

# Static Posture Assessment Screen of Athletes: Benefits and Considerations

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## SUMMARY

THERE IS AN EMERGING TREND WITHIN THE STRENGTH AND CONDITIONING PROFESSION TO IDENTIFY AND CORRECT THE FAULTY MOVEMENT PATTERNS OF ATHLETES BEFORE ANY SUBSTANTIAL STRENGTHENING OF MUSCLE IS UNDERTAKEN. STRENGTH AND CONDITIONING PROFESSIONALS IN SOME CASES FAIL TO RECOGNIZE THE RELATIONSHIP BETWEEN STATIC POSTURE AND DYNAMIC MOVEMENT ABILITY. THIS REVIEW WILL INFORM THE READER OF THE PROGNOSTIC VALUE OF SCREENING STATIC POSTURE BEFORE ASSESSING AN ATHLETE'S MOVEMENT ABILITY. THE CHARACTERISTICS OF OPTIMAL STANDING POSTURE ARE REVIEWED WITH SUPPORTING BIOMECHANICAL RATIONALE. SPORT-SPECIFIC POPULATIONS ARE REVIEWED, AND THE BENEFITS AND CONSEQUENCES OF "SPORT-SPECIFIC POSTURES" ARE DISCUSSED.

## INTRODUCTION

In recent years, there has been a growing interest within the strength and conditioning profession in

screening the movement capability of athletes by the use of various movement-screening tools designed to identify faulty movement patterns. The benefit of identifying faulty movement patterns in athletes is intuitive. However, what is surprising about these various screening tools is that they do not incorporate a screening of static standing posture. For example, Cook's (4) functional movement screening does not incorporate any static posture assessment. Static posture may be easier and quicker to measure than dynamic posture for screening purposes, but the relationship between static posture and dynamic movement is unclear. Therefore, the question of principal interest in this review is whether the standing posture of an athlete tells us anything about how that athlete will move. This review investigates what is reported in the literature as optimal standing static posture and provides supporting biomechanical rationale. In addition, this review includes an investigation into sport specific postures that are biomechanically incorrect, yet appear to be advantageous to performance.

## OPTIMAL STANDING POSTURE

According to many authors, posture is the alignment and maintenance of body segments in certain positions (2,4,7,10,12,16). Britnell et al. (3) offered a definition of good posture to be

a state of muscular and skeletal balance, which protects the supporting structures of the body against injury or progressive deformity. In this review, we shall consider posture as standing static posture that has been defined as a situation in which the center of gravity of each body segment is placed vertically above the segment below (27). Bloomfield (2), Roaf (21), and Norris (19) added that good posture is present when the line of gravity passes through the center of each joint just anterior to the midline of the knee and through the greater trochanter, bodies of the lumbar vertebrae, shoulder joint, bodies of the cervical vertebrae, and the lobe of the ear, placing the body in equilibrium and resulting in all internal forces equaling zero (Figure 1). A definition of optimal standing static posture that may resonate with the strength and conditioning coach is when the least amount of physical activity is required to maintain body position in space and that which minimizes gravity stresses on body tissues (8). Tables 1 and 2 detail the ideal position of each body segment in order for an optimal standing posture to be achieved.

The benefit of good standing posture to movement efficiency has indirectly received much attention in the

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kinematics; kinetics; static; dynamic

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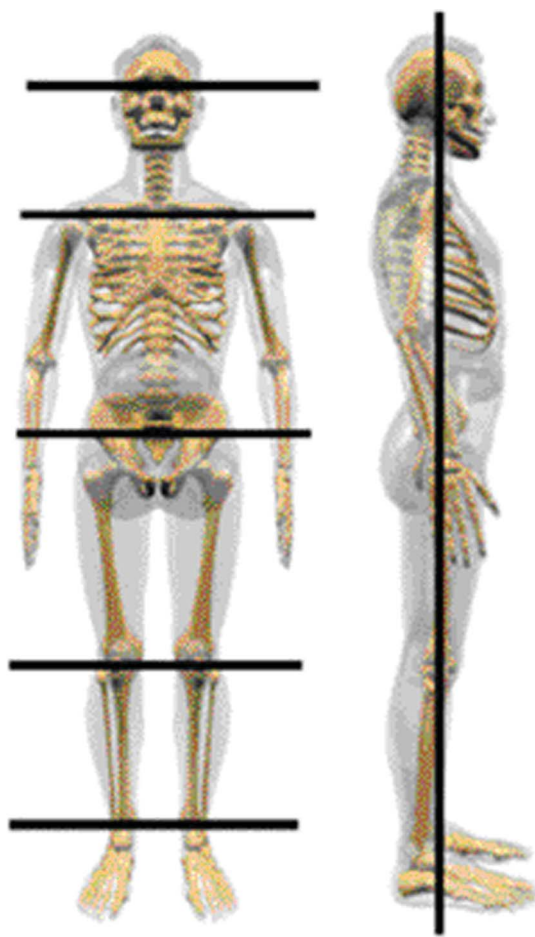


