SENSOR medica®

TECHNOLOGY IN MOTION

Baropodometria
Stabilometria
Biofeedback
Goniometria
Videografica morfologica

www.sensormedica.com

Sensor Medica was founded in 2011 after twenty years of experience in the areas of foot pressures & gait, biomechanics, posture and CAD-CAM orthotic systems.

We study, design and develop entirely in Italy high-tech products and software for the medical-scientific and sports fields, offering a real evolution in diagnostic systems, for the optimization of human biomechanical balance.

Sensor Medica technologies are actually available in 48 countries with over **8,000** software licenses purchased and **500** CNC milling systems working.

Thanks to a commitment to ongoing research, we can produce sensor systems among the most advanced of the sector: from the most evolved detection systems, to the most complete analysis software, all completely integrated with cad-cam for orthotic production.

Sensor Medica works constantly to update technology and products to ensure them among the most advanced and innovative in the world.

freeMed	Pressure sensor platforms
RunTime	Pressure sensor treadmill
Moover	3D inertial motion sensor
FlexinFit	In-Shoe bluetooth sensor insoles
Optoelectronic	2D-3D foot scanners, HD cameras
freeStep	Biomechanics software
easyCAD Insole	Orthotic modelling software
Vulcan Vx1 - twinCAM	CNC milling machines for orthotic production

freeMed®

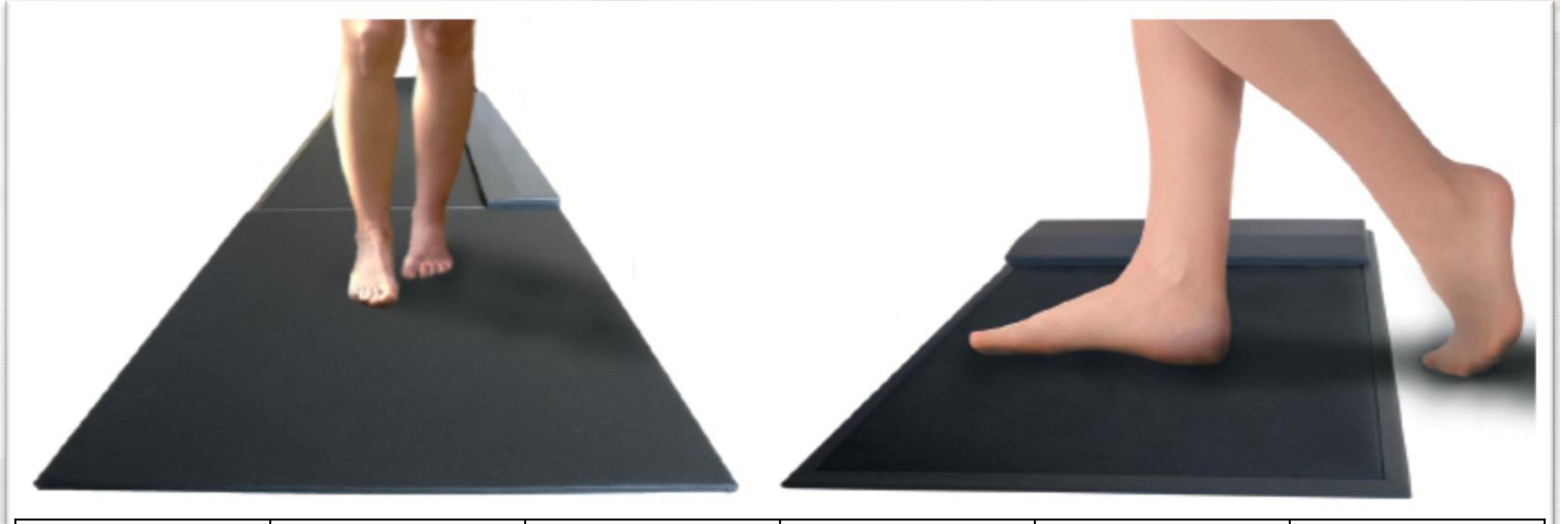
freeMed platforms are produced in aluminium for detecting plantar pressures, gait cycle with spatiotemporal measurements and balance during standing and walking.
They are lightweight and transportable, always complete of two passive plates.
High sample frequency of more than **400Hz** in real time.
All resistive sensors are **24K** gold coated to ensure an extreme reliability and repeatability and have a durability of more than one million work cycles.
All acquired information is processed in freeStep analysis software.
Maintenance free with no hardware re-calibration required.
3 year warranty.

