OPTOGAIT

RECOVER YOUR POTENTIAL

MICROGATE

The three steps for biomechanical assessment are the following:


1 Test
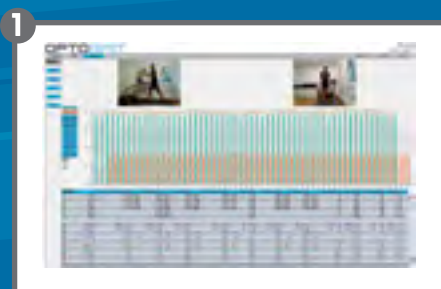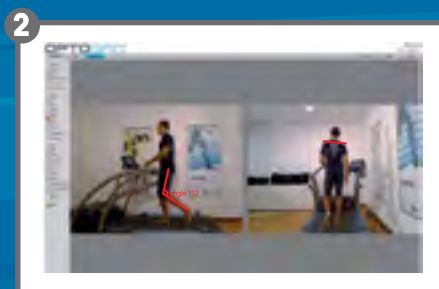
2 Analysis

3 Report

OPTOGAIT

Optogait is an innovative system for movement analysis and functional assessment of patients with normal or pathological conditions. Moreover, the system can be used as an active work instrument during the neuromuscular rehabilitation stage. The system is equipped with optical sensors working at a frequency of 1000 Hz and having an accuracy of 1 cm, detecting the relevant space and time parameters for gait, running or other test types.

The objective measurement of such data, combined with an integrated video acquisition, allows monitoring of a patient's condition on a constant basis, detecting problem areas, assessing mechanical inefficiencies and rapidly verifying the existence of asymmetries between the two legs. The software platform allows easy storage of all tests carried out and the ability to recall them instantly if necessary. This allows the development of a customized patient recovery plan. It is also possible to compare very quickly and easily data of tests carried out at different times, in order to assess the validity and the efficiency of the methodology applied.
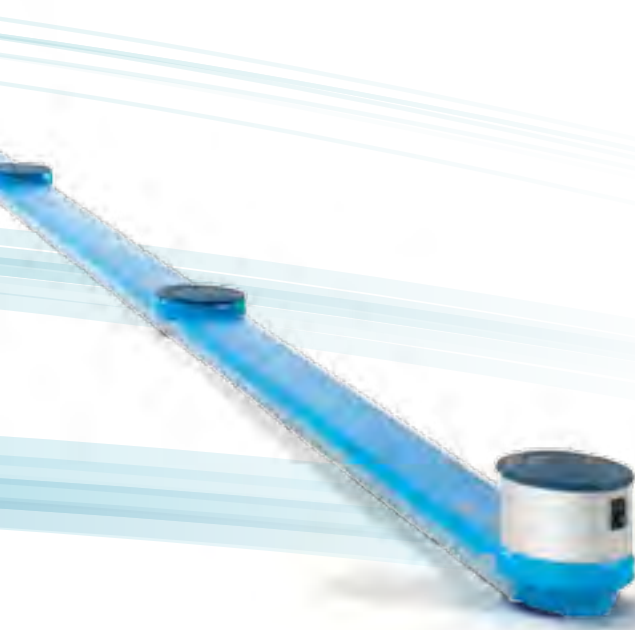
Optogait allows users to:

> Assess objectively the patient's general physical conditions

> Identify deficiencies, postural problems and asymmetries on the basis of data and videos and determine how the patients' performance is being effected.

> Develop and apply therapeutic-rehabilitation applications, rehab approaches and orthopedic solutions on the basis of precise data

> Prevent - thanks to immediate assessment of numerical values - of relapses, complications and involutions of the pathological or post-accident condition due to wrong evaluations or diagnosis

> Periodically verify the results and the efficacy of treatment

> Motivate patients giving them tangible proof of improvement

> Compare post- and pre-accident values if available

> Verify, in a dynamic situation, the efficacy of arch supports, insoles or functional tapes

> Compare various shoes and their effect on the patient's gait

> High intensity neuromuscular rehabilitation work thanks to the Biofeedback function in real time

Quantity and Quality Assessment

Optogait acquires numerical parameters in real-time for gait, running and jump tests that can be viewed immediately. The easy to read report contains all data, and asymmetries between the two legs are highlighted instantly and the coefficient of variability of the action expressed, namely quality and consistency.

