Introduction

A course long term project, A Biomechanical Analysis of The Gymnastics Cartwheel, was completed during lab portion of KIN 417 Analysis of Movement. This project required the comprehension and utilization of various biomechanical principles that were taught in the lecture course. The unique aspect of this project is the capability to scientifically analyze the performance of the gymnastics cartwheel using the Dartfish Motion Analysis Software. This software is the latest and most sophisticated computer video analysis software that is used by teachers, coaches, physical therapists and sports medicine specialists. It is used to detect errors in a person’s movement, calculate angles, times, distances, velocities and provide feedback using the drawing tools and media book. Stephen F. Austin State University is among an elite group of universities in the United States that utilize this sophisticated software.

Methods

A videotape of the gymnastics cartwheel was created and imported into the Dartfish Motion Analysis computer program following strict instructions. The performance was critically analyzed by utilizing the drawing tools. (See pictures) and conclusions were drawn using biomechanical principles and personal knowledge.

Results were provided to the performer by utilizing the drawing tools to illustrate errors and producing a DVD media book.

Introduction

The biomechanical analysis required videotaping two subjects performing the cartwheel to the best of their ability. Strict protocols were followed to ensure the analysis was accurate. In order to measure distances in the Dartfish program, an object of known length had to be recorded. Subjects were asked to hold a scaling rod for ten seconds before beginning their trials. Subjects recorded four trials each and all data was imported into the Dartfish program. Average trials for both subjects were chosen to be analyzed extensively for strengths, weaknesses and most importantly the overall biomechanics of the cartwheel. The subjects’ video was then broken down into separate frames to show the different phases of the cartwheel. The Dartfish drawing tools were used to illustrate the incorrect positions and form. An explanation was also offered to explain the illustrations and provide feedback on how the corrections were to be made. Basic physics and biomechanical principles were used to explain why the subject was struggling to complete the skill successfully; as well as explain why the corrections were beneficial. A DVD was created of each subject’s analysis so the subjects could watch and apply the corrections to improve their cartwheel.

Biomechanical Principle [Conservation of Energy]: The performer has more potential energy here than in the middle of the skill. When he begins the cartwheel the potential energy will turn into kinetic energy. At the end of the cartwheel, he will once again have potential energy.

Biomechanical Principle [Range of Motion]: High levels of joint Range of Motion and Flexibility are important in performing gymnastics skills. In this particular phase of the cartwheel, good hip flexibility is needed for hip joint abduction of at least 90 degrees. The performer is lacking the ROM and flexibility as shown by the measured angle.

Biomechanical Principle (Levers): The body is acting as a first class lever. The left leg is the fulcrum, the back leg is the resistance arm and the chest and arms are the effort arm. The further away the effort arm is from the fulcrum, the easier it is to lift the load. Depicted above, the fulcrum (left leg) was placed too close to the arms and hands. This will make it more difficult and require more effort to lift up the upper body.

Summary

The Dartfish Motion Analysis Software enabled the investigator to more efficiently view the performers movements using a sound scientific basis. Evaluation and critique of the performer’s movement using this software will provide the performer with more detailed feedback for improvement. A DVD media book was given to the performer as a resource for instruction and training to improve their gymnastics cartwheel.