freeMed® highlights

Resistive sensors, 24 K gold coated, conductive rubber foam

Sampling frequency up to 500Hz in real time; USB 2.0 interface

Bluetooth option with rechargeable batteries, sampling rate over 100 HZ



Sizes:	60x50	120x50	180x50	240x50	300x50

RunTime®

RunTime treadmill has **4,800** resistive sensors under the carpet for detecting plantar pressure, gait cycle with spatiotemporal measurements and balance during standing, walking and running.
All sensors are **24K** gold coated to ensure an extreme reliability and repeatability.
High sample frequency of more than **200Hz** in real time.
Normally used with two synchronized cameras for studying the body posture.
All acquired information is processed in our freeStep analysis software.
3D visualization of the steps, immediate evaluation of asymmetries, curves and graphs, angle measurements on video.
3 year warranty.

RunTime® highlights

Motor 2.5 HP AC - 4 HP peak

Speed: 0.5 - 14 mph

Inclination: 15 %

Sensorized area: 21 x 59 in

Max user weight: 330 lbs

Weight: 265 lbs

Dimensions: 81 x 35 x 62 in

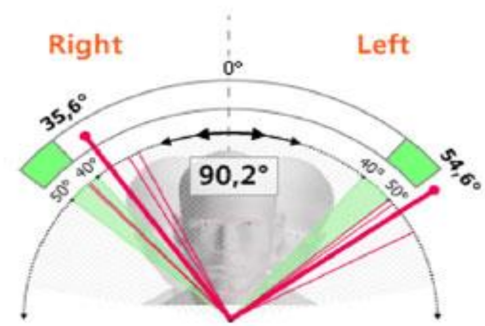
Dimensions folded: 55 x 35 x 64 in

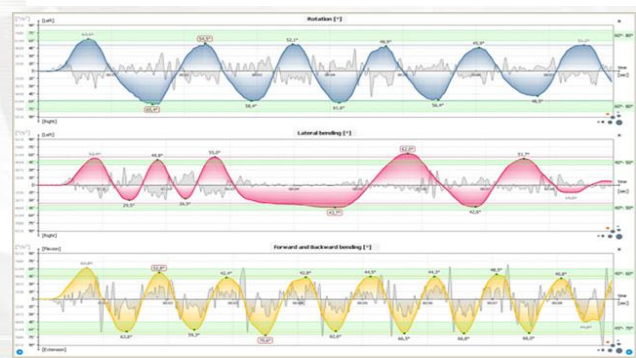
Moover®

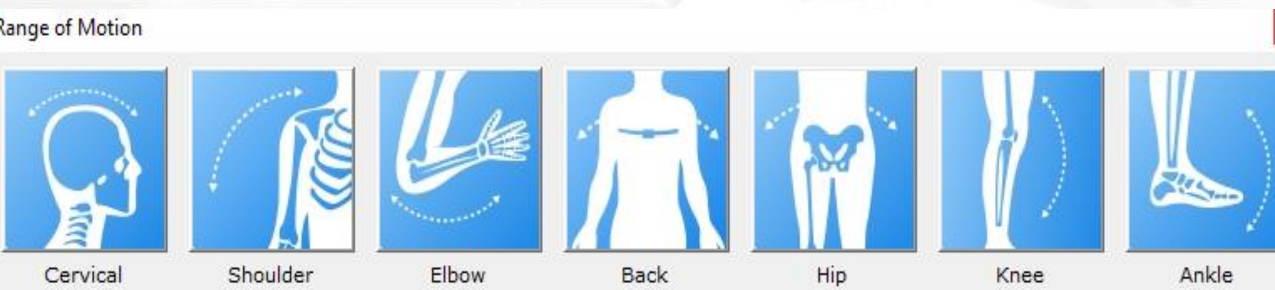
Moover is an inertial motion (IMU) sensor able to evaluate and measure your motions, accelerations and revolutions in space.

Moover® highlights

Its application in the scientific sphere allows the goniometric evaluation (range of movement) of any articulated joint.
Its measurements are very important both for prevention as well as for rehabilitation.
It's also useful for studying mobility and for monitoring and documenting improvements during therapy with the ability to compare different examinations with the normal values.
Moover is small, light, wireless, extremely precise and equipped with a long life battery.
freeStep software is easy to use, converts the mechanical motions into an electrical signal and always gives you normal values for comparison and generates an automatic test report.







