

Exercise Therapy

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Joint Movements During Gait: Sagittal, Frontal and Transverse Plane Motions

Details on joint movements during normal gait, including hip, knee, ankle and pelvis in the sagittal, frontal and transverse planes during the gait cycle.

Sagittal plane movements

Hip Joint

The hip is in maximum flexion ($\sim 20^\circ$) at initial contact (0% of the gait cycle). It gradually extends during stance and reaches maximum extension ($\sim 20^\circ$) at about 50% of the gait cycle, around the period between heel-off and toe-off. During swing, the hip gradually flexes again in preparation for the next initial contact.

Knee Joint

The knee is fully extended (0°) at initial contact (0%). It undergoes a small amount of flexion during early stance, reaching about 15° flexion at 10% of the gait cycle. The knee then extends and becomes nearly straight (0°) just before heel-off (about 40%). During swing, the knee flexes considerably and reaches maximum flexion ($\sim 60^\circ$) at about 70% of the gait cycle.

Ankle Joint

At initial contact, the ankle is close to the neutral position. The ankle gradually dorsiflexes during stance and reaches maximum dorsiflexion ($\sim 7^\circ$) at about 40%, around heel-off. It then plantarflexes and reaches maximum plantarflexion ($\sim 25^\circ$) at toe-off (60%). During swing, the ankle dorsiflexes again to prepare the foot for the next initial contact.

Frontal plane movements

Pelvis

During the first 20% of the stance phase, the pelvis on the opposite side drops by about 5° . This causes the hip to move into adduction. The hip then gradually moves into about 5° of abduction, reaching its maximum around toe-off, and returns to the neutral position by initial contact.

Knee joint

The knee remains approximately in the neutral position throughout most of the gait cycle. However, during midswing, it briefly moves into about 7° of abduction before returning to the neutral position.

Ankle joint

At the ankle, the foot moves from about 5° of inversion toward 5° of eversion during early stance. During push-off, the ankle then inverts by approximately 15°.

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Reference:

1. Levangie, P. K., & Norkin, C. C. (Eds.). (2011). Joint structure and function: A comprehensive analysis (5th ed.). F.A. Davis Company.
2. Kisner, C., & Colby, L. A. (2007). Therapeutic exercise: Foundations and techniques (5th ed.). F.A. Davis Company.

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