Figure 1. Optimal standing static posture front and side view.

scientific literature. The focus of most posture research is related to health and productivity in the workplace. The benefits of good posture may be assumed but not entirely understood. Bloomfield (2), Britnell et al. (3), and Dalton (5) stated that the advantages of having good posture are both mechanically functional and economical, with the least use of energy occurring when the vertical line of gravity falls through the supporting column of bones where the body does not have to continually adjust its position to counter the forces of gravity. For example, an athlete with rounded shoulder posture performing a pushing and pulling movement may need to first adduct and medially rotate the scapulae to be in the correct

dynamic posture position to perform a technically proficient pushing or pulling movement. These anticipatory strategies are less efficient, causing the athlete to expend extra energy to perform a safe and technically proficient pushing or pulling movement. In addition, force production would be sacrificed. Faulty movement is a deviation from the ideal pattern of motion. The deviation is an alteration of the normal counterbalancing action of muscular synergists (22). Posture assessment screening may indicate the presence of muscle impairments, which can be associated with movement impairments (22). It has been stipulated that good posture helps facilitate optimal musculoskeletal

health and performance (2,3,5,8,10,12,21,22,27,28).

## BIOMECHANICAL FACTORS OF STATIC AND DYNAMIC POSTURE

To gain a more clear understanding into how standing static posture may influence movement a review of key biomechanical principles, such as equilibrium and the work-energy relationship, that influence movement efficiency is necessary. Equilibrium is a state characterized by balanced forces and torques (9). In other words, there is no wasted energy or unnecessary force production to accommodate body segments that are out of alignment. A body that is in equilibrium would theoretically be able to produce forces more efficiently (9). The work-energy relationship involves force production over a distance. A baseball pitcher with limited range of motion in his shoulders and or hips would have difficulty producing the same work and power output as an athlete with optimal shoulder and or hip range of motion. Any restriction, imbalance, or malalignment within the musculoskeletal structure can affect optimal range of motion and, thus, the quality of force production, force application and movement efficiency. If the aforementioned baseball pitcher displayed sub-optimal shoulder or hip posture during a posture screening, further screening techniques could be used to assess the nature and magnitude of the dysfunction before extensive loading is prescribed either in the weight room or in the bullpen.

## SPORT-SPECIFIC POSTURAL ADAPTATION

There are a variety of postural deviations observed in athletes that appear to be advantageous to the production and application of force (2). Some coaches believe there is value in promoting certain abnormal postures because of the mechanical advantage that is gained in performance. The strength and conditioning professional would be remiss if he or she did not consider the lack of practical research

**Table 1**  
**Optimal posture criteria when assessing a person from the side**

| Anatomical Region | Kendall et al. (12)                                                                       | Sahrmann (22)                                                                      | Watson (25)                                         | Bloomfield (2)                                        |
|-------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|
| Head              | Neutral position not tilted forward or back                                               | NA                                                                                 | Neutral position not tilted forward or back         | Neck erect, chin in                                   |
| Cervical spine    | Normal curve, slightly convex anteriorly                                                  | NA                                                                                 | NA                                                  | Chest elevated                                        |
| Scapulae          | Flat against the upper back                                                               | Flat against the upper back                                                        | Flat against the upper back                         | Shoulders centered                                    |
| Thoracic spine    | Normal curve, slightly convex posteriorly                                                 | Slight posterior curve                                                             | Normal curve, slightly convex posteriorly           | Upper back normally rounded                           |
| Lumbar spine      | Normal curve, slightly convex anteriorly                                                  | Forward convex curve                                                               | Normal curve, slightly convex anteriorly            | Trunk erect, abdomen flat, lower back normally curved |
| Pelvis            | Neutral position, anterosuperior spines in the same vertical plane as the symphysis pubis | Anterior superior iliac spine is in the same vertical plane as the symphysis pubis | NA                                                  | NA                                                    |
| Hip joints        | Neutral position neither flexed nor extended                                              | Neutral position neither flexed nor extended                                       | NA                                                  | NA                                                    |
| Knee joints       | Neutral position, neither flexed nor hyper extended                                       | Neutral position, neither flexed nor hyper extended                                | Neutral position, neither flexed nor hyper extended | NA                                                    |
| Ankle joints      | Neutral position, leg vertical and at a right angle to the sole of the foot               | NA                                                                                 | Neutral position, leg vertical and at a right angle | NA                                                    |