FlexInFit®

FlexInFit has more than 400 resistive sensors.
The system allows you to perform precise analysis inside a patient's shoe. Capable of streaming live or recording the data via SD card.
It is a versatile tool with many applications for many types of professionals: foot specialist who wants to integrate in-shoe data into his gait analysis system, physical therapist who wants to check the results of therapy, athletic trainer interested in the study and improvement of sports movements, physician interested in verifying the real pressure points inside the shoe to prevent the formation of ulcers in diabetic patients.
It can also be used to determine the efficacy of custom orthotic correction.
It is totally wireless and junction box free, to avoid any kind of interference.

FlexInFit® highlights

- Bluetooth data transmission up to 100 meters in open space
- Li-Po batteries, USB charge
- Battery life up to 4 hours
- Real time sampling frequency from 25 to 50 Hz on streaming - 250 Hz SD card
- Auto identification of foot size

- 214 resistive sensors on each insole
- Measurement scale: 0-100N/cm2
- Sensitivity: 0.1N/cm2
- 10 Bit resolution
- Thickness 0,3mm
- Material: polyester
- Very flexible, can be cut to size

Optoelectronic Systems

Podoscan 3D is a high definition laser device for acquiring the foot morphology in 3D and also showing a 2D image.
It has a precision of 1mm, allows the acquisition the foot image in neutral, semi weight bearing and weight bearing positions. It can also scan foam boxes, resin slipper socks or plaster molds.
Podoscan 2D is making a digital analysis of footprints and plantar loads. freeStep software allows to capture and store feet images and automatically create measures, comparing asymmetries and foot angles.
High-definition cameras to analyse posture and movements; video systems synchronized to our freeStep software allow a complete morphological study of the patients.

freeStep®

freeStep is an advanced software for the study of plantar pressures, motion analysis, posturography, biomechanics and humans-space relationship.
It can perform many types of biomechanical evaluation including static and dynamic plantar pressures, motion analysis, EMG, morphological video analysis, digital foot scanners, posturographic studies with auto generated reports.

- Static, dynamic and balance analysis
- 2D - 3D foot scanner acquisition
- EMG detecting
- Pressure motion treadmill analysis
- One touch print and comprehensive reports
- 2D videography for asymmetry's evaluation
- Biofeedback for rehabilitation and muscles strengthening
- Statistics
- Live updates

PRESSURES analysis

Pressure sensor devices directly measure:

1. Pressures
2. Surfaces
3. Times

Pressure sensor devices indirectly measure:

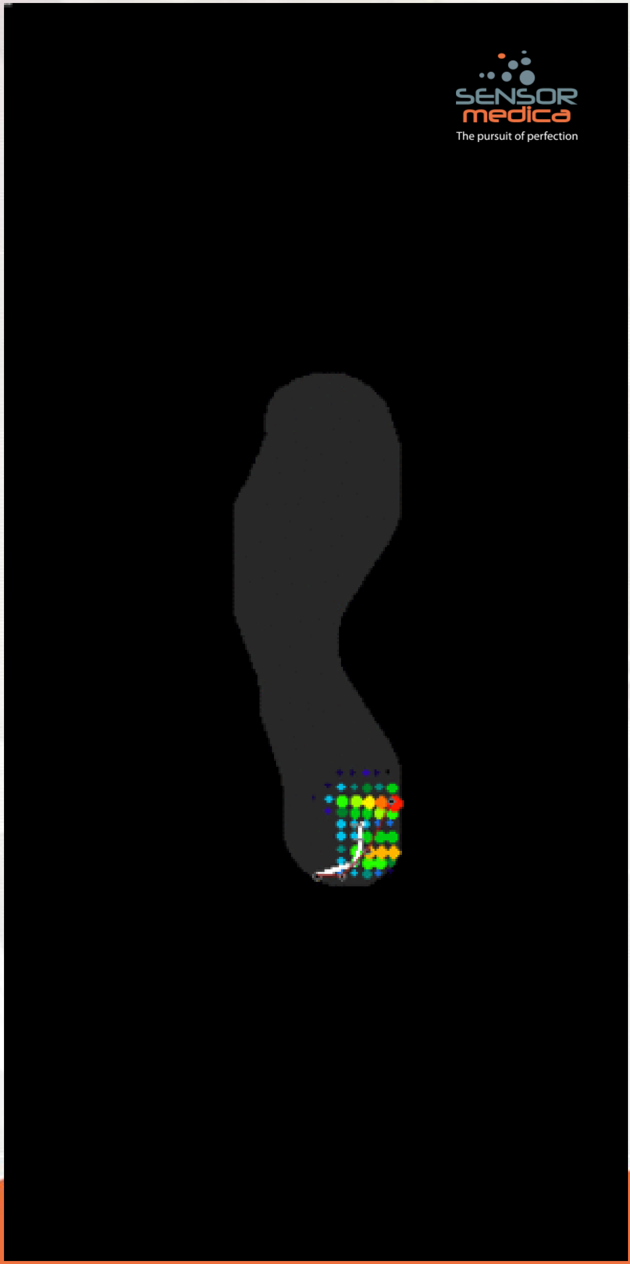
1. Ground reaction force
2. Speed
3. Angles

