velocity when the ball is released. ‘ In instances

where the ball is released too early or too late into the shot, the bal in flight lacks optimum velocity because the wrist is either speeding up or slowing down as opposed to being at maximum peak velocity' (MacGinnis, 2005). The non-executing hand should fall of during release so that the shooter can gain maximum control of the ball. However, the hand should remain in position facing the ball so as to avoid any sidespins on the ball. The release of the ball is accompanied by the relaxation in the muscles of the executing arm. However, there should be no excessive tension in the wrist or hand.

- The follow through

This is the final phase of the free throw shot. ' All the joints are required to continue moving through until the finish of their motion range upon release of the ball. In a skilled free throw, the legs of the shooter are at full extension and the ankles at full plantarflexion. The trunk of the shooter is also vertical with the executing hip aligned vertically with the knee, ankle and the joints of the executing arm. The executing shoulder should be in between one hundred and forty and one hundred and fifty degrees of flexion' (Krause, Meyer & Meyer, 2008). Follow through ensures that the release velocity of the ball does not reduce by keeping the joints in motion till their full range.

Individual trial deficiencies

Some of the trial deficiencies for subject one included: -

- Poor alignment: this is the failure by the shooter to align the executing side hip, elbow, knee and shoulder during the release of the ball. This results in the releasing of the ball off line leading to a miss of the shot. One needs to keep all the joints aligned during the throw.

- Full follow through after release: The subject failed to finish the full range of motion after releasing the ball. In order to rectify this, the player should finish in the while the executing hand in the full goose neck position. The arm ought to be pointed towards the ceiling and the executing hand pointed directly towards the basket.

The following were the trial deficiencies for subject two: -

- Leaning during release: during the release phase, the player was either leaning forwards or backwards. This resulted in the production and application of a off center force on the ball upon release. In order to avoid this, one should maintain a shoulder with gap at the legs and ensure the ball rises while aligned to the midriff of the body during the throw.
- Interferences by the non-executing hand: - this is resulted in the misalignment of the ball with the hoop. In order to rectify this, the player ought to ensure that the non-executing hand is not pronated or supinated upon release.
- Low arch on the ball: a low arch denies the ball the use of the maximum area in the basket during entry. This could result in a miss after the ball hits the rim of the basket. In order to avoid this, the player will need to increase his shoulder flexion and elbow and/or trunk extension.
- Lack of back spin: This affects the flight of the ball due to side spin or total lack of spin causing the ball to rebound hard on the board. In order to apply the backspin, the player ought to enhance his follow through during the throw.

Summary and conclusions

References

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