Appendix B: Relation impairment - possible gait features

Developed at Amsterdam UMC, Department of Rehabilitation Medicine, as part of the GAIT.SCRIPT project

Supplementary material to: Van der Krogt et al. (2022), Frontiers in Human Neuroscience

| Underlying impairment                  | Plane | Segment/joint | Gait Feature                                      | Gait phase | Likelihood Mean | Likelihood SD |
|----------------------------------------|-------|---------------|----------------------------------------------------|------------|----------------|---------------|
| Adductor spasticity / contracture      | F     | Pelvis        | Obliquity lift                                     | Gait cycle | 2,6            | 0,6           |
|                                        | F     | Hip           | Adduction increased                                | Gait cycle | 3,7            | 1,0           |
|                                        | T     | Hip           | Endorotation increased                             | Gait cycle | 3,1            | 0,8           |
| Anatomical leg length discrepancy - longest leg | F     | Pelvis        | Obliquity lift                                     | Gait cycle | 2,9            | 1,0           |
|                                        | S     | Knee          | Flexion increased                                 | Stance     | 2,9            | 1,0           |
| Anatomical leg length discrepancy - shortest leg | F     | Pelvis        | Obliquity lift                                     | Gait cycle | 3,0            | 1,0           |
|                                        | S     | Ankle         | Plantar flexion drop (vaulting)                    | Stance     | 3,4            | 0,9           |
| Excessive ankle plantar flexor length  | S     | Knee          | Flexion increased                                 | Stance     | 3,4            | 1,0           |
|                                        | S     | Ankle         | Dorsal flexion increased                           | Stance     | 3,5            | 1,0           |
| Extension lag                          | S     | Knee          | Flexion increased                                 | LR-EST     | 3,1            | 1,0           |
| Femoral anteversion increased         | T     | Pelvis        | Retraction increased                               | LST-PSW    | 3,1            | 0,8           |
|                                        | T     | Hip           | Endorotation increased                             | Stance     | 4,1            | 0,7           |
|                                        | T     | Foot          | Progression angle too internal                     | Stance     | 3,8            | 0,8           |
| Foot deformity                         | S     | Knee          | Flexion increased                                 | Stance     | 3,6            | 0,7           |
|                                        | S     | Foot          | Forefoot/ midfoot contact (v)                      | IC         | 3,2            | 0,8           |
|                                        | F     | Foot          | Lateral foot contact (v)                           | IC         | 4,0            | 1,0           |
|                                        | T     | Foot          | Progression angle too external                     | Gait cycle | 4,0            | 0,7           |
|                                        | T     | Foot          | Progression angle too internal                     | Gait cycle | 3,7            | 0,6           |
| Gastrocnemius spasticity / contracture | S     | Knee          | Extension decreased                               | LSW        | 3,3            | 1,0           |
|                                        | S     | Knee          | Flexion increased                                 | Stance     | 3,6            | 1,3           |
|                                        | S     | Ankle         | Plantar flexion increased                          | LSW        | 4,1            | 0,9           |
|                                        | S     | Ankle         | Plantar flexion increased                          | LR-LST     | 4,4            | 0,7           |
|                                        | S     | Ankle         | Plantar flexion peak too early                     | EST-LST    | 4,6            | 0,6           |
|                                        | T     | Ankle         | Internal rotation increased                       | Gait cycle | 3,2            | 0,4           |
|                                        | F     | Ankle         | Inversion (varus) increased                        | Gait cycle | 3,2            | 0,4           |
|                                        | S     | Foot          | Early heelrise (v)                                 | EST        | 4,5            | 0,6           |
|                                        | S     | Foot          | Toe walking (v)                                    | Stance     | 4,5            | 0,6           |
|                                        | S     | Foot          | Forefoot/ midfoot contact (v)                      | IC         | 4,2            | 0,9           |
|                                        | F     | Foot          | Lateral foot contact (v)                           | IC         | 2,6            | 0,9           |
| Gastrocnemius weakness                 | S     | Hip           | Peak extension delayed                            | Stance     | 2,7            | 1,2           |
|                                        | S     | Knee          | Flexion increased                                 | EST        | 3,8            | 1,1           |
|                                        | S     | Knee          | Flexion increased                                 | LST        | 4,2            | 0,9           |
|                                        | S     | Tibia         | Forward inclination increased (v)                  | EST-LST    | 3,9            | 0,7           |
|                                        | S     | Ankle         | Dorsal flexion increased                           | LST        | 4,2            | 0,6           |
|                                        | S     | Ankle         | Plantar flexion decreased                         | PSW        | 4,4            | 0,6           |
| Gluteus maximus weakness               | S     | Pelvis        | Anterior tilt increased                            | Stance     | 3,2            | 0,7           |
|                                        | S     | Hip           | Extension decreased                               | LST-PSW    | 2,7            | 1,3           |
|                                        | S     | Hip           | Peak extension delayed                            | Stance     | 2,6            | 0,9           |
|                                        | S     | Hip           | Flexion increased                                 | Stance     | 3,1            | 1,0           |
|                                        | T     | Hip           | Endorotation increased                            | Stance     | 2,9            | 0,8           |
|                                        | S     | Knee          | Flexion increased                                 | Stance     | 2,6            | 0,9           |
| Gluteus medius weakness                | F     | Trunk         | Ipsilateral lean                                  | EST-LST    | 4,1            | 0,6           |
|                                        | F     | Pelvis        | Obliquity lift                                    | Stance     | 3,6            | 1,0           |
|                                        | F     | Hip           | Adduction increased                               | Stance     | 3,8            | 0,8           |
| Hamstrings spasticity / contracture    | S     | Pelvis        | Posterior tilt movement increased                 | LSW        | 4,3            | 0,6           |
|                                        | T     | Hip           | Endorotation increased                            | LSW        | 4,2            | 0,8           |
|                                        | T     | Hip           | Adduction increased                               | LSW        | 4,2            | 0,8           |
|                                        | S     | Knee          | Extension decreased                               | LSW        | 4,1            | 0,7           |
|                                        | S     | Knee          | Flexion increased                                 | EST-LST    | 2,9            | 1,0           |
|                                        | F     | Foot          | Narrow stride width                               | Stance     | 3,4            | 0,7           |
| Hamstrings weakness                    | S     | Pelvis        | Anterior tilt increased                            | Stance     | 3,4            | 0,9           |
## Appendix B (continued): Relation Impairment - Possible Gait Features