NA = not reported.

supporting the advantages of sport specific postures.

Only 2 researchers, Bloomfield and Watson, have devoted a significant amount of time to investigating sport-specific postures. Table 3 summarizes the postural deviations that are indicative of high-level athletes in certain sports based on Bloomfield and Watson's research. The literature reviewed assessed athlete-standing posture and either correlated their posture to the incident of injury or detailed the postural characteristics of athletes participating in certain sports. No studies to date investigated the benefits of emphasizing sport-specific postures when performing specific weight

training exercises or during sport specific training.

## Shoulder Girdle

The shoulder girdle, which is made up of the clavicles and the scapulae, is a complex structure that is capable of varied and impressive mechanical abilities (9). Although the shoulder girdle is considered the most mobile joint in the human body, because of its structure and function, it requires substantial stability (4,9,12). Athletes participating in sports that require use of the shoulder for performance, such as swimming and throwing, may be subjected to specific postural adaptations. Bloomfield (2) noted that

swimmers competing in sprint events (200 meters and shorter) had square shoulders, upright trunks, and possessed long clavicles and large scapulae. This postural adaptation, which appears to provide lower levels of flexion and extension, seems beneficial for accommodating an increased stroke rate. In contrast, distance swimmers, who are defined by stroke length, are observed with abducted scapulae and rounded shoulders and, thus, an increase in flexibility of the shoulder girdle (2).

Overhead throwing athletes display abducted scapulae and rounded shoulder posture (2). Sahrmann (22)

| <b>Table 2</b><br><b>Optimal posture criteria when assessing a person from behind</b> |                                                                                                                                                                                                                               |                                                                                                                             |                                                            |                       |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------------|
| Anatomical Region                                                                     | Kendall et al. (12)                                                                                                                                                                                                           | Sahrmann (22)                                                                                                               | Watson (25)                                                | Bloomfield (2)        |
| Head                                                                                  | Neutral position neither tilted nor rotated.                                                                                                                                                                                  | NA                                                                                                                          | NA                                                         | Head erect            |
| Shoulders                                                                             | Level, not elevated or depressed.                                                                                                                                                                                             | Positioned slightly below the horizontal axis through the first thoracic vertebrae.                                         | Straight, one shoulder is not higher than the other        | Shoulders straight    |
| Scapulae                                                                              | Neutral position, medial borders essentially parallel and approximately 3–4 inches apart.                                                                                                                                     | Vertebral border of the scapula is parallel to the spine and is positioned approx. 3 inches from the midline of the thorax. | NA                                                         | Spine straight        |
| Thoracic spine                                                                        | Straight                                                                                                                                                                                                                      | NA                                                                                                                          | Straight, no lateral curve of the spine                    | Spine straight        |
| Lumbar spine                                                                          | Straight                                                                                                                                                                                                                      | NA                                                                                                                          | Straight, no lateral curve of the spine                    | Spine straight        |
| Pelvis                                                                                | Level, both posterior superior iliac spines in the same transverse plane                                                                                                                                                      | Hips level                                                                                                                  | NA                                                         | level                 |
| Hip joints                                                                            | Neutral position, not adducted or abducted.                                                                                                                                                                                   | Neutral position, not adducted or abducted.                                                                                 | NA                                                         | NA                    |
| Lower extremities                                                                     | Straight, not bowed or knock-kneed                                                                                                                                                                                            | Straight, not bowed or knock-kneed                                                                                          | Neutral position, neither internally or externally rotated | NA                    |
| Feet                                                                                  | Parallel or slight out-toeing. Outer malleolus and outer margin of the sole of the foot in same vertical plane so that the foot is not pronated or supinated. Tendo calcaneus should be vertical when seen in posterior view. | Neutral position with no signs of pronation or supination.                                                                  | NA                                                         | Feet pointed straight |
| NA = not reported.                                                                    |                                                                                                                                                                                                                               |                                                                                                                             |                                                            |                       |

