it is planned to estimate the pressure on the related ligaments after elongate the patellar tendon length on cadavers for the near future.

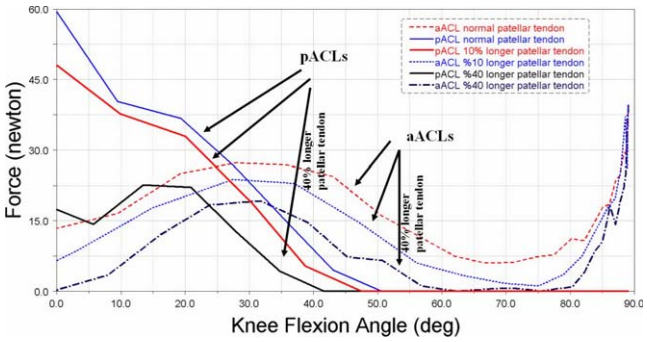

Figure 1. aACL and pACL force in different PTL.

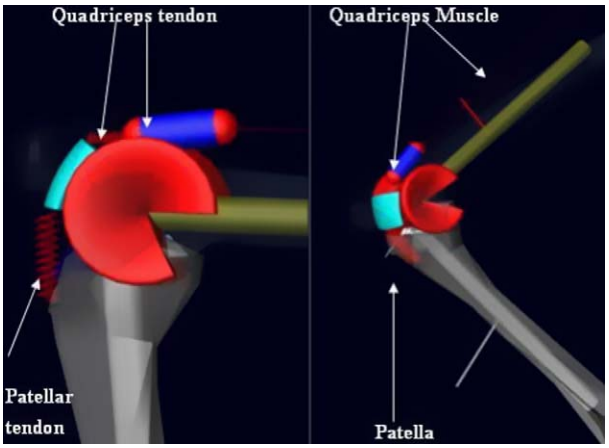

Figure 2. The present patella-tibio-femoral model.

References

[1] Gage JR, The Treatment of Gait Problems in Cerebral Palsy, Mac Keith Press, London, UK, 2004.
[2] Rodney K Beals MD, 2001. Developmental Medicine & Child Neurology 43, 802–5.
[3] Abdel-Rahman EM, Hefzy MS, 1998. Journal of Biomechanics 20, 276–90.
[4] Caruntu DI, Hefzy MS, 2004. Journal of Biomechanical Engineering 126 (1), 44–53.

O058

Mathematical modelling of pathological human gait

A. Olensek[1], Z. Matjacic[2]. *[1]Research Unit, Institute for Rehabilitation; [2]Research Unit, Institute for Rehabilitation, Slovenia*

Summary: In this abstract we address bipedal walking modeling as a potential tool in future instrumented gait analyses. We suggest implementation of two level control strategy in biped walking model that allows implicit push off control as well as characteristic gait patterns evolution.
Conclusions: Due to their versatility, biped walking models are becoming an important aspect of clinical gait assessment and are potentially considered to be a promising tool in future pathological gait analysis and treatment planning.

Introduction: While instrumented gait analysis can record detailed aspects of human locomotion, its applicability in interpreting pathological gait kinematics and kinetics and in predicting the outcome of particular therapeutical intervention is limited. For this purpose, the literature [1,2] suggest to exploit versatility of biped walking modeling to synthesize and analyze pathological gait as well as to test the outcome of particular therapeutical intervention in biped walking model. The aim of this paper is to present a biped walking model that allows evolution of pathological toe walking and crouch walking patterns.
Materials and Methods: Biped walking model consists of pelvis, torso, thighs, shanks and feet and the walking is confined to sagittal plane. Two level adaptive control strategy assures adaptive push-off control in a sense to maintain constant gait velocity. Push-off should increase if gait velocity should increase and should be less explicit if biped walker should decelerate. Additionally, the model allows us to change various control parameters to investigate the influence of different control principles on gait kinematics and kinetics.
Results: Extensive experimentation showed that the model is capable of generating stable cyclic gait in different walking regimens with gait velocity ranging from 0.6 m/s to 1.1 m/s. Moreover, the vertical ground reaction force pattern reveals increase in peak ground reaction force during push-off if the gait velocity is less than desired and vice versa which corresponds well with human walking. When varying control parameters, the model generates characteristic pathological gait kinematics and kinetics that qualitatively corresponds well with pathological gait as recorded in human. Stick diagram of a model mimicking toe-walking at different instances of gait cycle is shown in Fig. 1.

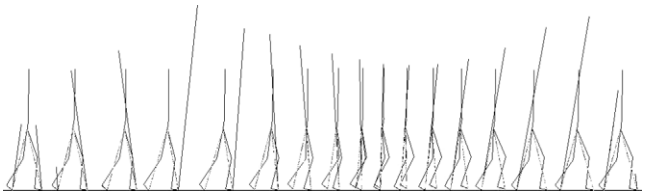

Figure 1.

Discussion: Compared to similar models from the literature [1], described walking model has proven to offer considerable diversity, when synthesizing different walking patterns. Extensive experimentation with the model showed that, gait of a model corresponds well with various forms of human locomotion and can display fundamental mechanisms of human gait, when adequately varying various control parameters.

References

[1] J.W. Grizzle, G. Abba and F. Plestan, “Asymptotically stable walking for biped robots: analysis via systems with impulse effects ” IEEE T Automat Contr, 46, No. 1, 51–64, (2001).
[2] L.A. Gilchrist and D.A. Winter, “A multisegment computer simulation of normal human gait ” IEEE Trans. Rehabil. Eng. 5(4), 290–299, (1997).