Optogait does not only detect the numerical data, but, via small cameras, which can be freely positioned, it allows the user to acquire images of carried out tests, synchronizing them perfectly and in real time with detected events. Without the need for any further synchronization between hardware and cameras, the numerous benefits of cross verification of data and images can be fully used. The software makes some dedicated functions available dedicated to the graphic analysis of the images: by using a variety of instruments, every photogram of the video recorded can be utilised, angles measured, markers inserted, etc.

What is Optogait?

Optogait is a system for optical detection made by a transmitting and a receiving bar. Each one contains 96 LEDs communicating on an infrared (visible) frequency with the same number of LEDs on the opposite bar. Once positioned on the floor or on the treadmill, the system detects the interruptions of the communication between the bars - caused by the patient's movement - and calculates the duration and position. During the execution of a running, gait or series of jumps test, the contact and flight times can be measured with an accuracy of 1 thousandth of a second and the position of the interrupted LEDs with a space resolution of 1 cm. Starting from this basic data, the dedicated software measures in real-time a series of crucial data for the movement analysis*.

The absence of mechanical moving parts ensures a long life, accuracy and repetition possibilities.

(*): please refer to the table to check the parameters available for each test

AND PRECISION

Portable, Easy to Use, and Quick to Install

The reduced weight and the practical bags (trolley for modular systems) ensure complete portability of the **Optogait** system. This allows the user to bring the unit wherever a test needs to be performed.

The system is extremely easy to install: position the bars on the floor and connect the receiving part to the PC using the USB cable - **Optogait** is ready to be used! The maximum distance between the bars is 6 meters and there is no need for connection cables. This makes the bars easy to move with minimal disturbance to the patient on which the test is carried out.

The correct alignment of the system is shown by a green LED. If the bars are not parallel or in case of any imperfections on the floor influencing the communication between the transmitting and the receiving part, the LED emits a red light to warn the user.

Max 6 mt

Single Meter
dim. 100 x 8 x 3 cm
weight 2,1 kg

Single Meter

In this configuration **Optogait** allows already to carry out various test types (*):

> **Gait and Run Analysis:** Positioned on the side bars of a treadmill, Optogait becomes a portable lab for small spaces and with reduced costs. The system is compatible with the wide majority of treadmills and no synchronization is necessary to start and carry out a test.

> **Analysis of walking on the spot:** this type of test conducted with eyes open and eyes closed, for example, can show the corrective influence of muscles and posture on the patient's proprioceptive system

> **Various jump tests:** in addition to classical strength measuring, explosiveness and elasticity test (thanks to some pre-set tests such as Drift, 5 Dot Drill, Single Leg 3 Hops) it analyses pliometric capacity, stabilisation ability, reactivity and resistance. At the same time, the user can easily create customized tests or protocols.

> **Tapping/Frequency Test:** This type of test is ideal for exercises where separate results are required for the left and right foot (e.g. tapping/frequency test, side movement, walking on the spot, etc.)

> **Reaction Test:** This test detects the time between one optical/acoustic impulse and the patient's movement. It can be used to measure simple reactions or more complex movements..

The single meter can be battery-operated (8 hours) or used with a net adapter.

> Thanks to the **biofeedback** function, neuromuscular type works can be managed with the patient creating a programme of training or retraining for specific motor patterns.

(*): please refer to the table to check the parameters available for each test

The Modular System

In addition to the works described for the single metre configuration, with its modular solution, **Optogait** performs

> **Floor walking test:** the gait, as a basic motor model, can be analysed comprehensively for all classical space-time parameters of Gait Analysis; it is possible to manage tests with simple exercises (movement from point A to point B), but also more complex tests, for example "go and come back" or walking backwards. They can then be rendered more complicated by the user, introducing obstacles, dual tasking or other actions that are done at the same time as walking (sitting down and getting up, for example)*.

