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## Background

Squat exercises are a popular multiple joint workout and form an integral part of most rehabilitation programmes. The use of eccentric squat activities for rehabilitation associated with tendinopathy has been well documented.

Purdam et al. (2003) identified this as an area for further investigation and proposed a conservative management technique for patella tendinopathy. The technique was based on performing a single limb squat with the eccentrically controlling limb placed on a 25º decline. The basis for using a 25º decline was that by forcing the ankle in to plantar flexion passive and active calf tension are reduced therefore reducing the work done about the ankle, thus producing a more focused exercise to target the knee extensors however the efficacy of a 25º decline angle is not well established.

## Purpose

The aim of this current study was to investigate the biomechanical effects and muscular involvement when performing squats on different decline angles, and to determine if there is a biomechanically optimum decline angle for this exercise.

## Methods

Eighteen pain and pathology free participants were recruited (9 males and 9 females) with an age range between 20 to 46 years with a mean mass of 75.1 kg with a range of 58.3 kg to 100 kg, all of whom were pain and pathology free.

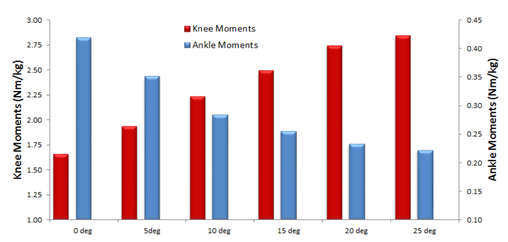
Movement analysis data were collected using a ten camera Oqus system and force data were collected using an AMTI force plate. Electromyographs (EMG) were collected from biceps femoris, rectus femoris, gastrocnemius and tibialis anterior using a DELSYS Bagnoli system. The raw data were then exported to Visual 3D (C-Motion Inc. USA) for processing.

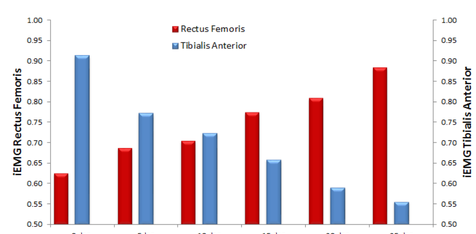
Six decline angles (0, 5, 10, 15, 20 and 25 degrees) were selected to perform five double limb squats using the “Rehab Angel” (Picture 1).

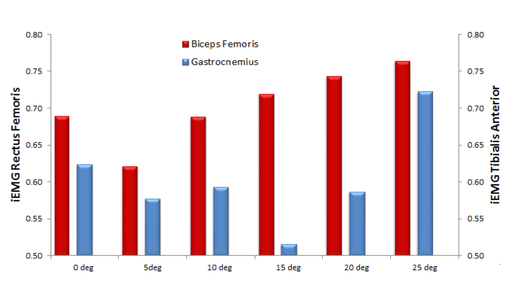
Picture 1: The Rehab Angel adjustable decline board

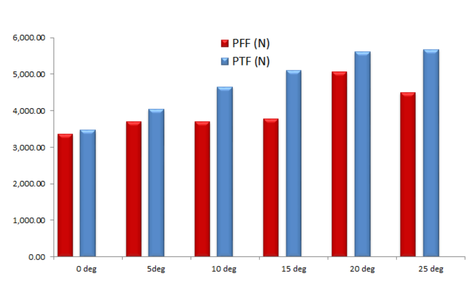
## Results

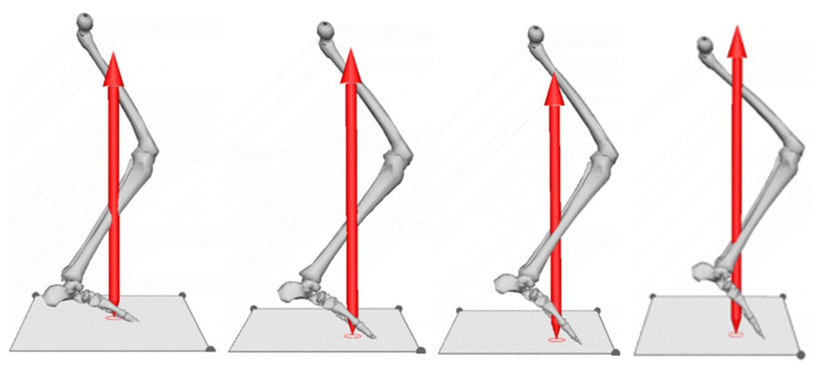
The gastrocnemius activity increases as the decline angle rises above 15 degrees at the same time as ankle moments and tibialis anterior are reducing. One explanation is that gastrocnemius, which is a two joint muscle, also plays a role in controlling and stabilising the knee as the decline angle exceeds 15 degrees.



The tibialis anterior muscle shows a reduction in activity as the decline angle increases which indicates less co-contraction is required as the incline angle increases. Both the reduction in moments and co-contraction would indicate a graduated offloading of the ankle joint.

## Conclusion

An increase in knee moments, patellofemoral force and patella tendon force were seen as the decline angle increases which may aid remodelling, However the optimum angle appears to be 20 degrees, which is less than the decline angles previously used in rehabilitation.