



**CYBEX**  
RESEARCH  
INSTITUTE

**PATELLOFEMORAL JOINT FORCES  
BETWEEN TWO NON-IMPACT  
CARDIO MACHINES**

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## INTRODUCTION

It is generally assumed, that because of the absence of shock, non-impact cardio machines, such as ellipticals and adaptive motion trainers, impart little to no stress on the knees during exercise. Shock, however, is not the only requisite of knee joint stress; in particular, compressive loading of the patella on the underlying surfaces. Yet, little evidence quantifying patellofemoral compressive joint stress on non-impact cardio trainers exists. It is possible, therefore, that certain machines may create higher levels of knee stress despite the lack of shock.

## OBJECTIVES

Is there a difference in patellofemoral joint stress between the Cybex Arc Trainer and the Precor AMT?

Is there a difference in patellofemoral joint stress between the Cybex Arc Trainer, Precor AMT, and traditional activities and exercises?

## METHODS

Sixteen subjects exercised at 75% of their age-predicted maximum heart rate on the Cybex Arc Trainer and Precor AMT cross trainer, at a constant pace of 100 steps per minute. An instrumented foot plate measured pedal reaction forces and an eight-camera infrared motion capture system measured pedal position, body position, and joint angles.

Inverse dynamics were used to calculate joint torques and a special equation was developed to calculate patellofemoral joint force (PFJF) in Newtons per kilogram (N/Kg).

## RESULTS

Peak PFJF on the Precor AMT (19.04 N/Kg) was 141% greater than on the Arc Trainer (7.89 N/Kg).

Peak PFJF on the Arc Trainer was lower than walking, stair climbing, squatting, and lunging. Peak PFJF on the AMT was greater than walking and similar to stair climbing, squatting, and lunging.

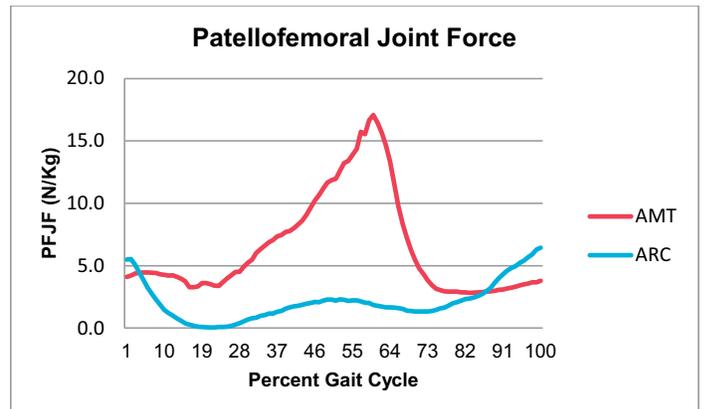


Figure 1: Patellofemoral joint force (Newtons/Kg) for the Precor AMT and Cybex Arc Trainer.

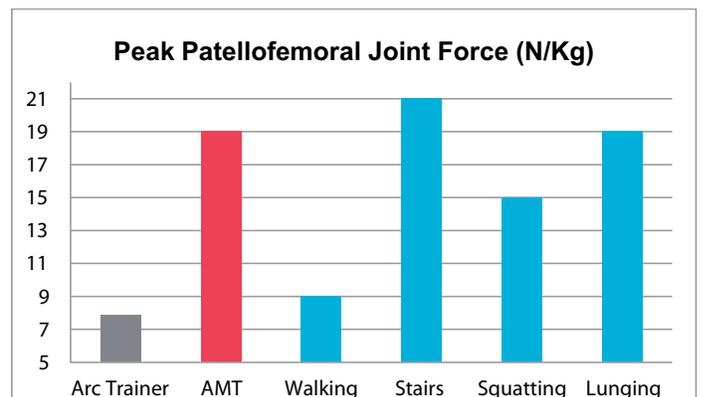


Figure 2: A comparison of peak PFJF on the Arc Trainer, AMT, and traditional activities.

## CONCLUSION

Despite the absence of shock, some cardio machines create relatively high peak knee stresses that are accentuated by the fact that they are applied repeatedly over the course of a cardio workout. The Cybex Arc Trainer, on the other hand, allows users to exercise at relatively high workloads with insignificant levels of knee stress.

This study is available in its entirety at:

[http://www.cybexintl.com/institute/pdf/LaCrosse\\_CRI\\_Study.pdf](http://www.cybexintl.com/institute/pdf/LaCrosse_CRI_Study.pdf)