alleged that this posture is in part attributable to an increased length of the serratus anterior muscle, which from a biomechanical perspective allows the throwing athlete to increase the time and distance

that force can be applied, affording more impulse and work, respectively, and as a result a harder or longer throw. Additionally, athletes involved in contact sports have been observed with abducted scapulae

and rounded shoulder posture. It is theorized that this posture is beneficial because it allows the athlete to assume a tuck or covered-up position quickly while running into defenders (2).

**Table 3**  
**Common postural deviations observed in athletes who compete in sports as reported by Bloomfield (2) and Watson (25)**

| Sport                        | Medial tibial torsion (pigeon toe) | Lateral tibial torsion (duck feet) | Hyperextended knees | Lordosis/ anterior pelvic tilt | Scoliosis | Flat back | Kyphosis | Round shoulders |
|------------------------------|------------------------------------|------------------------------------|---------------------|--------------------------------|-----------|-----------|----------|-----------------|
| American Football            |                                    |                                    |                     | X (2)                          |           |           |          |                 |
| Australian Football          |                                    |                                    |                     | X (2)                          |           |           |          |                 |
| Basketball                   | X (2)                              |                                    |                     | X (2)                          |           |           |          |                 |
| Boxing                       | X (2)                              |                                    |                     |                                |           |           | X (2)    | X (2)           |
| Field hockey                 | X (2)                              |                                    |                     | X (2)                          | X (2)     |           | X (2)    | X (2)           |
| Gaelic football              | X (2)                              |                                    |                     | X (30)                         |           |           |          |                 |
| Gymnasts                     |                                    |                                    |                     | X (2)                          |           |           |          |                 |
| Hurling                      |                                    |                                    |                     | X (2)                          | X (30)    |           | X (2)    | X (30)          |
| Judo                         |                                    |                                    |                     |                                |           |           | X (2)    | X (2)           |
| Lacrosse                     | X (2)                              |                                    |                     | X (2)                          | X (2)     |           | X (2)    |                 |
| Racquetball                  | X (2)                              |                                    |                     |                                |           |           |          |                 |
| Rugby                        | X (2)                              |                                    |                     | X (30)                         |           |           |          |                 |
| Soccer                       |                                    |                                    |                     | X (30)                         |           |           | X (2)    |                 |
| Squash                       | X (2)                              |                                    |                     |                                |           |           |          |                 |
| Swimming (freestyle)         | X (2)                              |                                    | X (2)               |                                |           | X (2)     |          |                 |
| Swimming (backstroke)        | X (2)                              |                                    | X (2)               |                                |           |           |          |                 |
| Swimming (butterfly)         | X (2)                              |                                    | X (2)               |                                |           |           |          |                 |
| Swimming (breaststroke)      |                                    | X (2)                              |                     |                                |           |           |          |                 |
| Track & Field (distance)     |                                    |                                    |                     |                                |           | X (2)     |          |                 |
| Track & Field (jumpers)      |                                    |                                    |                     | X (2)                          |           |           |          |                 |
| Track & Field (mid-distance) |                                    |                                    |                     | X (2)                          |           |           |          |                 |
| Track & Field (sprints)      |                                    |                                    |                     | X (2) (30)                     |           |           |          |                 |
| Track & Field (throwers)     |                                    |                                    |                     | X (2)                          |           |           |          |                 |
| Volleyball                   | X (2)                              |                                    |                     | X (2)                          |           |           |          |                 |
| Wrestling                    |                                    |                                    |                     |                                |           |           | X (2)    | X (2)           |