PRESSURE analysis

What foot plantar pressure is?

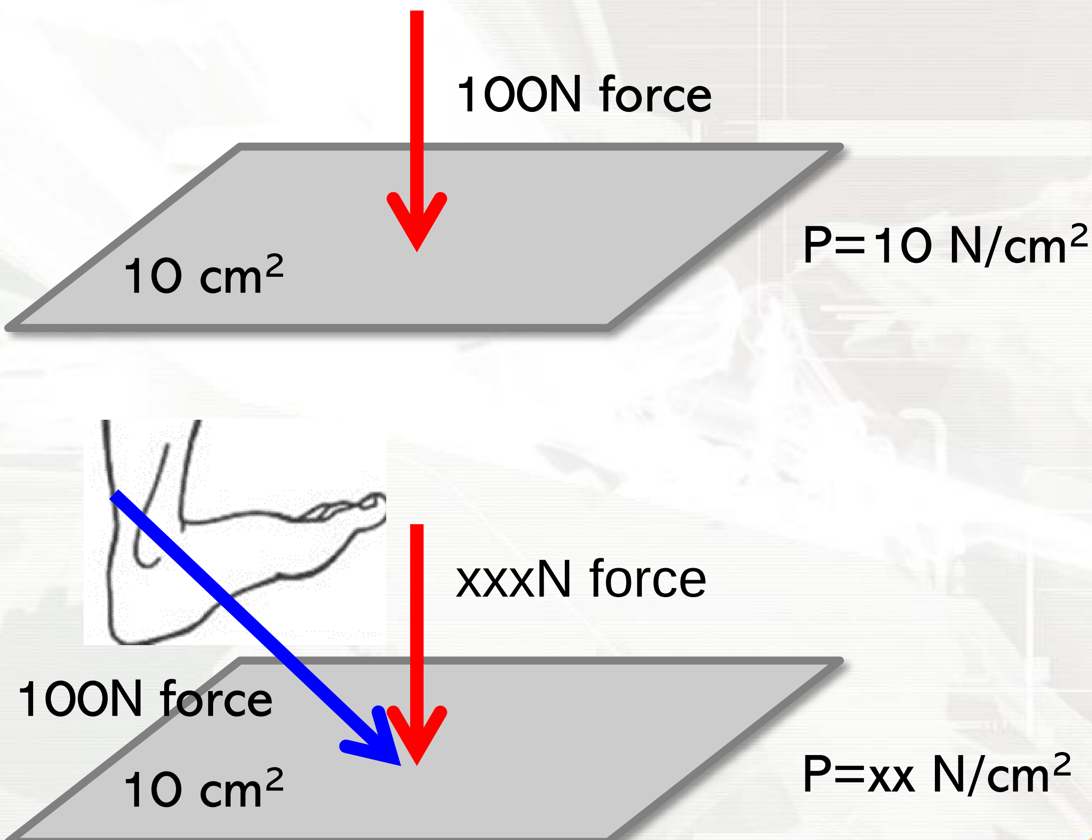
$$p = \frac{F_\perp}{S}$$

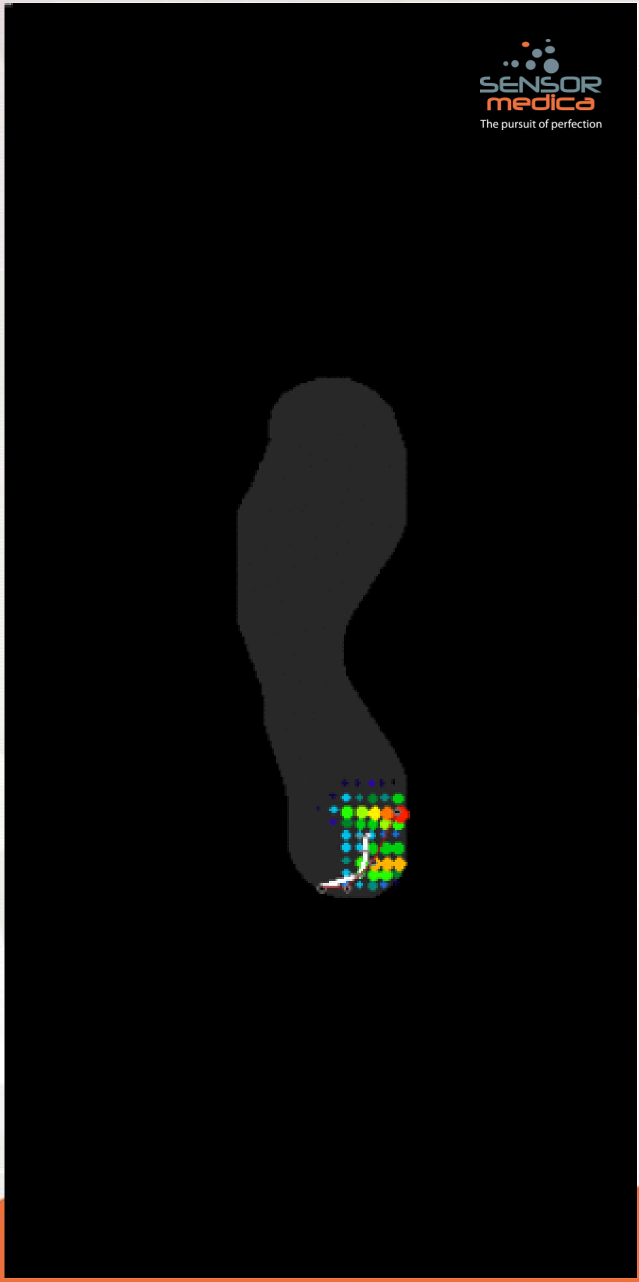
Pressure is an intensive physics measure