| Underlying Impairment | Plane | Segment/ Joint | Gait Feature | Gait Phase | Likelihood |
|------------------------|-------|----------------|--------------|------------|------------|
|                        |       |                |              | Mean       | SD         |
| **Iliopsoas Spasticity / Contracture** |       |                |              |            |            |
| Iliopsoas spasticity / contracture | S     | Pelvis         | Anterior tilt increased | Stance | 3.9, 0.6 |
|                                     | S     | Pelvis         | Anterior tilt increased | Swing | 3.6, 1.0 |
|                                     | T     | Pelvis         | Retraction increased | LST-PSW | 3.6, 0.6 |
|                                     | S     | Hip            | Extension decreased | LST-PSW | 3.8, 0.6 |
|                                     | S     | Knee           | Flexion increased | Stance | 3.2, 0.9 |
| **Iliopsoas Weakness** |       |                |              |            |            |
| Iliopsoas weakness | S     | Hip            | Flexion decreased | Swing | 2.9, 0.9 |
|                                     | S     | Knee           | Flexion decreased | PSW-ESW | 2.6, 1.1 |
| **Knee Flexion Contracture** |       |                |              |            |            |
| Knee flexion contracture | S     | Knee           | Flexion increased | Gait cycle | 4.1, 1.0 |
|                                     | S     | Ankle          | Dorsal flexion increased | Stance | 3.3, 1.0 |
| **Limited Selective Control (Flexion/Extension Synergy)** |       |                |              |            |            |
| Limited selective control (flexion/extension synergy) | S     | Hip            | Flexion delayed | ESW | 2.9, 1.0 |
|                                     | S     | Hip            | Flexion increased (high steps) | Swing | 2.8, 1.1 |
|                                     | S     | Knee           | Extension decreased | LST-PSW | 3.6, 0.8 |
|                                     | S     | Knee           | Flexion delayed | ESW | 3.4, 0.9 |
|                                     | S     | Knee           | Flexion increased | Stance | 3.2, 1.0 |
|                                     | S     | Ankle          | Plantar flexion increased | LST-PSW | 3.7, 0.9 |
|                                     | S     | Ankle          | Plantar flexion increased | EST-LST | 2.9, 0.8 |
|                                     | S     | Foot           | Forefoot/ midfoot contact (v) | IC | 3.5, 0.8 |
| **Peroneus Spasticity / Contracture** |       |                |              |            |            |
| Peroneus spasticity / contracture | F     | Ankle          | Eversion (valgus) increased | Gait cycle | 2.2, 0.9 |
| **Peroneus Weakness** |       |                |              |            |            |
| Peroneus weakness | T     | Ankle          | Internal rotation increased | Gait cycle | 3.2, 0.8 |
|                                     | F     | Ankle          | Inversion (varus) increased | Gait cycle | 3.2, 0.8 |
|                                     | T     | Foot           | Progression angle too internal | Stance | 2.7, 0.9 |
|                                     | F     | Foot           | Lateral foot contact (v) | IC | 3.3, 0.7 |
| **Quadriceps Weakness** |       |                |              |            |            |
| Quadriceps weakness | S     | Knee           | Extension increased | Stance | 3.2, 1.3 |
|                                     | S     | Tibia          | Backward inclination | EST-LST | 2.2, 0.6 |
| **Rectus Femoris Spasticity** |       |                |              |            |            |
| Rectus femoris spasticity | S     | Hip            | Extension decreased | LST | 2.6, 1.0 |