## Trunk and Hip

The most commonly reported sport-specific postural adaptations of the trunk and hip region are lordosis and anterior pelvic tilt (2,25,28). Lordosis is considered to be an increase in the anterior curve of the lumbar spine

resulting in an anterior tilt of the pelvis (12,14,21,22,25,27,28). Anterior pelvic tilt is a condition in which the pelvis is positioned forward, resulting in flexion of the hip joint; the low back arches forward, creating an increased forward curve of the lumbar spine (Figure 2),

i.e., lordosis (12). Field sport athletes and sprint runners are typified by varying degrees of lordosis and anterior pelvic tilt (2,25). The results of Watson's (25) investigation of posture and participation in sports, involving 181 male athletes, 17 to 20 years of age,



**Figure 2.** Side view of an athlete with lordotic posture and anterior pelvic tilt.

from 15 different sports are summarized in Table 4. The principal finding was that lordosis was significantly greater for those men who played football and soccer as compared with other sportsmen (25).

Within the same study, a secondary study observed 11 soccer players over the course of 3 years. The player's posture was assessed 3 times (beginning, middle, and end) during the duration of the study. It was established that the lordosis of 8 of the 11 players significantly increased with their participation in soccer (25). An additional study by Watson (24) involving 61 rugby players from the under-15, under-16, and senior rugby teams of an Irish school, observed

lordosis as the most common postural deviation (28%).

Researchers and sports medicine professionals attribute the cause of lordosis in field sport athletes to adaptation from sport participation as well as coaches using specific training methods designed to strengthen muscles considered to be responsible for performance (2,25,28). However, specific training methods designed to overdevelop the psoas and iliacus muscles for improved kicking power and knee lift for improved running performance may be misguided (28). The advantages of anterior pelvic tilt and resulting lordotic posture are believed to be an increased hip extension, which allows the running and jumping athlete to apply force over a longer time resulting

in a greater impulse. However, athletes with severe anterior pelvic tilt have reported increased incidence of low back pain (15,18,20,22,23).

### **Lower Limbs**

It has been proposed that players involved in sports requiring quick steps within a short distance are likely to possess pigeon toe posture (see Figure 3) of the feet (2). The reason for this postural adaptation is thought to be caused by tibial torsion shortening the hamstring muscle group, preventing the individual from taking long steps (2). It has also been observed that swimmers (depending on stroke specialty) display a pigeon toe (Figure 3) or duck foot posture and knee hyperextension (Figure 4) (2). It is alleged that hyperextended knees are the result of the cruciate ligaments of the knees being slowly stretched with the repetition of kicking (2). Although there is no experimental evidence to support the benefits of the aforementioned lower limb postural abnormalities in swimmers, it has been theorized that the pigeon toe posture (Figure 3) affords greater propulsive force from the feet and increased knee hyperextension allows for a greater kicking range of motion and hence more work performed during the kick.

Although there is a lack of research supporting the advantages of postural deviations of the lower limb for improving sport performance, there is a significant amount of research in which researchers have investigated the affects of these postures on the nature and magnitude of lower limb injury. Eighty male athletes who competed in Gaelic football and hurling over the course of 4 years were involved in a 4-year experimental design study in which posture was assessed. Participants sustained on average 3.01 injuries per year or a combined 962 significant sport injuries during the 4-year period. Participants who sustained ankle sprains had a greater incidence of postural defects of the ankle and knee (26). Several studies have reported overuse injuries of the lower extremity because of faulty alignment of the feet and knees

