Patellar Tendon Advancement for the Treatment of Crouch Gait in Patients with Cerebral Palsy

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Background

Crouch gait is a frequent gait pathology in children with cerebral palsy (CP). Patellar tendon advancement (PTA) is a typical surgery among single-event multilevel surgery (SEMLS) for the treatment of crouch gait and performed to enhance the knee joint kinematics and kinetics

Patella position had a considerable effect on the torque-producing capacity of the quadriceps and hence, patellar height is a typical metric to assess the influence of PTA on knee function. Patellar height can be assessed by using several radiographic imaging methods. However, in the literature, there is no consensus on objective quantification of the patellar height

In our study, we aimed to i) objectively quantify the patella position using X-ray data and musculoskeletal modeling and ii) monitor the effect of PTA in combination with SEMLS on the knee kinematics of patients with CP and crouch gait.

Methods

Temporospatial, kinematics, kinetics, and X-ray data of the patients with PTA (PTA group) and without PTA (NoPTA group) were recorded pre- and postoperatively

Musculoskeletal modeling and simulation tools available in OpenSim software were utilized to determine patella positions. The generic musculoskeletal model was scaled to the anthropometry of each patient. Then, the hip and knee joint angles of the patients' musculoskeletal models were adjusted considering the X-ray data of each related patient. To measure patellar height in a standard pose, the hip and knee joints of the musculoskeletal models were set at $0°$ and $30°$, respectively. The patellar height was measured as the length between the tibial tuberosity and the patella inferior pole using the musculoskeletal model. Inverse kinematics was performed to calculate joint angles.

Results

The patellar height of the PTA group was found 53.8 ± 7.0 mm preoperatively and 43.0 ± 6.8 mm postoperatively. The patellar height of the NoPTA group was found 47.3 ± 6.9 mm preoperatively and 44.2 ± 6.4 mm postoperatively.

The preoperative knee joint angle patterns of the PTA group and NoPTA group were similar. The PTA group was closer to the healthy group postoperatively when compared to the NoPTA group (Figure 1).
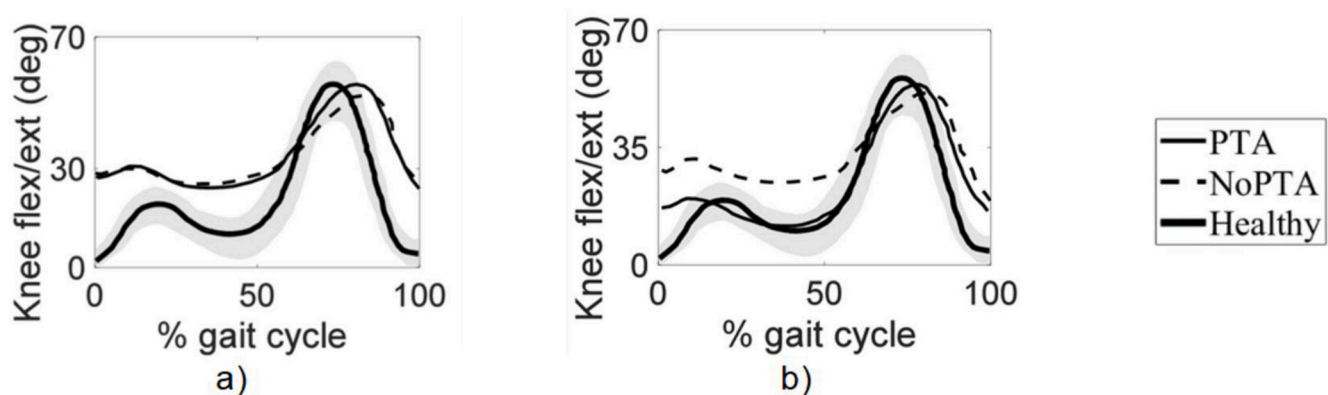

Fig. 1. Joint angle patterns of PTA and NoPTA group compared to healthy reference.

Conclusions

Musculoskeletal modeling was found to be a powerful tool for the objective identification of patellar height. PTA improved knee joint kinematics and is considered a functional surgery to improve knee extension in patients with CP and crouch gait.