|                                     | S     | Knee           | Flexion decreased | ESW | 3.6, 0.6 |
| **Soleus Spasticity / Contracture** |       |                |              |            |            |
| Soleus spasticity / contracture | S     | Knee           | Extension movement | LR | 4.1, 0.9 |
|                                     | S     | Knee           | Extension increased | EST-LST | 4.2, 0.9 |
|                                     | S     | Tibia          | Backward inclination | EST-LST | 3.9, 0.9 |
|                                     | S     | Ankle          | Plantar flexion increased | LST-PSW | 3.1, 1.0 |
|                                     | S     | Ankle          | Plantar flexion increased | LR-LST | 4.1, 0.7 |
|                                     | S     | Ankle          | Plantar flexion peak too early | EST-LST | 4.3, 0.8 |
|                                     | S     | Foot           | Early heelrise | EST | 4.2, 0.8 |
|                                     | S     | Foot           | Toe walking (v) | Stance | 4.2, 0.8 |
|                                     | S     | Foot           | Forefoot/ midfoot contact (v) | IC | 3.9, 1.0 |
| **Soleus Weakness** |       |                |              |            |            |
| Soleus weakness | S     | Hip            | Peak extension delayed | Stance | 2.8, 1.3 |
|                                     | S     | Knee           | Flexion increased | EST | 4.0, 1.0 |
|                                     | S     | Tibia          | Forward inclination increased (v) | EST-LST | 4.3, 0.8 |
|                                     | S     | Ankle          | Dorsal flexion increased | LR-LST | 4.5, 0.6 |
|                                     | S     | Ankle          | Plantar flexion decreased | PSW | 4.0, 0.9 |
| **Tibial Torsion Too External** |       |                |              |            |            |
| Tibial torsion too external | T     | Hip            | Endorotation increased | Stance | 3.1, 1.0 |
|                                     | T     | Foot           | Progression angle too external | Stance | 4.0, 0.7 |
| **Tibial Torsion Too Internal** |       |                |              |            |            |
| Tibial torsion too internal | T     | Hip            | Exorotation increased | Gait cycle | 2.1, 0.9 |
|                                     | T     | Foot           | Progression angle too internal | Stance | 3.6, 0.9 |
| **Tibialis Anterior Weakness** |       |                |              |            |            |
| Tibialis anterior weakness | S     | Ankle          | Plantar flexion increased | Swing | 3.9, 1.0 |
|                                     | S     | Foot           | Forefoot/ midfoot contact (v) | IC | 4.1, 0.9 |
| **Tibialis Posterior Spasticity / Contracture** |       |                |              |            |            |
| Tibialis posterior spasticity / contracture | T     | Ankle          | Internal rotation increased | Gait cycle | 3.3, 1.1 |
|                                     | F     | Ankle          | Inversion (varus) increased | Gait cycle | 3.9, 0.7 |
|                                     | F     | Foot           | Lateral foot contact (v) | IC | 4.5, 0.5 |
| **Tibialis Posterior Weakness** |       |                |              |            |            |
| Tibialis posterior weakness | F     | Ankle          | Eversion (valgus) increased | Gait cycle | 3.3, 0.6 |

Abbreviations of gait events and phases: IC, initial contact; LR, loading response (~0-10% gait cycle); EST, early stance (~10-30%); MST, midstance (~30%); LST, late stance (30-50%); PSW, preswing (~50-60%); ESW, early swing (~60-80%); LSW, late swing (~80-100%)

(v): item can best be determined from video rather than from 3D motion capture data