> **Running Tests:** Running tests, just like gait tests, can be carried out in different ways: for example, starting from a standstill to analyse the ability to accelerate or at a full run, to analyse the characteristics of the different stages of running in various tiring situations. The system provides a series of space-time parameters that characterise the patients' motor ability both in terms of symmetry as well as efficacy (acceleration, stags of contact with the ground - coming into contact, stabilization - propulsion stage - theoretical race corner, etc.). The running test with this configuration permits total flexibility in integrating specific movements to better characterise the analysis and work done (as an example.changes in direction, jump and running, obstacles/hurdles and so on)

Thanks to the practical and innovative assembling system using special interconnected caps, the modular system is assembled in a few minutes and does not require cables to connect the bars or further net adapters. The length goes from a minimum of 2 meters to a maximum of more than 100 meters.

(*): please refer to the table to check the parameters available for each test

The two-dimensional system

With the **OptoGait** software it is possible to use a particular bar configuration for obtaining a two-dimensional measurement area. After positioning the bars on the ground in a linear configuration, it is enough to set up additional TX and RX bars (connected with an appropriate cable to the linear bars) transversally at the beginning and at the end of the measurement area, in order to obtain a rectangle allowing to carry out a two-dimensional gait analysis. Using the regular **OptoGait** bars it is possible to set up a two-dimensional linear analysis system of up to **5 m**. The maximum length of the 2D measurement area can be increased up to **13 m** purchasing one or more TX bars called **2D Boosted**, equipped with stronger transmission leds compared to the normal ones. Besides the typical Gait analysis parameters, the 2D Gait analysis allows to collect new information, such as:

> **Step width**: distance between the middle support point of each foot

> **Walking Base:** distance between the innermost foot support points (for superposed steps this value can be negative)

> **Walking Points:** middle points between the two support feet; their connection defines the gait progress (**Line of Progression**)

> **Walking Point Gap:** progressive variation of the current walking point with respect to the previous one

Thanks to the 2D analysis it is possible to analyze normal walking steps, steps with superposed feet, as well as walking steps with crutches.

The Software

The interface with which the OptoGait system is managed is divided into three main sections: Patients' Personal Data, Tests and Results.

Patients' Personal Data

This is the section where the patients' profiles are created and stored. A profile can contain all sorts of information: personal data, notes, patient's photo, etc. Each patient can be added to one or more groups or subgroups. Therefore the Patients' Personal Data can be fully customized and adapted to the user's requirements, and imported and/or exported from/to other programs or formats (xml, Excel, etc.). In the patient's Personal Data section, video can be uploaded and pictures taken of the patient on the webcam to optimally characterise his/her functional behaviours, such as a squat movement or standing upright for some seconds with eyes open/eyes closed, etc. In this module also, every image can be analysed using the graphic tools available.

Test

This section is the software's nerve center. It is accessed to devise and configure new tests (jump, reaction, running, etc.) and to perform tests by choosing from the pre-defined tests or those created by the user. It is furthermore possible to group several tests (protocols), if this is useful for measuring particular capacities or conditions (some protocols are already pre-configured, e.g. for measuring reactivity and dynamic stability).
During the test, the user receives three kinds of feedback in real-time: numerical, graphical, and video (from one or two webcams). If the starting foot has been previously selected, the results are calculated assigning the values to the left or right leg. Once confirmed the test, all three types of data are stored and are available for immediate editing or further use in future. The user can also temporarily hide certain unnecessary information (e.g., if the video is of importance for the user, the images can be viewed full-screen).