**Table 4**  
**Results of posture screening performed on 181 athletes**

| Lordosis                                                                                                                |                                     |              |                       |
|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------|-----------------------|
| Posture rating                                                                                                          | Soccer, Gaelic, rugby (98)          | Hurlers      | Other sportsmen (83)  |
| 2 and below                                                                                                             | 9 (9%)                              | NA           | 0                     |
| 2.1 to 3.0                                                                                                              | 24 (24%)                            | NA           | 15 (18%)              |
| 3.1 to 4.0                                                                                                              | 39 (40%)                            | NA           | 28 (34%)              |
| 4.1 to 5                                                                                                                | 26 (27%)                            | NA           | 40 (48%)              |
| Scoliosis                                                                                                               |                                     |              |                       |
| Posture rating                                                                                                          | Soccer, Gaelic, rugby               | Hurlers (23) | Other sportsmen (158) |
| 2 and below                                                                                                             | NA                                  | 0            | 1 (.01%)              |
| 2.1 to 3.0                                                                                                              | NA                                  | 7 (30%)      | 16 (10%)              |
| 3.1 to 4.0                                                                                                              | NA                                  | 10 (43%)     | 31 ((20%)             |
| 4.1 to 5                                                                                                                | NA                                  | 6 (26%)      | 110 (70%)             |
| Abducted Scapulae                                                                                                       |                                     |              |                       |
| Posture rating                                                                                                          | Soccer, Gaelic, rugby (15)          | Hurlers (23) | Other sportsmen (143) |
| 2 and below                                                                                                             | 0                                   | 5 (22%)      | 7 (.05%)              |
| 2.1 to 3.0                                                                                                              | 0                                   | 7 (30%)      | 29 (20%)              |
| 3.1 to 4.0                                                                                                              | 8 (53%)                             | 8 (35%)      | 63 (44%)              |
| 4.1 to 5                                                                                                                | 7 (47%)                             | 3 (13%)      | 44 (31%)              |
| Flat feet                                                                                                               |                                     |              |                       |
| Posture rating                                                                                                          | Soccer, Gaelic, rugby, hurlers (80) |              | Other sportsmen (101) |
| 2 and below                                                                                                             | 18 (23%)                            |              | 20 (20%)              |
| 2.1 to 3.0                                                                                                              | 38 (48%)                            |              | 30 (30%)              |
| 3.1 to 4.0                                                                                                              | 21 (26%)                            |              | 32 (32%)              |
| 4.1 to 5                                                                                                                | 3 (.04%)                            |              | 19 (19%)              |
| Adapted from Watson (29).                                                                                               |                                     |              |                       |
| Rating scale: 5, ideal posture; 4, minor deviation; 3, significant deviation; 2, marked deviation; 1, severe deviation. |                                     |              |                       |
| NA = not reported.                                                                                                      |                                     |              |                       |

(1,6,11,13,30). However, it was not clear whether the postural deviations were caused by participation in sports.

## PRACTICAL APPLICATION

A primary responsibility of the strength and conditioning professional is to prevent injury while loading athletes in a manner that will give them an

advantage in their specific athletic or sporting activity. From the literature reviewed, it seems that some postures thought to be “faulty” actually may offer athletes a sport specific advantage (e.g., anterior pelvic tilt for sprinters and kickers, hyperextension of the knees for swimmers). One issue to consider, however, is whether emphasizing some postures under load during

strength and conditioning training sessions are beneficial or a potential danger to athletes. For example, the lordosis and anterior pelvic tilt found in running, sprinting, and jumping athletes may provide a mechanical advantage, but caution should be taken when attempting to exaggerate anterior pelvic tilt during loading in the weight room. Athletes attempting to “set” the

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Figure 3. Front view of athlete with pigeon toe posture.

lumbar spine before performing a bilateral back squat may over extend the lumbar spine, given the normal anterior position of their pelvis. The exaggerated lumbar position may look protective when compared with a round back position; however, an excessive lumbar extension position substantially increases lumbar compressive forces (17).

In this case, athletes with significant anterior pelvic tilt may be better served by positioning their lumbar spine in a neutral position (Figure 5) to reduce the microtrauma caused by holding a severe anterior pelvic tilt position under load. The information from a posture screening may assist the strength and conditioning professional with identifying an athlete's general movement tendencies based on their static standing posture. For these reasons, it would seem appropriate to include a static standing posture assessment in union with

a dynamic movement screening of athletes before any heavy loading in a general or sport specific manner.

### CONCLUSION

Optimal standing static posture is when the least amount of neuromuscular activity is required to maintain body position in space and that which minimizes gravity stresses on the body. The biomechanical rationale for achieving and maintaining optimal posture is to move efficiently, free of impairment and dysfunction. It is not clear whether the sport-specific postures discussed in this review are truly beneficial to sport performance or merely an adaptation of committed sport participation void of specific strength training interventions designed to build a balanced body. It is therefore not clear whether loading sport-specific postures will yield performance enhancements or

increase the incident of injury. Further research needs to be conducted to ascertain the benefit of training with sport specific postures. Given the relationship between static posture and dynamic movement, assessing static standing posture may enable the strength and conditioning professional to identify areas of the body where muscle impairments are present. Because muscle impairments contribute to postural abnormalities and are associated with movement impairments the additional information provided by a static standing posture assessment may assist the strength and conditioning professional in developing strength programming that is more specific to the athlete's needs in order to enhance performance and possibly reduce the incident of injury.■



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**Figure 4.** Static standing posture side view of an elite swimmer.

