



Information Sheet - Human Gait

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gait *Manner of walking, bearing or carriage as one walks; (go one's (own) ~, pursue one's own course); manner of forward motion of runner, horse, vehicle, etc.*
- The Concise Oxford Dictionary, Sixth Edition

In relation to human walking, gait refers to the style or manner of walking, rather than the walking process itself. The study of gait dates back to the Renaissance in terms of descriptive studies and the 1870's in terms of kinematic study. Studies in gait analysis have resulted in the development of the gait cycle concept.

The gait cycle breaks down the walking motion into a stance phase (subject leg on ground) and a swing phase (subject leg swinging). The figures¹ below show the 'normal' human gait cycle (with the critical steps within each phase) and a side view of typical motion during the swing phase.

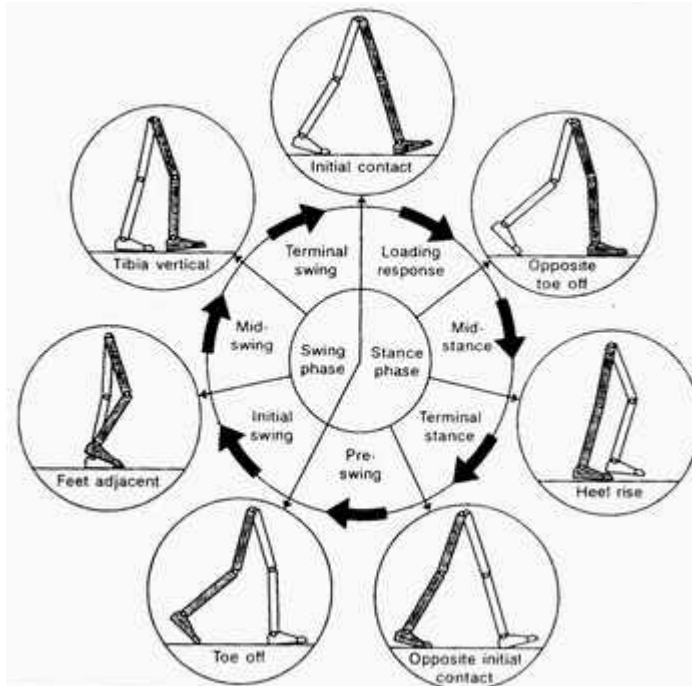


Fig 2.1 - Positions of the legs during a single gait cycle by the right leg (shaded).

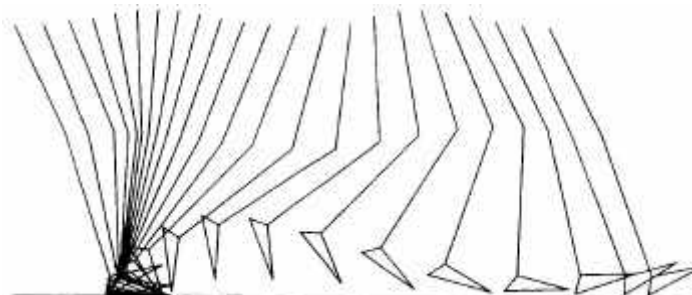


Fig 2.4 - Position of the right leg in the sagittal plane at 40ms intervals during a single gait cycle.

(cont over)

¹ "Gait Analysis- an introduction" Second Edition, MW Whittle, Butterworth-Heinemann, 1996



Normal human gait relates to unaided bipedal motion that is not effected by disease, deformity or other disability. Significant details of human walking with 'normal' gait are set out in point form as follows:

- When walking there is at least one foot on the ground at all times. This is a defining distinction of walking - both feet are momentarily off the ground while running, jogging, skipping and jumping.
- The 'stance phase' of gait occurs while the subject leg is touching the ground. The alternate leg may be touching the ground (in which case there is 'double support') or swinging during this phase.
- The 'swing phase' of gait occurs while the subject leg is not touching the ground. The alternate leg is always touching the ground during this phase.
- At the start of the 'swing phase', the toe is the last part of the foot to lift off the walking surface. This occurs at 'toe off'.
- At the end of the 'swing phase' the heel is to first part of the foot to make contact with the walking surface. This occurs at 'initial contact'.
- During the swing phase, the toe is generally the lowest part of the swinging foot (see Figure 2.4 above). However, just before 'initial contact' the foot pivots so that the heel touches first.
- Weight shift, from one leg to the other, occurs during 'loading response', after 'initial contact' and before 'opposite toe off'.
- Ground reaction forces (the force between the foot and the walking surface) vary though the gait cycle. Vertical forces peak just after 'opposite toe off' early in 'mid stance' and again just before 'opposite initial contact' late in 'terminal stance'. Fore - aft forces peak just after 'opposite toe off' early in 'mid stance' for braking and just after 'opposite initial contact' early in 'pre-swing' for propulsion.

In built environments the walking surface is smooth and even - a consistent environment with minimal variation. Persons walking in such built environments have an expectation to place each foot on a surface that is the same as the last step. This expectation applies to surface level (including change in surface level), slope and friction properties. This kind of almost automatic walking is only broken where there is a visual or other cue to a change in surface conditions. Examples of consistent built environments include: building floors, footpaths, sealed roads, paved areas, ramps, stairways, walkways and sporting fields.

Natural environments are often uneven and inconsistent, with sometimes large variation. Persons walking in these environments do not have the same expectations as for built environments. Accordingly, pedestrians are more tolerant to variation of surface level, slope or friction properties in natural environments. Examples of natural environments with significant variation include: bushland and hiking trails.

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