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TEACH

Module Biomechanics of Gait

Didactic Unit D: Instrumented Analysis of Gait

D.1 Which gait biomechanical instrumented evalution protocols exist?

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1. Objectives

In this Didactic Unit, we will review the main biomechanical techniques used for gait evaluation through instrumental techniques. The objectives of this didact unit are:

1. To define the main biomechanical evaluation techniques for gait assessment.
2. To review the methodologies and protocols used for gait evaluation with the most used instrumental techniques in the clinical and research field.
3. To review the main results / outcomes that can be extracted from gait assessment with the main biomechanical instrumental techniques.

2. Key ideas

- Human gait can be evaluated with different biomechanical assessment instruments, which allow us to objectify its performance and deficits.

- Photogrammetry is a technique for measuring kinematic variables from images, either from photo cameras or video cameras.

- To perform a gait analysis with photogrammetry, it is necessary to instrument the person evaluated with a biomechanical model composed of markers that will indicate the points that make up the body segments that perform the movement.

- The most used biomechanical model to measure gait is the Calibrated Anatomical System Technique (CAST), which allows to analyze the march in the three planes of movement.

- Among the clinical gait variables that can be measured with photogrammetry are Range of flexion-extension movement, internal-external rotation, abduction-adduction in each joint of the biomechanical model and Peak angles, which refers to the maximum degree of movement reached in the analyzed curve.

- Linear acceleration during gait is possible to measure with an accelerometer system and is refers to the change in the linear velocity over successive time intervals. The unit of acceleration, in the International System of Unit, is meters per second square (m/s^2) although it can often be found expressed in gravity ratio (g). Positive acceleration have a positive value, but a negative value represents a deceleration.

- The protocol using accelerometers in gait analysis typically consists of attaching an accelerometer to the trunk, head and tibial segment. One of the most important points of the protocol is the fixation of the accelerometer on the skin, which must prevent the relative movement of the accelerometer to faithfully represent the acceleration of the segment to be measured.

- A force platform or a force plate is an equipment to measure ground reaction forces (GRF) and their point of application known as centre of pressure (COP). It is an element widely used in the assessment of human gait and balance, as well as in a several human activities and functions.

- The registered forces will depend, as we have already said, on the speed, but also on the weight of the valued person. That is why, in order to make comparisons between individuals we need to divide the forces obtained by the weight of the person and thus obtain a comparable dimensionless parameter between subjects. On the other hand, the control of gait speed is also necessary between gait trials of the same condition.

- The ground reaction force vector has three component, in the three axes of space: a) Vertical force component in the Z axis, b) Anterior-posterior force in the Y axis, and, c) Medial-lateral component in the X axis.

- The instrumented insoles for plantar pressure are a kinetic analysis technique that, inside the insoles have a several of pressure sensors strategically distributed, to measure the static and dynamic plantar pressure. These insoles are located inside the footwear of the person evaluated, so it is a portable equipment and allow the assessment of gait in functional conditions, it is mean, with footwear and in movement. The importance of measuring plantar pressure is that excessive pressures can cause tissue damage.

- In the analysis of plantar pressures, it is more useful to study the parameters for each area of the foot. Usually the devices allow to analyze the results of the plantar pressure divided in the heel, midfoot, forefoot and internal and external area of the foot.

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