The Quantification of ACL Orthosis Posteriorly Directed Forces – A Case Study

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Summary

This study assessed the posteriorly directed forces exerted by a DonJoy Playmaker II anterior cruciate ligament (ACL) orthosis on the anterior tibia, showing increased force with knee flexion and dynamic movements. The orthosis demonstrated potential for stabilizing the knee and protecting healing grafts, with the methodology proving feasible for broader applications of ACL rehabilitation investigations.

Introduction

Functional ACL orthoses are prescribed to patients with the goal of preventing anterior tibial translations and valgus moments at the joint. Through contact loading, the anterior tibial pads on the orthosis provide a posteriorly directed force to minimize anterior strain to the healing ACL graft. The goal of this study was to not only measure the posteriorly directed force of an ACL orthosis, but also determine the feasibility of this methodology.

Methods

The participant, a 29-year-old female with a history of ACL reconstruction in her right knee, was fit into a DonJoy Playmaker II orthosis. IRB approval and consent were obtained. A small loadpad sensor (Novel Electronics Inc.) was placed on the tibia, between the skin and orthosis pad.

Peak posteriorly directed force of the orthosis were measured during static (knee flexion at 30°, 60°, and 90°) and dynamic trials. During the static trials, the participant was standing in a neutral position with both feet on the ground. For each flexion angle, data was collected for a total of 5 seconds and correct position was confirmed with a goniometer. For the dynamic trials, the patient performed a pivot shift test based on protocols that have been established in the literature [1]. Each trial was repeated a total of three times. Data was analyzed in MATLAB (MathWorks) to calculate peak forces and averaged across trials.

Results and Discussion

The average peak posteriorly directed forces exerted by the DonJoy Playmaker II orthosis were calculated for each static and dynamic condition (Figure 1). During the static trials, the peak forces increased with greater knee flexion angles. The average peak forces were: 5.2 N, 6.8 N, and 7.0 N at 30°, 60°, and 90° of knee flexion. Unsurprisingly, the pivot shift test produced the highest average peak force at 9.4 N. This suggests that the orthosis generates greater posteriorly directed forces during dynamic movements compared to static conditions. These findings demonstrate the ability of the orthosis to apply measurable anterior tibial restraint across different knee positions and during functional tasks.

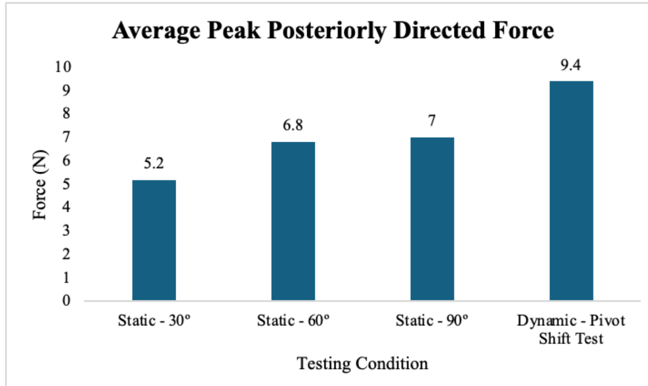

Figure 1: Average orthosis peak posteriorly directed force applied to the tibia during the static and dynamic trials.

This case study provides preliminary insights into the posteriorly directed forces exerted by the DonJoy Playmaker II orthosis during static and dynamic conditions. The orthosis demonstrated measurable forces across various knee flexion angles and pivot shift test loading, suggesting its potential in anterior tibial restraint. The increasing forces observed during dynamic conditions highlight the orthosis' capacity to adapt to varying biomechanical demands. These results reinforce its potential utility in supporting knee stability during both static postures and functional movements. While limited in generalizability due to the case study format, the experiment aimed to evaluate the practicality of its methods. The peak forces measured align with values previously reported [2], supporting the feasibility of this approach for force quantification. The developed protocol will next be applied to a larger pediatric ACL-reconstructed population to establish statistically significant results.

Conclusions

The findings of this study demonstrate that the posteriorly directed forces applied to the tibial by ACL orthoses can be measured using the proposed methodologies.

References

[1] Yoshida, N et al. (2009). *Sports Med-Open*, **129**: 353 – 358.
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