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**Prosthetics and orthotics —  
Vocabulary —**

**Part 1:  
Normal gait**

*Prothèses et orthèses — Vocabulaire —*

*Partie 1: Démarche normale*



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## Foreword

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ISO 29783-1 was prepared by Technical Committee ISO/TC 168, *Prosthetics and orthotics*.

ISO 29783 consists of the following parts, under the general title *Prosthetics and orthotics — Vocabulary*:

- *Part 1: Normal gait*
- *Part 2: Prosthetic gait*
- *Part 3: Pathological gait*



# Prosthetics and orthotics — Vocabulary —

## Part 1: Normal gait

### 1 Scope

This part of ISO 29783 establishes a vocabulary for the description of normal gait.

### 2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

#### 2.1

##### **body load loading**

force exerted by the foot upon the ground at any time during the stance phase due to gravity and the forward, sideways and vertical accelerations of the body mass

#### 2.2

##### **cadence**

number of steps taken per unit of time in steps per second

#### 2.3

##### **double support**

those two parts of the gait cycle when both limbs are in contact with the ground

**NOTE** The first of these (approximately 0 % to 10 % of the gait cycle) commences after initial ground contact (and ends as the contralateral limb commences initial swing) the second (approximately 50 % to 60 % of the gait cycle) commences at the beginning of pre-swing (and ends as the limb commences initial swing).

#### 2.4

##### **gait cycle**

the sequence of actions of a lower limb usually taken from initial contact of the foot until the next initial contact of the same foot when walking or running

#### 2.5

##### **ground reaction force**

reaction by the ground to the force exerted by the foot at any time during the stance phase

#### 2.6

##### **pelvic obliquity**

alignment of the pelvis (moves upwards or downwards) in the coronal plane

#### 2.7

##### **pelvic rotation**

alignment of the pelvis (moves forwards or backwards) in the transverse plane

## 2.8

### **pelvic tilt**

alignment of the pelvis (anterior or posterior movement) in the sagittal plane

## 2.9

### **single support**

that part of the gait cycle when only the limb under consideration is in contact with the ground

## 2.10

### **stance phase**

that part of the gait cycle during which the limb is in contact with the ground

NOTE The stance phase is further described by reference to five sub-phases (see 2.10.1 to 2.10.5).

### 2.10.1

#### **initial contact**

sub-phase of the stance phase which commences at the instant of initial foot contact and ends when knee flexion and ankle plantarflexion commence

### 2.10.2

#### **loading response**

sub-phase of the stance phase which commences after initial contact and continues until full foot contact occurs

### 2.10.3

#### **mid-stance**

sub-phase of the stance phase which commences when the contralateral limb commences its swing phase and ends when the heel leaves the ground

### 2.10.4

#### **terminal stance**

sub-phase of the stance phase which commences when the heel leaves the ground and ends at initial contact of the contralateral limb

### 2.10.5

#### **pre-swing**

final sub-phase of the stance phase which commences with initial contact by the contralateral foot and ends when the foot loses contact with the ground

## 2.11

### **step length**

distance (measured in the line of progression) between the point of initial contact of a foot and the point of initial contact of the opposite foot in successive steps in metres

## 2.12

### **stride length**

distance between the point of initial contact of the same foot in successive gait cycles in metres

## 2.13

### **swing phase**

that part of the gait cycle during which the limb is not in contact with the ground

NOTE The swing phase is further described by reference to three sub-phases (see 2.13.1 to 2.13.3).

### 2.13.1

#### **initial swing**

sub-phase of the swing phase which commences as the foot loses contact with the ground and ends when the limb achieves maximum knee flexion

**2.13.2****mid-swing**

sub-phase of the swing phase which commences when the knee joint starts to extend and ends when the hip joint reaches maximum flexion

**2.13.3****terminal swing**

sub-phase of the swing phase which commences when the hip joint reaches maximum flexion and ends when initial foot contact occurs

**2.14****the (three) foot rockers**

method of describing the action of the ankle and foot during the stance phase

**2.14.1****first rocker**

(from 0 % to 10 % of the gait cycle approximately) commences at initial foot contact and extends through the loading response sub-phase of the gait cycle

NOTE 1 Its purpose is shock absorption.

NOTE 2 During first rocker, the ankle plantar flexes under the eccentric control of the pre-tibial muscles with the heel acting as the fulcrum.

**2.14.2****second rocker**

(from 10 % to 30 % of the gait cycle approximately) coincides with the mid-stance sub-phase of the gait cycle

NOTE 1 Its purpose is to control the position of the ground reaction force relative to the limb joints above.

NOTE 2 During second rocker, the tibia moves forward, with the centre of the ankle joint acting as the fulcrum, under the eccentric control of the ankle plantar flexor muscles.

**2.14.3****third rocker**

(30 % to 60 % of the gait cycle approximately) commences when the heel leaves the ground and continues until ground contact is lost

NOTE 1 Its purpose is to accelerate the limb in preparation for the swing phase of the gait cycle.

NOTE 2 During the third rocker, the foot pivots over the fulcrum provided by the metatarsal heads as a consequence of the concentric contraction of the ankle plantar flexor muscles.

**2.15****walking base****step width**

distance between the centres of the heels of each foot measured perpendicular to the line of progression in metres

**2.16****walking speed**

average rate of linear motion of the body in the line of progression in metres per second

**3 Description of the sub-phases of the gait cycle****3.1 General**

The motions of the pelvis and lower limb segments during each of the sub-phases of the gait cycle are described in 3.2 to 3.9 using the terminology specified in Reference [1], unless otherwise specified in Clause 2.