Results and Video Analysis

The tests carried out previously can be recalled at any moment accessing the Results area. Selecting a test and clicking on 'View', (numerical or graphical) data can be compared with the images. The video is of great help to the user to detect immediately postural or motor problems, and, more in general, to carry out a qualitative analysis. In fact, thanks to the 'video memory', possible anomalies of the numerical data can be easily identified and motivated.
The video images are synchronized with the data. This allows to verify with accuracy what has happened at the time of acquisition of a certain value (e.g. if a contact time is extremely long, it is possible to look for the cause viewing the images of the instant, when the value has been recorded). Synchronization is carried out automatically by the software; no user action is necessary. The video reproduction speed can be reduced down to a still image, to view the video frame-by-frame. A video analysis utility is also provided, with traditional tools such as lines, arches, circles, text, ruler, goniometer to measure angles and other.
In the Results section two or more tests can be compared ('Compare' option) using the video as well as the data, having all necessary information at dispostion. This allows to quickly and intuitively carry out an analysis of quantitative and qualitative differences between tests carried out at a different time (pre-/post- rehab, for example) or between different patients (healthy and rehab).
If more than two tests are to be compared, the 'History' function must be used, which allows to select an infinite number of tests to verify the parameters (indicated when a patient's progress must be measured constantly carrying out numerous tests).
All data, numerical and graphical, can be printed or exported to the most common formats.
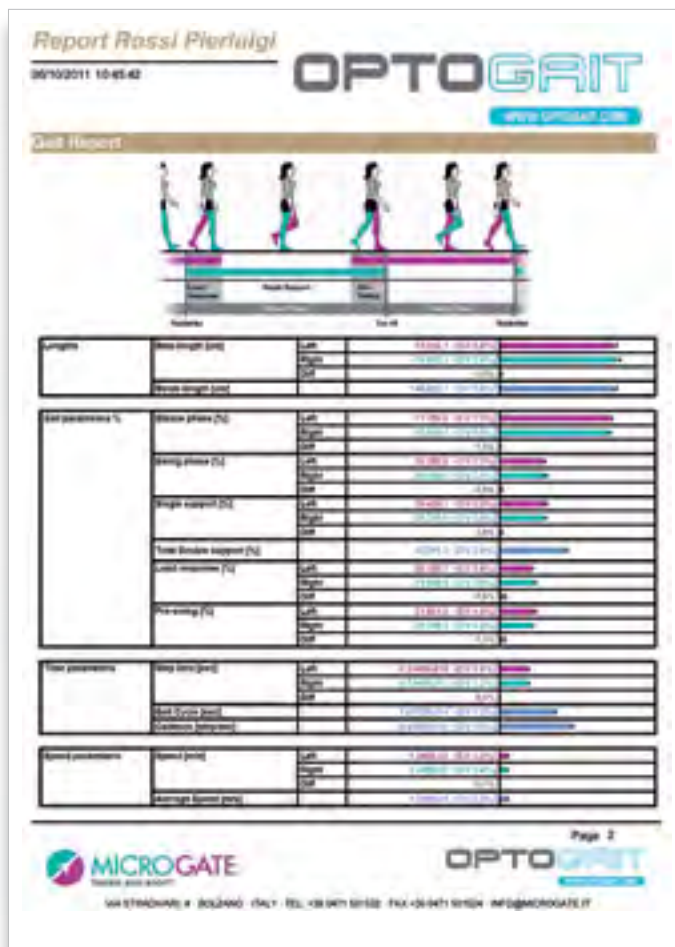
Report

A detailed report can be printed for every test conducted and saved, and for every protocol, with all the information relative to the same. The report is made up of numeric data, graphs of the individual parameters and any notes and images saved by the user.
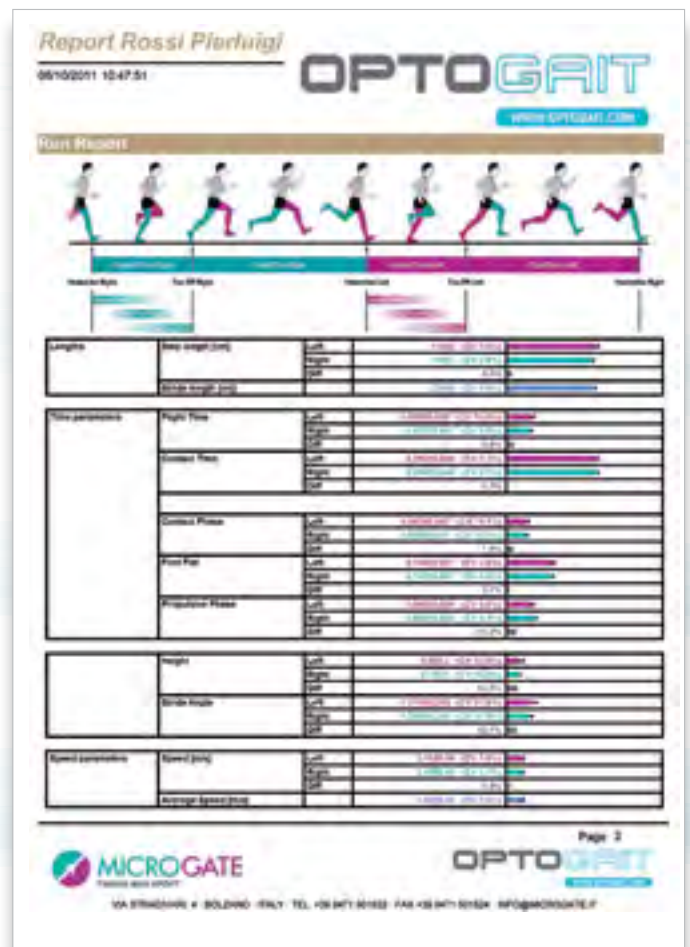
The reports can be customized by inserting their logo and establishing which graphics, photos or personal notes to print.

