Showmotion

Transforming the way human

movements are evaluated and measured

Gait Analysis

MEDICAL DEVICES

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APPLICATION OF SHOWMOTION TECHNOLOGY IN GAIT ANALYSIS

WHITE PAPER

Introduction – In the past decade, motion analysis technology has been widely used in gait analysis and for specific exercise evaluations. Laboratory analysis is typically used to examine upper and lower body range of motion during a specific action.
This type of analysis has several limitations including; being restricted to a specific environment, passive markers captured by infrared cameras suffer from occlusion problems, length of time needed to perform an evaluation, the need for technically trained personnel, and often the lack of real time visual feedback for teaching and training correct movements.
For applied research the use of wearable and wireless technology has opened new horizons for the ability to measure a patient in any environment and in less time.

Show Motion™ - Is very different from existing tools. Show Motion™ developers extrapolated parameters from validated protocols (1,6) for the analysis of kinematic coordination, range of motion and muscle activity. From this they were able to characterize the essence and phases of movement (fig.1)

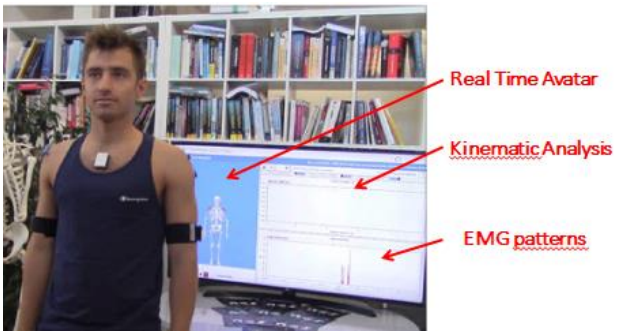

Figure 1: Applied measurement using wearable and wirless technology such as inertial sensors and electromiography

With Show Motion™ it is possible to:

- Quantify the evolution of treatment over time
- Correlate results to expected outcomes
- Show and indicate alterations in movement
- Objectify compensatory strategies
- Provide biofeedback input to understand/teach correct movements
- Assist future clinical decision with objective data

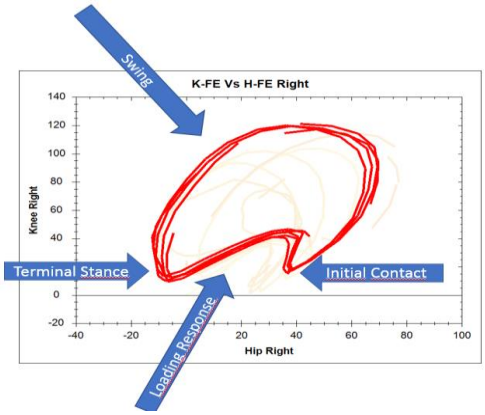

Figure 2: Example of Gait cycle with representation of knee and Hip Kinematic

Application - Gait Analysis - The Show Motion™ generated gait analysis provides quantitative information that will analyse problems related to posture and ambulation, load anomalies and muscular insufficiencies. These conditions can-not typically be measured by objective examination and video recording. (fig.2)

Show Motion™ has been implemented according to the OUTWALK protocol (6) for lower limb applications. The technology provides an easy way to evaluate knee/hip/foot kinematics using validated protocols along with an integrated EMG system to measure muscle activity.

A gait analysis can be completed in 10-15 minutes. The sensors are activated, positioned per the protocol (fig.6) and the patient walks without shoes from an initial static position for 10 meters (5,6)

Figure 3: Placement of the sensors according to the Outlook protocol

In this study we have captured the kinematic variables of the knee and the hip along with the temporal variables associated with the step including: average stride, step, stance, swing, double support, and single support time. (Figure 4)
An electromyography analysis of the vast medial and rectus femoris muscles is also performed, using Cometa EMG.

GAIT PARAMETERS		
	Left	Right
Average Stride Time [s]	1.103	1.115
Average Step Time [s]	0.529	0.488
Average Stance Time [s]	0.603	0.610
Average Swing Time [s]	0.500	0.505
Average Double Support Time [s]	0.066	0.043
Average Single Support Time [s]	0.525	0.557
Knee Max Flex [°]	68.2	61.7
Knee Min Flex [°]	4.7	1.9
Hip Max Flex [°]	27.3	24.2
Hip Min Flex [°]	-10.9	-13.8

Figure 4 – Case report of gait analysis

Proprietary algorithms automate the segmentation of movement and identifies the various phases in the exact instant in which the alteration occurs.
During simple movements, phase segmentation shows the part of the movement in which the alteration might be influencing gait (fig.5,6)

Figure 5 shows flexion and extension of the knee during one gait cycle. From this graphic, it's possible to understand the kinematic and ROM of the knee in every phase. It's also possible to compare it with a healthy kinematic in order to understand which phase is dis-functional. The same is true for figure 6 where the flexion and extension of the hip is shown during a step cycle.

