DARTFISH
Case Study

Valgus Knee Collapse : Spring Arbor University

Developing a Diagnostic Tool to Measure Valgus Collapse in College Aged Females

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As more females participate in athletics more and more anterior cruciate ligament (ACL) injuries are reported. Multiple studies have shown that females are more prone than males to experience ACL injury. This difference could be due to multiple issues, including valgus knee collapse (Hewett, Myer, & Ford, 2006; Hewett et al., 2005; Ruiz & Barber, 2005). Since valgus knee collapse is recognized as a possible contributor to ACL injury, a way to screen for this condition would be very valuable. According to Hewett et al., "A successful method for screening and identifying athletes at increased risk of ACL injury is currently not available" (2005, p. 493).

Therefore, it would be highly beneficial to develop a new way to measure the valgus collapse using the computer movement analysis system called Dartfish. The aim of this study was to identify the potential of using Dartfish to map valgus collapse, and therefore predict risk for ACL injury.

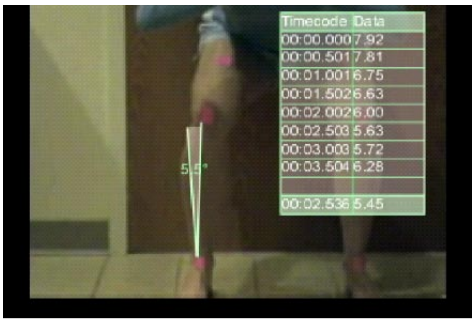
Abstract

PURPOSE: The purpose of the study was to examine the potential of identifying valgus collapse in the knees of females by using Dartfish Motion Analysis Software.

METHODS: This study involved nine college-aged females between the ages of 18 and 24. These subjects performed stepping movements and both single and double leg squats, while being taped with a digital video camera.

Fluorescent sticky notes were placed on the knees and ankles of a participant to aid the tracking device in Dartfish. The footage was entered into the Dartfish software and analyzed using various tools, such as, the angle tracking device, Simulcam, distance tool, and vertical lines. Each of these tools was applied to various clips to assess possible valgus collapse in the subjects.

RESULTS: The vertical lines and Simulcam were successful in identifying valgus collapse in a qualitative manner. The angle tracking device and the distance tool generated useful numerical measurements that could be placed in an Excel spreadsheet and analyzed. Dartfish was successful in identifying a difference between valgus collapse and healthy neuromuscular functioning of the knee.



Squat displaying proper neuromuscular control

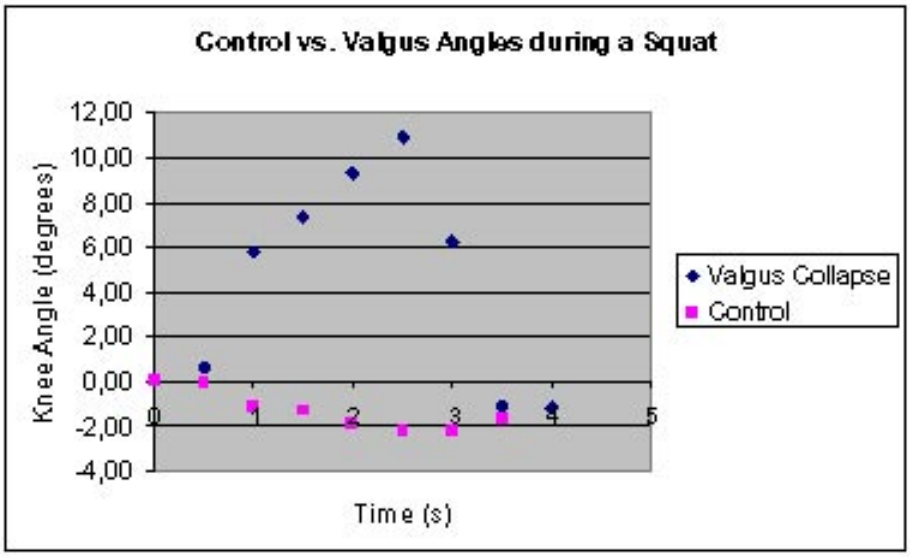
CONCLUSION: Dartfish motion analysis software was capable of identifying valgus collapse in college-aged females. Using Dartfish's innovative technology, four tools: angle tracking device, vertical lines, Simulcam, and distance tool, were used to detect valgus collapse. These findings suggest Dartfish could play a critical role in the early assessment of valgus collapse, thereby decreasing the risk of ACL injury in females through identification and development of appropriate training practices for those so identified.