(*): please refer to the table to check the parameters available for each test

Gait Report

Run Report

Evaluation of static postural analysis using pictures and videos in the MediaGallery can be managed via the Patients section.

Viewing videos, graphs, and data during a Treadmill Gait Test
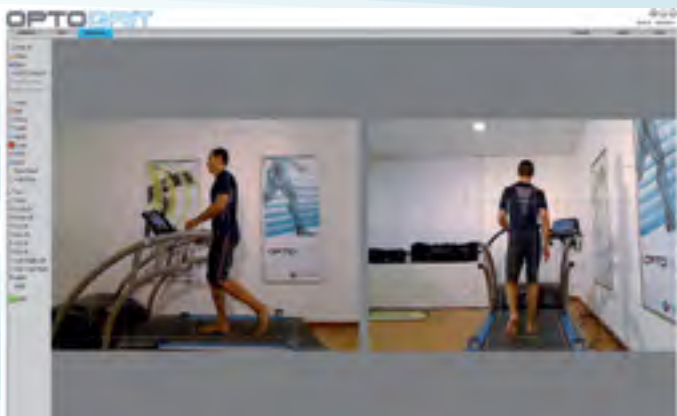

*Viewing increased-size videos, dynamical gait report and **Optogait** bar status in real-time*

Comparing two tests with compared Gait Report and videos (T1 = test with shoes, T2 = barefoot test)
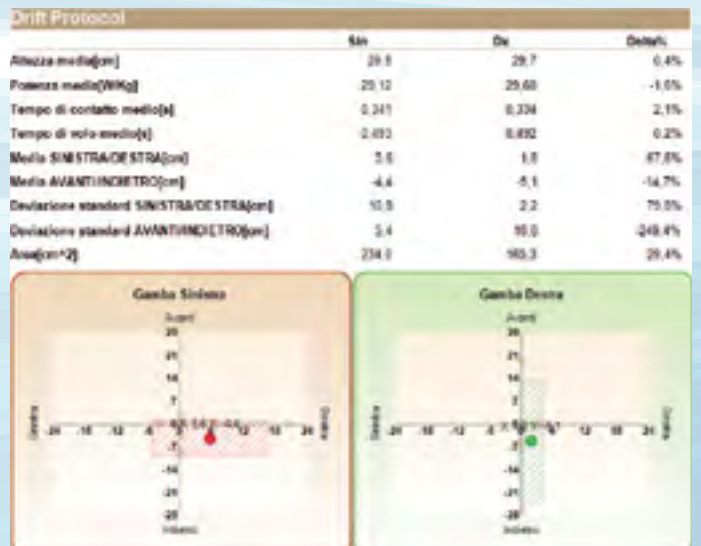

History mode for analyzing the results of a series of tests

Video analysis of two synchronized still images with the possibility of adding graphical notes, as well as angle and length measurements

Report Drift Protocol >

Audio and video biofeedback tools

The Videofeedback Module

The main idea of this new feature is to show the patient directly some main parameters in real time of the test he/she is carrying out. This way, the patient can be invited to "correct" some aspects autonomously or anomalies in his/her motor movements, thanks to neuro-muscular type, high intensity work. In this way, Optogait becomes more than an excellent diagnostic tool, it becomes a tool and a way to exercise for the patient, that can help them in a simpler and more immediate way understand, control and correctly implement the desired motor patterns. The patient's attention can be directed at the absolute value concept (for example, reduced contact time, stride length, rhythm etc.) as well as the concept of asymmetry, or the difference between the right and left limb (in % value) compared to a particular parameter. A classic example is walking on a treadmill; the patient is shown a specific parameter of their walking (a parameter selected by the therapist depending on the pathology, deficiency, or rehabilitation course). Thanks to numeric and graphic feedback representing the difference between the two limbs, the patient is able to understand and adapt their movements rationally and precisely according to the motor pattern. The therapist can define different thresholds-goals on a case by case basis for the patient, highlighting using different colours: green (good: meets the goal), yellow (warning: slightly misses the goal) and red (bad: totally misses the goal).