that is defined as the ratio between the orthogonal force module on a specific surface and on its area.



PRESSURE analysis

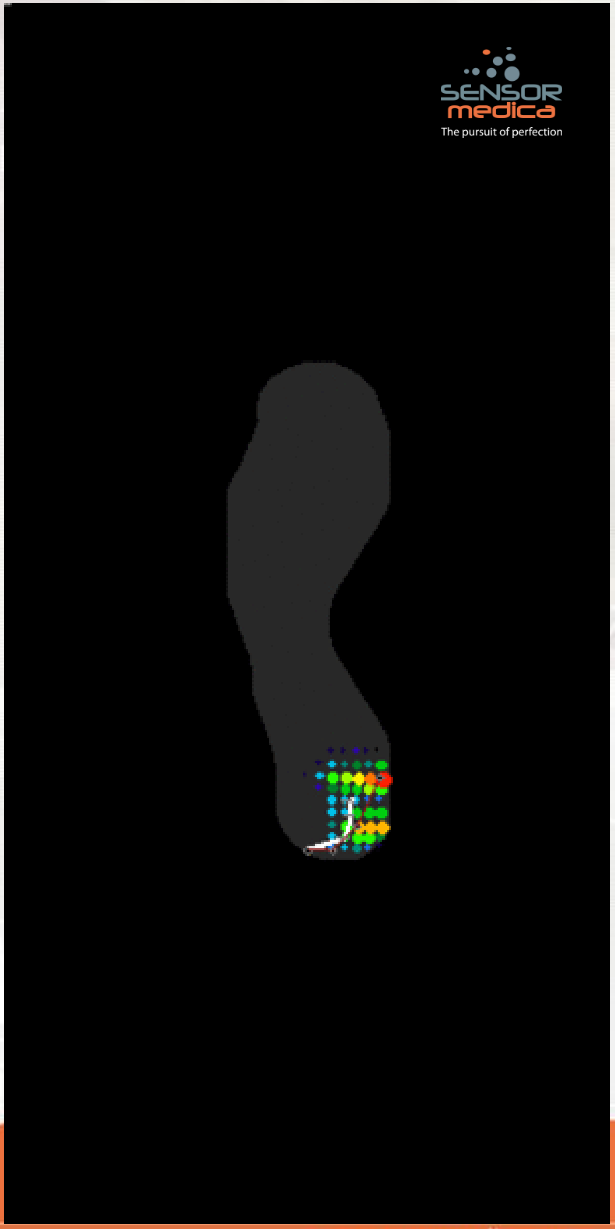
What foot plantar pressure is?