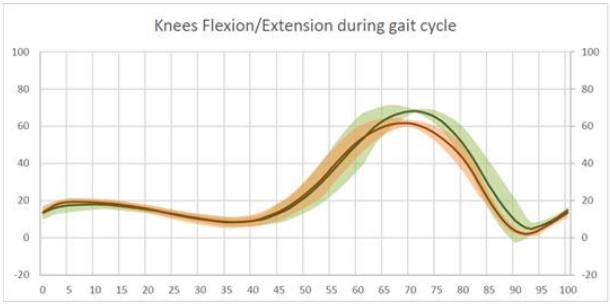

Figure 5: Flexion / extension of the knee according to a step cycle.

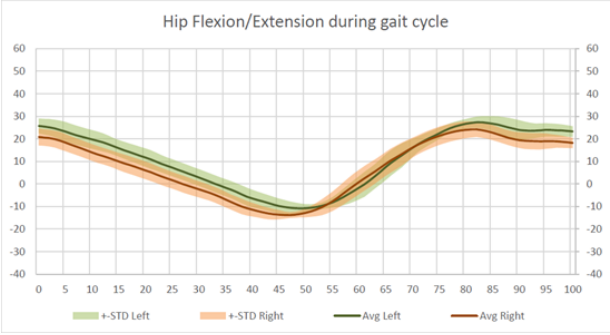

Figure 6: Flexion / extension of the hip according to a step cycle.

In the below case (fig.7), the data shows a slight asymmetry of the gesture. In both limbs the times difference and the kinematics data between the right and left limb indicate they are normal, and not considered pathological.

Despite this, the subject would probably need to have some advice concerning their step; possibly for the complete extension of the left knee that appears to be flexing more than the right.

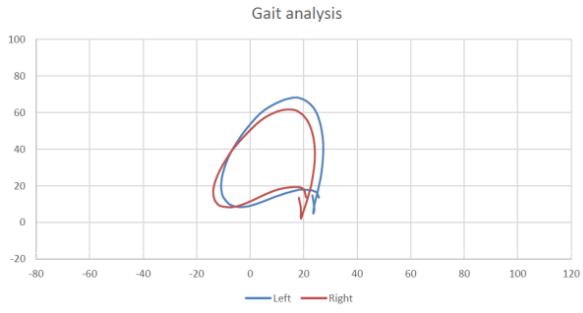

Figure 7: the cycle of the step. In the x-axis there is the flexion/extension of Hips and in the y-axis the flexion/extension of the Knees

The minimal variation seen in the hip appears to originate from the incorrect extension of the knee that involves a greater flexion of the hip as well as inclination of the pelvis (fig.10)

The analysis of the path has been integrated with an electromyography analysis that shows a correct pattern of muscular activation during the gait.

From the report it is possible to observe that the Vastus Medialis muscle is activated in the pre-contact and initial contact phase, while it turns out during the swing phase. (fig.8)

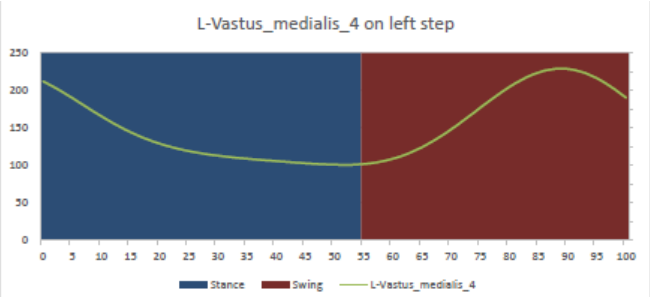

Figure 8: Vastus Medialis left arm activity, during gait analysis

In conclusion, the subject demonstrates a standard gait, but should be educated to perform a complete extension of the left knee to prevent problems in the future.

With Show Motion™ it is possible to identify and objectify small discrepancies not easily recognizable with the classic optical observation.

Thanks to some of its important features, especially the non-invasive nature, one is able to:

- Quickly perform diagnostic examinations
- Validate rehabilitation treatment and its impact on recovery;
- Understand human movement in a more scientific way
- Provide an objective evaluation during the therapeutic continuum.

References

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