At the end of every session, the summary report can be displayed verifying the quality of the work done: a pie chart will show how much the patient has worked and met and not met the set threshold-objective.

The Audiofeedback Module

Similarly to the Videofeedback module, the Audiofeedback module stimulates the patient to correct some anomalies and asymmetries in real-time. During a Treadmill Gait Test, for example, the Audiofeedback module generates acoustic signals according to the gait rythm; the better the rhythmicity and the cadence of the acoustic signals, the lower is the asymmetry.

Special tests and protocols

Gait with Crutches

OptoGait allows to acquire data from a gait test carried out with crutches. The software automatically filters the support points of the crutches and the patient can execute various roundtrips inside the acquisition area, while the typical gait analysis parameters are detected and displayed automatically.

3 Hops Protocol

There are several specific protocols created specifically for the evaluation of various rehabilitation phases, among which the 3 Hops Protocol to evaluate the recovery of the anterior cruciate ligament functionality.
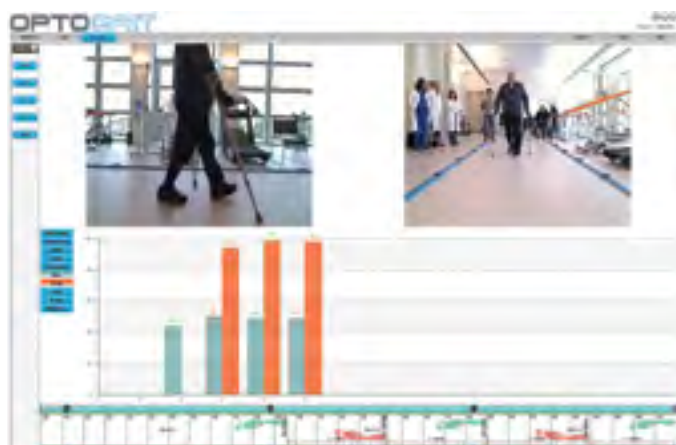
Integration of external devices

The Optogait software can manage a series of external devices such as the Gyko inertia system, heart-rate monitors (according to specifications set out in the manual) and timing systems (Witty automatically integrated).

Inertia sensor - GYKO

The Gyko inertia system is a new device, developed by Microgate, for obtaining information about the kinematics of any body segment as it performs a certain physical movement.
Gyko contains new generation components that accurately and repeatedly measure acceleration, angular velocity and magnetic field in 3 dimensions.
Gyko is automatically recognized and synchronized with Optogait software and integrates various tests, providing parameters fully comparable with a strength platform. The parameters are summarized by control indexes, coordination and movement fluidity, using a simple, easy to read method.
> Walk and run tests: front-posterior and medial-lateral imbalance, main breadth and direction of core movement, coordinating index between legs and core, and so on.
> Sway/posture tests: length and area of the stance of movement, speed of travel time of the stance and frequency of the oscillations
> Jump test: duration and work during the eccentric and concentric phases, strength, speed, maximum power, Rate of force Development, Landing Rate, and so on.
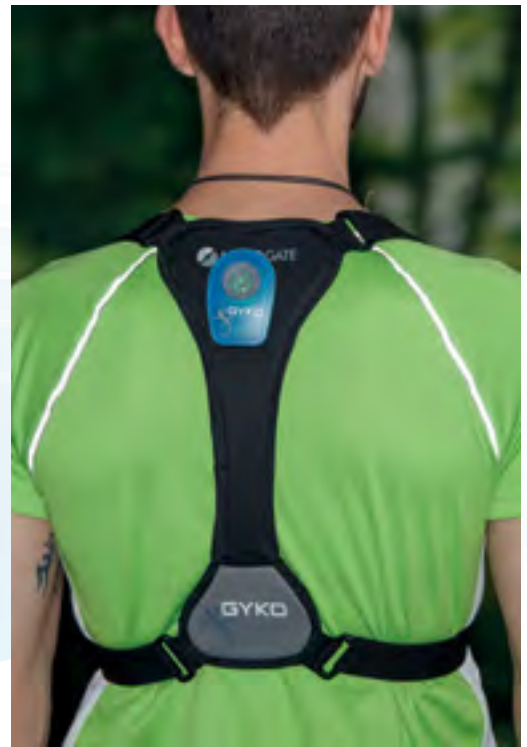
Heart-Rate Monitor