NOTE 1 The dominant pattern of motion is in the sagittal plane. However, important motion also occurs in the coronal and transverse planes.

NOTE 2 The time at which the sub-phases occur is expressed as a percentage of the gait cycle duration following the initial foot contact.

NOTE 3 All joint and body segment angles and all sub-phase durations are approximate.

NOTE 4 The pelvic position and motions described refer to the ipsilateral side.

NOTE 5 The terms “maximum” and “minimum” refer to the joint positions achieved during the gait cycle, and not the possible range of joint motion.

### **3.2 Initial contact — at 0 % up to 2 % of the gait cycle**

a) Sagittal plane:

— during this sub-phase, the pelvis is tilted anteriorly by 5°, the hip joint is flexed by 25° to 30°, the knee joint is flexed by 0° to 5° and the ankle joint is in a near neutral attitude.

b) Coronal plane:

— the pelvis and hip joint are held in neutral alignment; the subtalar joint pronates to a neutral alignment.

c) Transverse plane:

— the pelvis is rotated forward to a maximum of 10° and the hip joint is externally rotated 10°.

### **3.3 Loading response — at 2 % up to 10 % of the gait cycle**

a) Sagittal plane:

— during this sub-phase, knee flexion increases to 15° and ankle plantar flexes to 10° to 15° with the heel acting as the fulcrum until full foot contact occurs.

NOTE This action of the ankle is termed first rocker.

b) Coronal plane:

— the pelvis tilts obliquely upwards by 5° (as a consequence of the drop on the contralateral side) and the hip joint adducts; knee joint abduction increases minimally and the subtalar joint pronates 5°.

c) Transverse plane:

— the pelvis starts to rotate backwards and simultaneously the hip joint rotates internally.

### **3.4 Mid-stance — at 10 % up to 30 % of the gait cycle**

a) Sagittal plane:

— during this sub-phase, the pelvis returns to a neutral alignment, the hip and knee joints extend to neutral, and the ankle joint dorsiflexes over a stationary flat foot to a position of 10° dorsiflexion.

NOTE This action of the ankle joint is termed second rocker.

b) Coronal plane:

— the pelvis returns to horizontal, the hip joint abducts and the subtalar joint further pronates.



## c) Transverse plane:

- the pelvis continues to rotate backwards to a neutral alignment and the hip joint to rotate internally to neutral.

**3.5 Terminal stance — at 30 % up to 50 % of the gait cycle**

## a) Sagittal plane:

- by the end of this sub-phase, the pelvis is once again tilted anteriorly by 5°, the hip joint is extended to its maximum of 10° to 15°, the knee joint is fully extended and the ankle joint has plantar flexed to a neutral position.

## b) Coronal plane:

- the subtalar joint returns to neutral.

## c) Transverse plane:

- the pelvis rotates backwards by 10° and the hip joint internally by 5° to 10°.

**3.6 Pre-swing — at 50 % up to 60 % of the gait cycle**

## a) Sagittal plane:

- during this sub-phase, the hip joint moves from maximum extension to neutral, the knee joint flexes to a position of 30° to 35° and the ankle joint plantar flexes at a position of 20° of the plantar flexion.

NOTE The pivoting action of the foot at the metatarsal heads, which occurs through terminal stance and pre-swing, is termed third rocker.

## b) Coronal plane:

- the pelvis tilts obliquely downwards by 5°, the hip joint abducts and the subtalar joint reaches its maximum position of supination.

## c) Transverse plane:

- the pelvis commences forward rotation with corresponding external rotation at the hip joint.

**3.7 Initial swing — at 60 % up to 70 % of the gait cycle**

## a) Sagittal plane:

- during this sub-phase, the thigh advances to a position of 20° of hip joint flexion; knee joint flexion reaches 60° and the ankle joint dorsi-flexes to a position of 10° of the plantar flexion.

## b) Coronal plane:

- the pelvis starts to tilt upwards and the hip joint to adduct while the subtalar joint pronates to a position of slight supination.

## c) Transverse plane:

- the pelvis continues to rotate forward and the hip joint to rotate externally.

### 3.8 Mid-swing — at 70 % up to 85 % of the gait cycle

a) Sagittal plane:

- during this sub-phase, the anterior pelvic tilt returns to neutral, hip joint flexion increases to 30° while the knee joint extends to a position of 30° flexion to achieve a vertical alignment of the lower leg; the ankle joint dorsi-flexes to neutral.

b) Coronal plane:

- the pelvis, hip joint and subtalar joint all achieve neutral alignment.

c) Transverse plane:

- the pelvis rotates forwards and the hip joint externally, through neutral alignment.

### 3.9 Terminal swing — at 85 % up to 100 % of the gait cycle

a) Sagittal plane:

- during this final sub-phase of the gait cycle, hip joint flexion is restrained while full knee joint extension occurs.

b) Coronal plane:

- the pelvis and hip joint remain in neutral alignment and the subtalar joint moves into slight supination.

c) Transverse plane:

- the pelvis continues to rotate forwards and the hip joint externally to a maximum of 10°.

## Bibliography

- [1] GREENE, W.B. and HECKMANN, J. D. (eds), The Clinical Measurement of Joint Motion, *American Academy of Orthopaedic Surgeons*, 1994

