How to control postural tremor to improve shooting performance

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✓ The purpose of this article is to better understand the postural tremor in relation to shooting sport with the end goal of improving shooting accuracy.

Introduction

Successful shooting performance is a highly skilled task that requires exceptional cognitive, visual, and neuromuscular functions. Because an important level of precision is required in shooting, tremor adversely affects performance. Tremor is a series of rapid involuntary rhythmic movements or oscillations [1]. Postural tremor (of the trunk, arms and hands) appears as muscle noise whenever an athlete attempts to keep a steady position against gravity during aiming or pointing (action tremor) [2, 3]. Postural tremor is influenced by intrinsic and extrinsic parameters related to neural, mechanical, and environmental factors. A postural tremor in shooting happens when an athlete attempts to hold a particular posture for a long time and experiences involuntary movement instead. Postural tremor can affect accuracy, precision and aim time in shooting performance. Most elite shooting athletes have remarkably low tremor [1-4] and by being able to suppress their tremor, elite shooting athletes achieve even greater success [1].

A) Intrinsic parameters

Physiologic tremor

Physiological tremor occurs in healthy persons by way of irregular fluctuations in muscle forces and movements occurring during fine motor tasks. Tremors can be enhanced by disease, medication, or physiological and psychological stressors [5].

Heart rate and Respiratory rate
Breathing is a primary determinant of heart rate. Rapid shallow breathing decreases heart rate whereas slow deep breathing increases heart rate [6]. There is a change in heart rate values and increased muscle stress prior and during shooting which is influenced by psycho physiological factors as well as shooting position, limited time of shooting and repetitive shooting. Elite shooting athletes control their heart rate with respiratory rate. Prior to shooting, elite athletes lower their heart rates and wait for their heart rate and respiratory rate cycles to coincide so that they can fire, or they hold their breath until there in an appropriate time in their cardiac cycle to shoot [6,7].

**Heat stresses and Dehydration**

Heat stress affects shooting performance including cognitive function, vision, and neuromuscular control. Heat stress, affected by increased humidity, increased air temperature, shooting clothing and dehydration arising as a result can all have a negative influence on elite athlete’s performance. Dehydration causes a drop in blood plasma volume which induces an increase in an athlete’s heart rate. The increased heart rate decreases the potential cardiac supply required for muscles to perform. Consequently, a decrease in performance may arise from heat stresses and dehydration. However, light to moderate levels of dehydration do not decrease shooting performance [8].

**B) Extrinsic parameters**

**Shooting position**

The prone position should result in better shooting performance due to the high surface area with the ground and high rifle stability. In the standing position, the ability to limit postural sway (and tremor) is determinative to a good shooting performance. The kneeling position alters vertical deviation, and performance, more than prone or standing positions [8].

**Aiming posture (notably in pistol)**

Pistol Shooting with a bent rather than a straight elbow theoretically capitalizes on a reduced moment of inertia around the shoulder joint by bringing the arm and gun closer to the body. This requires less muscle activation of the shoulder flexors to hold the arm up against gravity. For these reasons, some pistol athletes improve shooting performance by slightly bending their elbows [4].

**Muscle temperature**

Cooling of a muscle can affect its force, power and contraction velocity, but may improve force control during precision movements by reducing physiological tremor [9 -11]. Cooling the forearm produces a large decrease in tremor power and improves the accuracy of the shooting [1, 11]. However, cooling the hand for a short time reduces the sensory feedback and causes high error and also
increased shooting time, probably due to high force application on trigger [12]. Studies show forearm cooling improves pistol shooting accuracy while forearm heating worsens accuracy, due to the decrease and increase physiological tremor size, respectively [10]. Local cooling may therefore be useful for athlete who wishes temporarily to reduce tremor in order to improve dexterity for shooting [1].

**Balance**

Shooting performance is related to postural balance and gun stability particularly in inter-individual level. Thus, balance training programs can improve shooting performance with postural tremor control [13].

**Fatigue**

The effects of fatigue resulted by prolonged muscle loading are widespread, affecting tremor and muscle activity in both limbs through a combination of neural and mechanical mechanisms. Tremor in the mediolateral and vertical directions within a limb are strongly coupled in loaded condition compared with unloaded condition. In addition, when holding a weight to failure, postural tremor in all directions increases [14].

**Altitude**

Altitude affects shooting performance with both acute and chronic exposures. In acute exposure, there is a decrease in shooting accuracy in the horizontal and vertical directions, a decrease in precision, and a decrease in aiming time. Hypoxia (low level oxygen) simulates in high altitude thus induces a decrease in shooting performance. In chronic exposure, shooting performance improves back to sea level conditions [8].

**Mass**

The addition of a mass to the limb (e.g., the weight of the gun in the athlete’s hand) increases tremor. The location and weight of the extra mass in the gun can both significantly affect tremor amplitude. Additional mass can also have impact tremor depending on the duration of time the arm is outstretched [4].

**C) Shooting skill**

Shooting performance includes both muscular contraction of the limb to pull the trigger as well as control and recovery of the recoil. Both of these actions cause external motions that must be compensated during the shot. Finger placement on the trigger (too medial or lateral), improper trigger pull, and weight of the trigger pull may also influence motion and accuracy. This is why shooters with greater training are typically those who exhibit the greatest skill.
**External factors**

External factors such as gravity and wind can play a significant role in shooting accuracy. But intensive training allows elite athletes to develop skills to control those factors.

**Natural factors**

Natural factors such as respiratory and cardiac rates, body sway, and limb motion may also significantly impact shooting performance. But skilled shooters learn to partially control some involuntary intrinsic factors related to postural tremor such as the heart rate (by pulling the trigger between breaths) and a temporary pause in the respiratory cycle by modifying their stance, reducing heat stresses, increasing training and skill and by understanding of the importance of controlling their respiratory and heart rates [4].

**Conclusion**

Every shooter has some level of physiological tremor. When an athlete holds a shooting position or is aiming at a target, small involuntary fluctuations will invariably negatively affect shooting performance. Shooting athletes are thus encouraged to alter their training and skill sets in order to better control their tremors. Doing so will certainly lead to greater success. Good luck!

**References**

4) Kelleran KJ. Physiological Tremor in Handgun Aiming and Shooting Tasks. Old Dominion University; 2018.