The patient wears a heart monitor during the test and the monitor is connected to the software (in line with the specifications for each individual device), his/her heartbeat is recorded and associated in real time to all the parameters recorded during the work. This means that the association between cardiovascular behaviour and the biomechanics of the movement are evaluated in real time. The tests graphs can also be personalised for every patient, using coloured monitors, the so-called "Sport Zone" according to the maximum frequency and the rate at rest.

Metronome

The "Metronome" function is an auditory stimulation helping the patient to keep focused on the essential features of the movement to carry out. The software allows to set various cadences and rhythms; thanks to this auditory, rhythmic help, the patient's gait speed, cadence, stride width, symmetry, etc. improve.

Surface electromyography

OptoGait can be used in a very easy and mildly invasive manner to support Surface EMG. The OptoGait digital outputs (or analogic, as needed) can be used as virtual foot switches avoiding the use of contact sensors on the patient's foot. This is a huge step forward in terms of patient preparation time and data reliability. The correlation of EMG data with Gait Analysis data processed by OptoGait give a complete picture of the patient in a very short period of time and on any natural surface or treadmill.

GMF module Gait Muscles & Functions

This new module, called GMF (Gait Muscles & Functions), displays a form of multimedia "encyclopaedia" related to muscles and all the functions involved when walking. The module was developed based on data taken from leading literary texts referring to Gait Analysis and muscular function.

For each phase of the walk and for each body "district" (namely, calf, pelvis and thigh), the muscles involved are listed. The activation timing of each of these is also specified, in relation to the total of the phase.
According to the same principle, all the possible "motor functions" are listed (plantar flexion, dorsiflexion, rotation, eversion, etc.), which are associated with that phase for each body part.
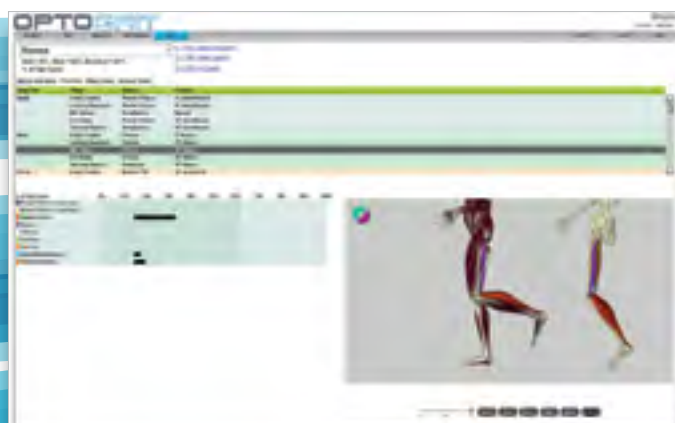
Data table available for each test

In addition to the data listed, medium, standard deviation and variability coefficients are available for each individual test; for some types of test, featuring monopodalic movements (running, walking, running on the spot, skipping), data is also differentiated for the LT or RT limb, with percentage difference between the two.

	Gait/Run Test	Gait Test on Treadmill	Run Test on Treadmill	Jump Test	Tapping Test	Reaction Test
Stance Time	X	X				
Swing Time	X	X				
Step Time	X	X	X			
Gait Cycle	X	X				
Single Support	X	X				
Double Support	X	X	X			
Loading Response	X	X				
Pre-Swing	X	X				
Step Length	X	X	X			
Stride Length	X	X	X			
3 Foot Phases (Contact, Flat, Propulsive)	X	X	X			
Cadence/Rhythm/Pace	X	X	X	X	X	
Speed	X					
Acceleration	X					
Flight Time	X		X	X	X	X
Contact Time	X		X	X	X	
Height	X		X	X		X
Stride Angle	X	X				
Imbalance	X	X				
Specific Power				X		
Jumping Point				X		
Jumping Point Gap				X		
Used Area					X	
Cycle Time (Flight + Contact)					X	
Reaction Time						X

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