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Muscle Contribution to Supporting Phase During Normal Speed of Walking.

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Abstract

Backgrou The vertical ground reaction force (GRF) during normal gait is well known with its characteristic shape. The contribution of lower limb muscles to this vertical force was previously estimated but limited to using dynamic models and simulation. However, patients suffering from gait disturbances are referred by having muscle group dysfunctions. No previous studies investigated the contribution of muscle moments of the lower limb to the vertical GRF using 3D gait analysis system.

Purpc The purpose of this study is to investigate how the hip, knee and ankle moments in the sagittal plane contribute to the vertical GRF in normal subjects during normal speed of walking.

Methc Forty male subjects volunteered to participate in this study. They were filmed using six high speed (120 Hz) Pro-Reflex Infrared cameras (Qualisys) while walking on an AMTI force platform. Each lower limb joint position was detected using twenty reflective markers placed on the respective joint center of rotation according to the Pro-Reflex user manual. The data collected were the moments of the hip, knee and ankle joint in the sagittal plane at the instant of occurrence of the first peak and second peak and the trough of the vertical GRF. Relative contribution of each muscle moment to the vertical GRF was measured as the percentage relative to the maximum moment generated during stance.

Resu The results revealed that at the first peak of the GRF (at loading response), the highest contribution was generated from the knee extensor moment (80.2%), followed by hip extensor moment (36.81 %). The ankle plantar flexion moment produced least contribution to this peak (16%) relative to its maximum moment. Knee flexors and ankle plantar flexors moments produced high contribution to the trough of GRF (at midstance) with approximately equal values (53.88% and 54.1% respectively) while hip extensor moment contribution was less than both knee and ankle moments (34.75%). The second peak of the GRF was mainly produced by the ankle plantar flexors with highest percentage contribution of (99.1%), with lower contribution from knee flexors (41.44%) then hip flexors (36.9%). Hip and knee extensors contribution to this peak were 11.95% and 15.9% respectively.

Conclusion(Hip and knee flexors and extensors moments contributed to the three studied points of the GRF while the plantar flexors were the contributors to the trough and the second peak with a maximum percentage contribution at the second peak.

Implicatio Muscle contributions to the vertical ground-reaction force afford further insight into how support is generated in walking. As the classical shape of GRF reflects normal integrity of lower limb muscles, maintenance of the stance limb stability requires interplay of muscle activations with varying percentages. Weakness in one group is supposed to be compensated for by increasing or decreasing the activation of another group. In abnormal gait patterns, substituting weak muscle group with another normal muscle group can not only improve the global parameters of gait, but also to re-program the locomotor pattern to develop normal muscle moments without increasing joint loads or energy loss.

Key-Words: Muscle Contribution; Normal Gait; Ground Reaction Force

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