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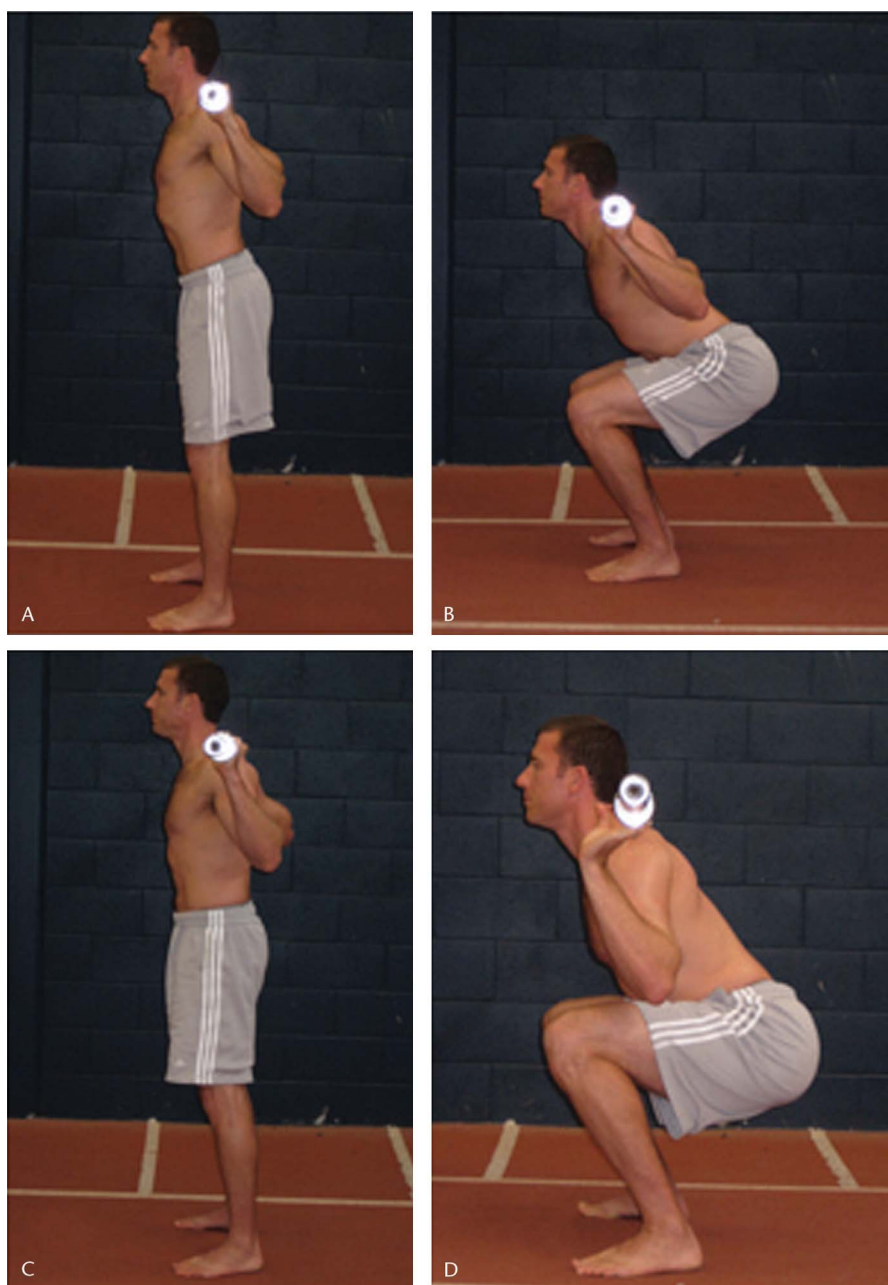


**Figure 5.** (A) Athlete with lordotic posture and anterior pelvic tilt with a “set” back posture before performing a bilateral back squat. (B) “Set” back posture resulting in exaggerated lumbar extension. (C) Athlete with a neutral spine position before performing a bilateral back squat. (D) Neutral spine position results in reduced lumbar extension.

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