PRESSURE analysis

- The pressure is not directly connected with the weight of the patient
- The pressure indicates the zones that has got much more load on the tissue
- During gait the pressure (maximum) indicates the real zone where the foot goes through
- The pressure can drive the process of construction of insoles
- In an advanced point of view, the pressure can be also useful in studying posture and muscular chains function



PRESSURE SENSOR PLATFORMS

PROS	CONS
Natural walk	*Limited step number*
Self-selected speed	*Self-selected speed*
Barefoot / Shoes	*Acceleration / Deceleration*

PRESSURE SENSOR TREADMILL

PROS	CONS
High step number	*Unknown walk way*
Constant speed	*Constant speed*
Barefoot / Shoes	*Hight from the floor*
Running	*Carpet vs Sensors*
	Not a natural Walk

IN-SHOE SENSOR INSOLES

PROS	CONS
Freedom in movement	
Self-selected speed	*Self-selected speed*
Shoes	*Shoes*
Shoes vs Diabetic Patients	~~*Barefoot*~~
Feedback from corrective elements on orthotics	

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STATIC analysis on platforms

1. Invite the patient on the platform,
2. Start the acquisition,
3. Make sure that his feet are aligned on same horizontal axis,
4. Position his feet in comfort position and start acquisition.
5. For balance control, repeat the static acquisition with the feet open on 30 degrees and the hills divided by 1 inch.

It offers information about the effects on foot loading of postural alignment.

STATIC analysis on platforms

- Loads and global footprints
- Maximum load pressure points
- CoP and CoF alignment
- Latero-lateral and anterior-posterior balance
- Rear-forefoot relations
- Geometric analysis
- Surface distribution

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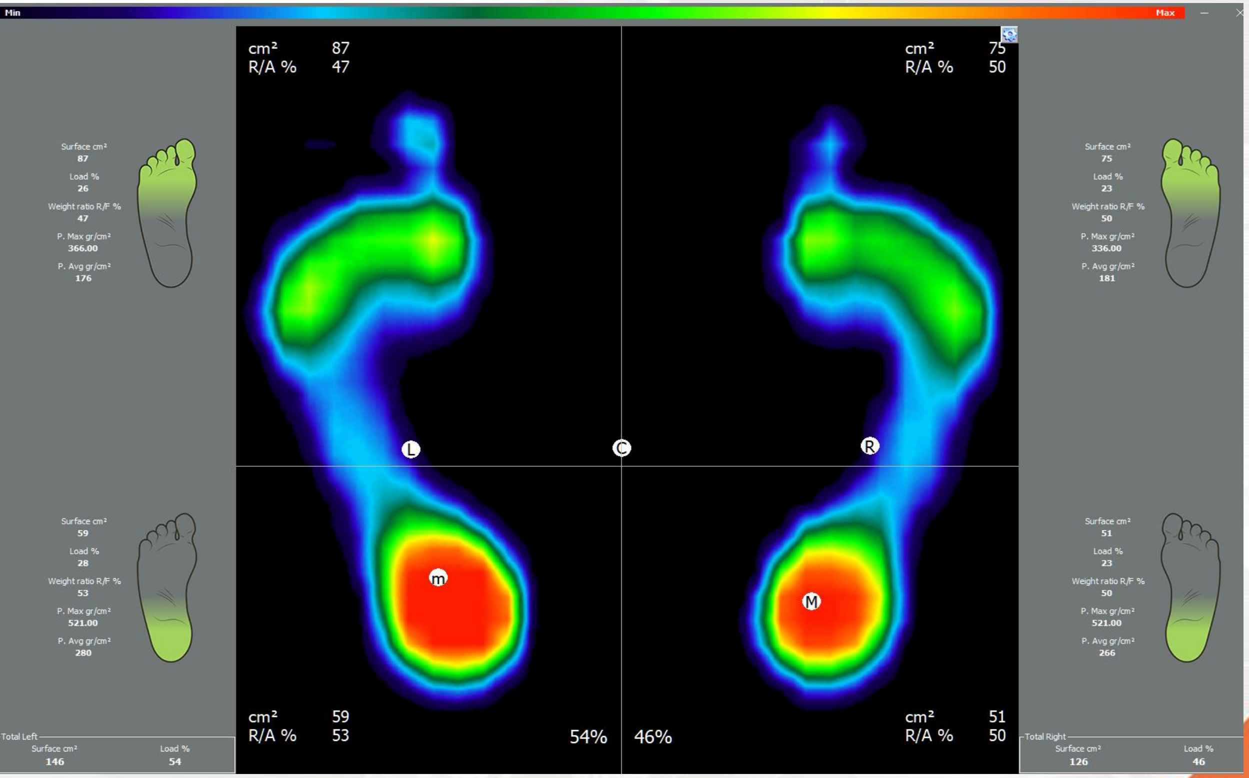
STATIC analysis on platforms
Morphological and numerical evaluation



