Q4E Case Study 20 – Anatomical Movements

Proposed Subject Usage:

Physical Education (A/AS level)

Introduction

In order to perform a practical analysis of human movement a sound understanding of anatomical movements is necessary. Anatomical movements can be defined as the act or instance of moving the bodily structures or as the change of position in one or more of the joints of the body. Joint actions are described in relation to the anatomical position which is the universal starting position for describing movement. A subject is considered to be in the anatomical position when they are standing in an upright posture, facing straight ahead, with their feet close together and parallel and the palms of their hands facing straight ahead. This position is demonstrated in figure 1 below.

When studying the various joints of the body and analyzing their movements it is helpful to characterize them according to specific planes of motion and their axes. A plane of motion may be defined as an imaginary two-dimensional surface through which a limb or body segment is moved. In the human body there are three planes of motion (Figure 1) in which the various joint movements can be classified. Similar to the planes of motion the axes of rotation may be considered as a series of imaginary lines that run through the body; there are also three axes of rotation (Figure 2) where movement can occur.

- Sagittal (anteroposterior) plane – This plane is vertical and bisects the body from front to back. Dividing it into right and left symmetrical halves. For movement to occur in the sagittal plane rotation about the horizontal axis (transverse axis) must take place.

- Frontal (coronal) plane – This plane bisects the body laterally from side to side, dividing the body into front and back halves. Movement in the frontal plane takes place about the anteroposterior axis (frontal axis) must take place.

- Transverse (horizontal) plane – This plane divides the body horizontally into superior and inferior halves. Movement in this plane takes place about the longitudinal axis (vertical axis).

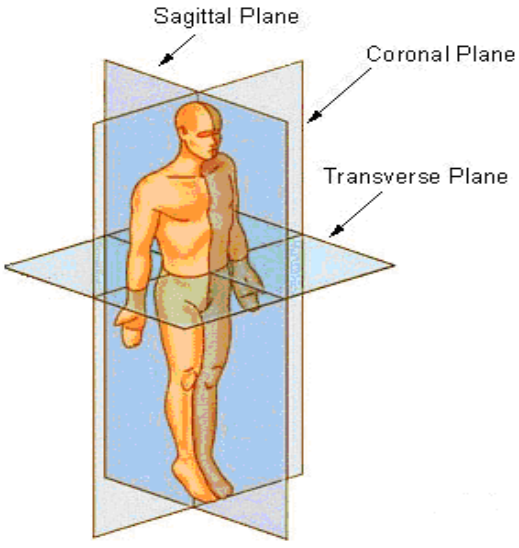

Figure 1 – Subject in anatomical position with planes of motion

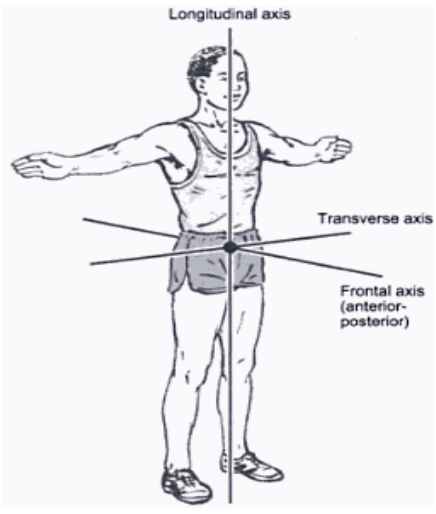

Figure 2 – Axes of Rotation

Objectives

1. To define a number of anatomical movements and demonstrate these movements with appropriate illustrations using the Quintic software.
2. Identify sport specific skills where the identified anatomical movements occur and determine the role these movements play in successful completion of the sport skill.

Methods

- Video footage was captured at 50 fps using a Panasonic Camera of a subject performing anatomical movements. The videos were then exported into Quintic Biomechanics 9.03v17 software.
- The blend, shapes and still capture functions in Quintic were used to illustrate the various anatomical movements from the captured footage.
- Video footage was then captured of various sport skills and opened in the Quintic software where they were analysed in order to determine the specific joint movements that the skill was composed of.

Functions of the Quintic software used:

- Single Camera Function
- Still Image Capture
- Photo Sequence module
- Shape Tools
- Blend Function
- Play Speed Function

Results

Note: All movements being described assume the body begins from the anatomical position unless stated otherwise as described in the introduction.

1. Flexion

Flexion is a bending movement that results in the decrease of the angle in a joint by bringing bones closer together. It usually occurs in the sagittal plane. The table below represents some of the joints where flexion can occur and an example of that motion;

Flexion	
Joint	Example
Shoulder	Raising your arms upwards and in front of the body.
Elbow	Movement of the forearm to the shoulder by bending the elbow to decrease its angle
Spine	Moving the chin towards the chest.
Hip	Movement of the femur towards the pelvis / bringing knee into chest
Knee	Moving the heel towards the buttocks.