Methods

- This study was a quantitative/qualitative comparison study designed to assess valgus collapse in a select number of Spring Arbor University female students by using the Dartfish motion analysis software.
- The subjects were videotaped performing a box step test consisting of step downs and depth jumps, and single and double leg squats. These video clips were analyzed using the Dartfish software's angle tracking tool, values table, distance tool, vertical lines, and Simulcam.
- Dartfish tools were used to distinguish medial motion of the knee from straight line motion. The Dartfish software was used to mark the subject's knee in the middle of the knee cap and also in the middle of the ankle joint at the foot to keep consistent points of measurement.
- When measuring the angle of the knee during bending, the fulcrum point of the angle was set at the ankle joint. The first side of the angle was placed as a perpendicular line from the horizontal line running through vertex of the angle; then the final marker was placed on the knee cap. The angle tool tracked the valgus-varus knee movement during the exercise.
- One participant was taped performing double leg squats; fluorescent sticky notes were used to mark the knee and ankle. This subject performed two squats with proper technique and neuromuscular control, then with two squats mimicking valgus collapse.
- Knee angles generated from the various squat trials were automatically placed in a values table in Dartfish. Additional analysis was performed using Microsoft Excel.
- The focus of this study was not placed on how many participants showed valgus collapse or what angles were reached during movement. The most important task and goal involved assessing Dartfish's capability to measure valgus collapse and the potential to show valgus movement in a dynamic way.

Results

- Dartfish successfully generated angle measurements of the knee in the plane of valgus/varus motion.
- With the proper lighting, fluorescent markers on the actual subject during taping, and a plain background, the tool's ability to track accurately is greatly improved.
- The diagram below shows a graphical representation of angles in the valgus/varus plane of the knee recorded using the angle tracking device during one subject's double legs squats. Clearly Dartfish possesses the capabilities to differentiate between proper movement and valgus movement.
- The graph shows a distinctive difference between the control and the squat showing valgus collapse. This difference was also displayed in the means of the analysis in both data sets. The control squat showed a mean angle of zero degrees deviation from normal, while the other squat showed a mean angle of 4.21 degrees in the valgus direction. The maximum angle deviations from normal were 2.29 degrees in the varus direction and 10.92 degrees in the valgus direction respectively. This shows the potential for Dartfish to distinctly portray the difference between valgus collapse and proper technique.
- Using vertical lines provided by Dartfish on a video clip of a single leg squat, valgus motion or lack thereof was evident as the knee was analyzed in relation to two parallel lines bordering the knee. A movement past the line on the medial side was defined as indicative valgus collapse.
- Simulcam allowed a valgus squat to be mapped over a control squat so that maximum flexion points occurred at the same time. Upon watching the new overlaid video clip, the valgus motion in one of the squats was easily distinguishable from the control squat.
- The distance tool showed deviation of the knees in the valgus position by providing numerical distances during the entire squat. A substantial decrease in the distance between the knees during the squat indicated valgus motion.



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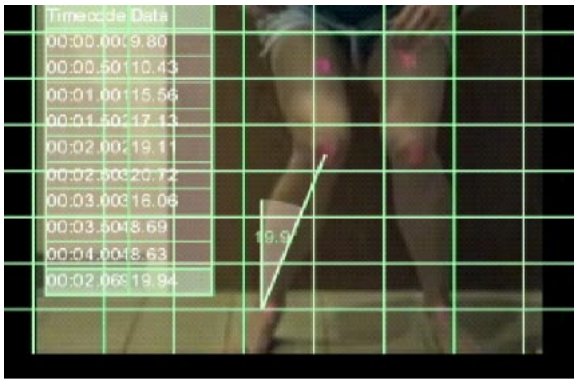
Conclusions

- Four successful ways of using Dartfish to detect valgus collapse in female college students' knees were developed during this research. The Dartfish tools involved in this study were the angle tracking device, vertical lines, Simulcam, and the distance tool.
- Vertical lines and Simulcam show valgus collapse qualitatively, while both the angle tracking device and distance tool demonstrate valgus collapse quantitatively.
- **Dartfish could play a critical role in early assessment of valgus collapse, thereby decreasing the risk of ACL injury in females. The diagnostic procedures developed can be extended to other populations.**
- **Simulcam could work extremely well for identifying changes in valgus collapse resulting from neuromuscular training.**



Squat displaying valgus collapse

References

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