Focus on:

- Isthmus presence
- Load points
- Adduction foot
- Width between the points
- Load on the heel and midfoot
- Aligning pressure centers
- balancing
- Rearfoot-forefoot relation

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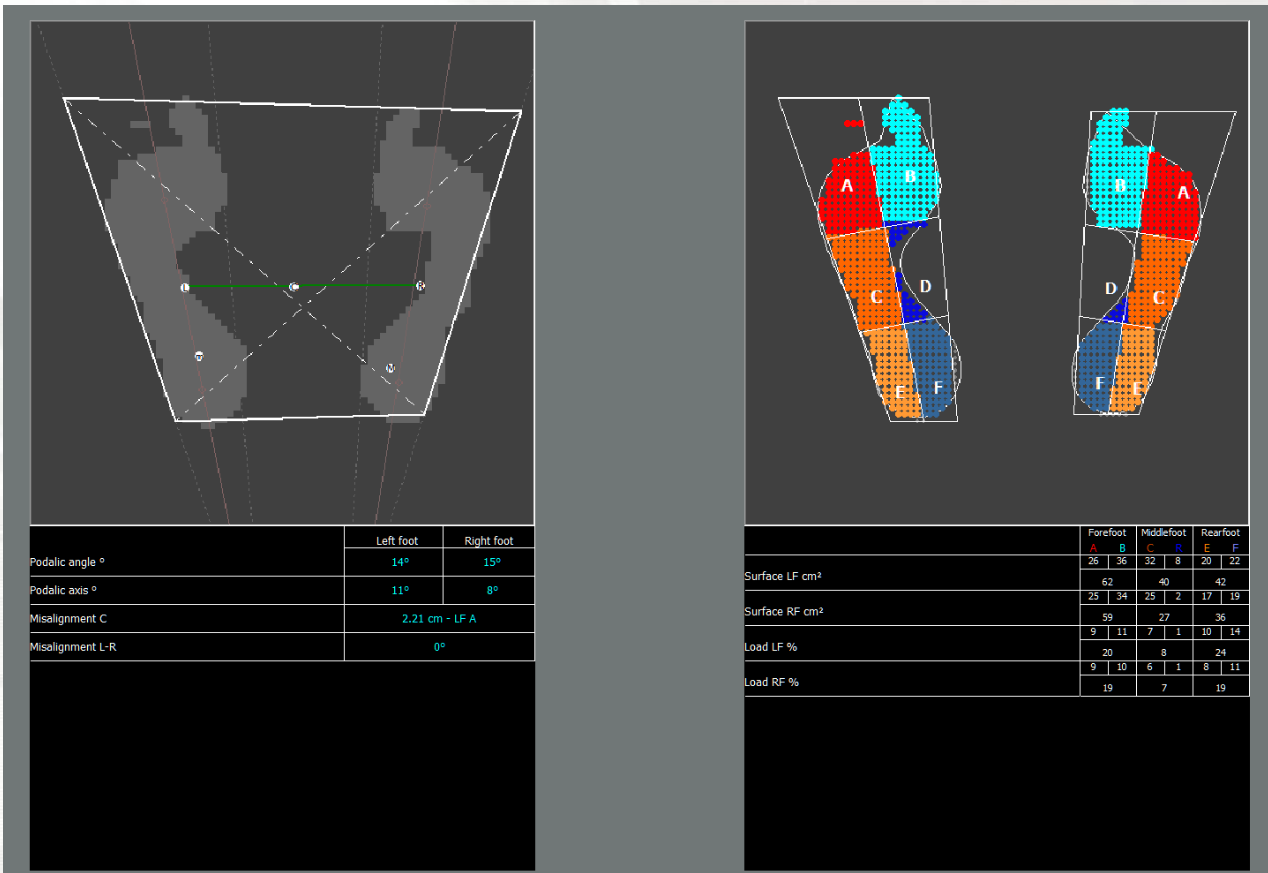
Geometric evaluation of polygon, analysis of pressure centers and loading areas