Figure 3 below demonstrates flexion of the wrist joint. Flexion of the wrist joint is an important movement in many sport skills especially racquet sports as it can provide stability and power to a performance. In the follow through phase of a basketball free-throw wrist flexion is evident. The purpose of this movement which is technically known as a wrist snap (demonstrated in figure 4 below) is to generate enhanced spin on the ball which will in turn add lift to the trajectory (flight of the ball), this can increase release velocity

of the ball and improve the overall performance making it an important aspect to the execution of a basketball free-throw.

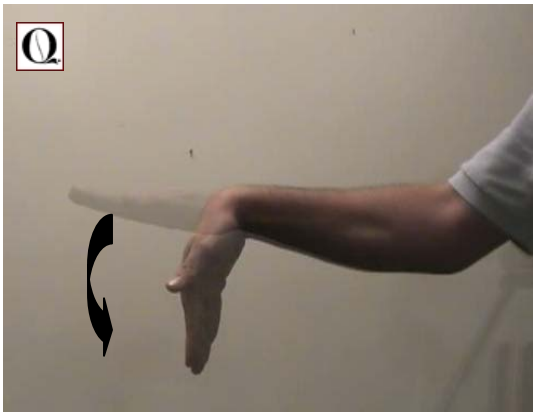

Figure 3 – Wrist Flexion

Figure 4 – Basketball Wrist Snap Wrist Flexion

2. Extension

This is a straightening movement that results in the increase of the angle in a joint by moving bones further apart. This movement occurs in the sagittal plane and is the reverse movement to flexion. The table below represents joints of the body that extension can occur in and an example;

Extension	
Joint	Example
Shoulder	From flexion lowering your arms downwards and in front of the body.
Elbow	Following flexion it involves movement of the forearm away from the shoulder by straightening the elbow.
Spine	Moving the head backwards so that you would finish looking straight up.
Hip	From flexion returning the femur to anatomical position
Wrist	Movement of the hand towards the back of the forearm

Figure 5 demonstrates the knee joint performing extension. The knee joint is the largest joint in the body and is primarily concerned with weight bearing and locomotion, for these reasons knee extension is a part of numerous sport skills. Any sport that requires jumping relies greatly on knee extension for successful completion of the jump. Running is one of the most basic skills where knee extension can be seen (figure 6 shows the knee in extension). During the drive phase of running the drive leg extends at the knee joint in order to generate forward and upward thrust which propels the body making knee extension a principle component of running.

Figure 5– Knee Extension

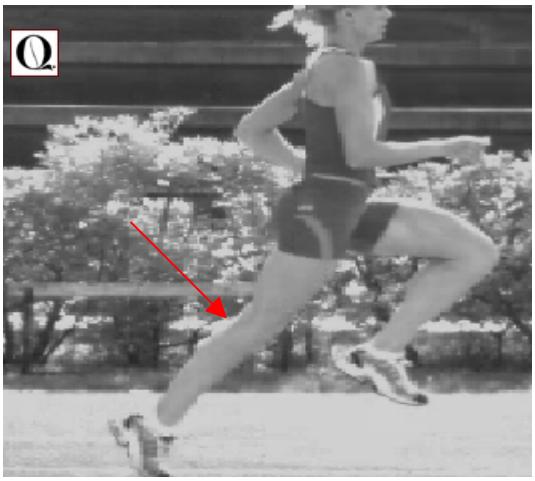

Figure 6 – Knee Extension while Running

3. Abduction

This is a lateral movement away from the midline of the trunk and it occurs in the frontal plane. The table below demonstrates the joints in the body where abduction can occur along with an example;

Abduction	
Joint	Example
Shoulder	Upward lateral movement of the humerus out to the side.
Hip	Movement of the femur in the frontal plane laterally to the side away from the midline
Wrist	Movement of the thumb side of the hand toward the lateral aspect of the forearm

Abduction at the hip joint is shown in figure 7 below. Some cricket bowlers demonstrate hip abduction during a fast bowl as illustrated in figure 8 below. In order to produce high ball release speeds, fast bowlers require high joint torques. High joint torques can be created through counter rotation which is rotation of the upper trunk away from the direction that the ball is to be thrown. By abducting the hip joint as well as other movements counter action can be created which will increase the joint torques and subsequently increase the release speed of the ball. Also from the position shown in figure 7 below the hip abduction creates a greater distance for trunk rotation to occur over which allows more momentum and power to be created.

Figure 7 – Hip Abduction

Figure 8 – Cricket Bower demonstrating Hip Abduction