Movement Strategies During Stand To Sit And Sit To Stand Tasks In Transtibial Amputees

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Transtibial osteomyoplastic amputation (Ertl) is suggested to improve functional outcomes following transtibial amputation (TTA) and enhance "end-bearing" capability of the residual limb. Sitting and standing tasks are important tasks to daily living. The purpose of this study was to evaluate lower extremity kinetics during sit-to-stand tasks in individuals with an Ertl TTA. Seven unilateral Ertl TTA participants (84.1±16.9 kg, 1.78±0.08 m) performed a sit-to-stand task five times as fast as possible without the use of hands; the middle three cycles were analyzed. Participants wore a total surface bearing socket and dynamic elastic response foot, and were K3 or above. Motion and ground-reaction force data were captured during each trial and standing (STAND) and sitting (SIT) phases were analyzed separately. Ankle range of motion (ROM) was reduced in the involved limb compared to the intact limb for STAND (5.2±0.02° vs. 9.8±8.2°, $p<.05$) and SIT (4.9±0.49° vs. 9.6±13.6°, $p<.05$). Compared to the intact limb, the involved limb knee extensor moment was significantly smaller (STAND: 0.45±0.14 vs. 1.4±0.34 $Nm \cdot kg^{-1}$, $p<.05$; SIT: 0.24±0.21 vs. 1.3±0.41Nm kg^{-1}, $p<.05$) and the hip extensor moment was larger (STAND: 1.2±0.2 vs. 0.8±0.2 $Nm \cdot kg^{-1}$, $p<.05$; SIT: 0.98±0.16 vs. 0.74±0.23 $Nm \cdot kg^{-1}$, $p<.05$). As a result, during STAND, the involved limb generated less knee power (0.91±0.38 vs. 3.2±1.2 $W \cdot kg^{-1}$, $p<.05$) and increased hip power generation (2.5±.62 vs. 1.5±.1.1 $W \cdot kg^{-1}$, $p<.05$). During SIT, the involved limb exhibited less knee power absorption (-0.73±.38 vs. -2.95±0.94 $W \cdot kg^{-1}$, $p<.05$) and increased hip power absorption (-2.02±0.79 vs. -1.47±0.57 $W \cdot kg^{-1}$, $p<.05$). Several strategies emerged during analysis: two subjects produced a larger intact ankle ROM, whereas the other five subjects had limited ankle ROM due to not standing completely (n=2) or beginning the standing phase with the shank at a 90° angle to the foot (n=3). These results suggest that individuals with unilateral TTA utilize different neuromuscular control strategies for the uninvolved and involved limbs during both STAND and SIT tasks. Neuromuscular control of the knee joint appears to drive the sitting and standing process on the intact side, whereas neuromuscular control at the hip appears to drive these same tasks on the involved side. This observation is consistent with neuromuscular control noted in transtibial amputees during stair ambulation (Alimusaj et al. 2009). The shift on the involved side to a more proximal control strategy may be related to instability between the socket and residual limb or lack of muscular control at the ankle.

REFERENCES

Alimusaj, M., Fradet, L., Braatz, F., Gerner, H. J., & Wolf, S. I. (2009). Kinematics and kinetics with an adaptive ankle foot system during stair ambulation of transtibial amputees. *Gait & posture, 30*(3), 356-363.).