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# Mechanisms of improved knee flexion after rectus femoris transfer surgery

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Purpose:
One of the most common gait problems in children with cerebral palsy is the inability to sufficiently flex the knee during the swing phase of walking, or "stiff-knee gait" [1,2]. Surgical transfer of the rectus femoris muscle is a common treatment; however, individual patient outcomes vary substantially [3]. It is difficult to improve surgical outcomes because the mechanism by which some patients improve is unknown. Traditionally, it has been thought that transferring the muscle converts it from a knee extensor, which inhibits knee flexion, to a knee flexor. However, experimental studies have found that the muscle produces a knee extension moment even after transfer [4], possibly due to scarring to underlying tissue [5]. The purpose of this study was to investigate the mechanism by which the transferred muscle improves knee flexion and to compare different surgical techniques.

Methods:
Muscle-actuated dynamic simulations were created of ten children with cerebral palsy and stiff-knee gait. These simulations were altered to represent surgical transfers of the rectus femoris to the sartorius and the iliotibial band. Rectus femoris transfers in which the muscle remained attached to the underlying vasti through scar tissue were also simulated. We compared simulated improvements in peak knee flexion in swing from different transfer simulations to determine how knee flexion is improved after transfer surgery.

Results:
Both transfer to sartorius and transfer to iliotibial band simulations predicted greater ($p<0.001$) improvement in peak knee flexion (32°±8° and 28°±8°, respectively) than the scarred transfer simulation (14°±5°).

Conclusion:
Simulations revealed that the mechanism for improvement in knee flexion after surgery is reduction of the muscle's knee extension moment. Our results suggest that significant improvement in knee flexion can be attained even when the extension moment of the rectus femoris is only reduced by half, as may occur in a scarred transfer, supporting the finding that the muscle is not converted to a knee flexor after transfer. Our simulated knee flexion improvements after scarred transfer are consistent with reported surgical improvements following isolated transfer [6]. Simulated non-scarred transfers to iliotibial band and sartorius predict greater improvements in knee flexion, suggesting methods to reduce scarring may augment knee flexion.

URL: http://stanford.edu/~melanief/BCATS08.pdf

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