	Left foot	Right foot
Podalic angle °	14°	15°
Podalic axis °	11°	8°
Misalignment C	2.21 cm - LF A	
Misalignment L-R	0°	

	Forefoot		Middlefoot		Rearfoot	
	A	B	C	R	E	F
Surface LF cm²	26	36	32	8	20	22
	62		40		42	
Surface RF cm²	25	34	25	2	17	19
	59		27		36	
Load LF %	9	11	7	1	10	14
	20		8		24	
Load RF %	9	10	6	1	8	11
	19		7		19	

Pay attention to:

- CoP feet axis
- rotation of the centers of pressure
- areas with high or low pressure and areas with high or low loads

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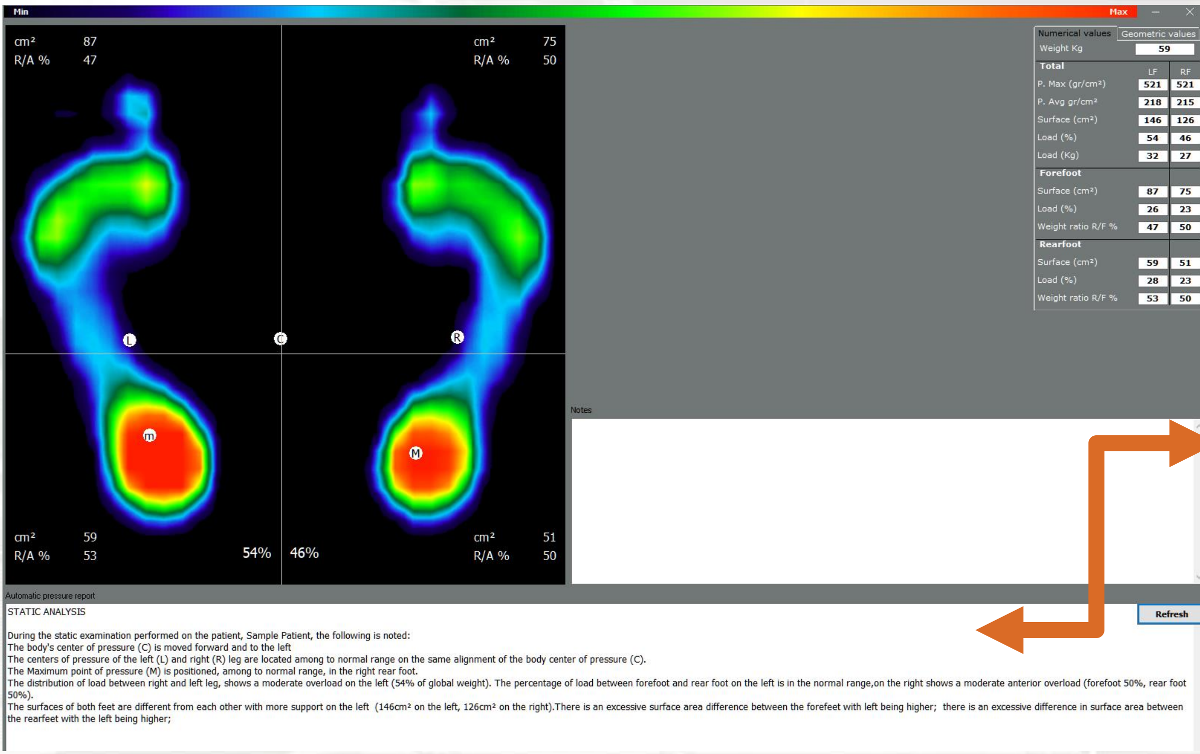
Automatic Analysis Report



Static analysis performed on the patient shows the following:

center of gravity C is located in front with respect to the polygons total support.

Centers of pressure of the legs are disaligned. Respect to the body center of gravity, the left one is in the back, the right is good.

Point of maximum pressure M is located, according to the rule in the rear right area.

Load distribution between left and right leg is in the standard value (50% of the weight to the left, 50% right).

Load distribution between forefoot and rear foot, both right and left, is in the physiological values.

The surfaces of the two feet are quite similar to each other (110cm2 to the left, 104cm2 to the right).

Between the two rearfoot is detectable a slight difference of surface, more in the right.

Between the two forefoot is detectable an excessive difference of surface, more in the left.

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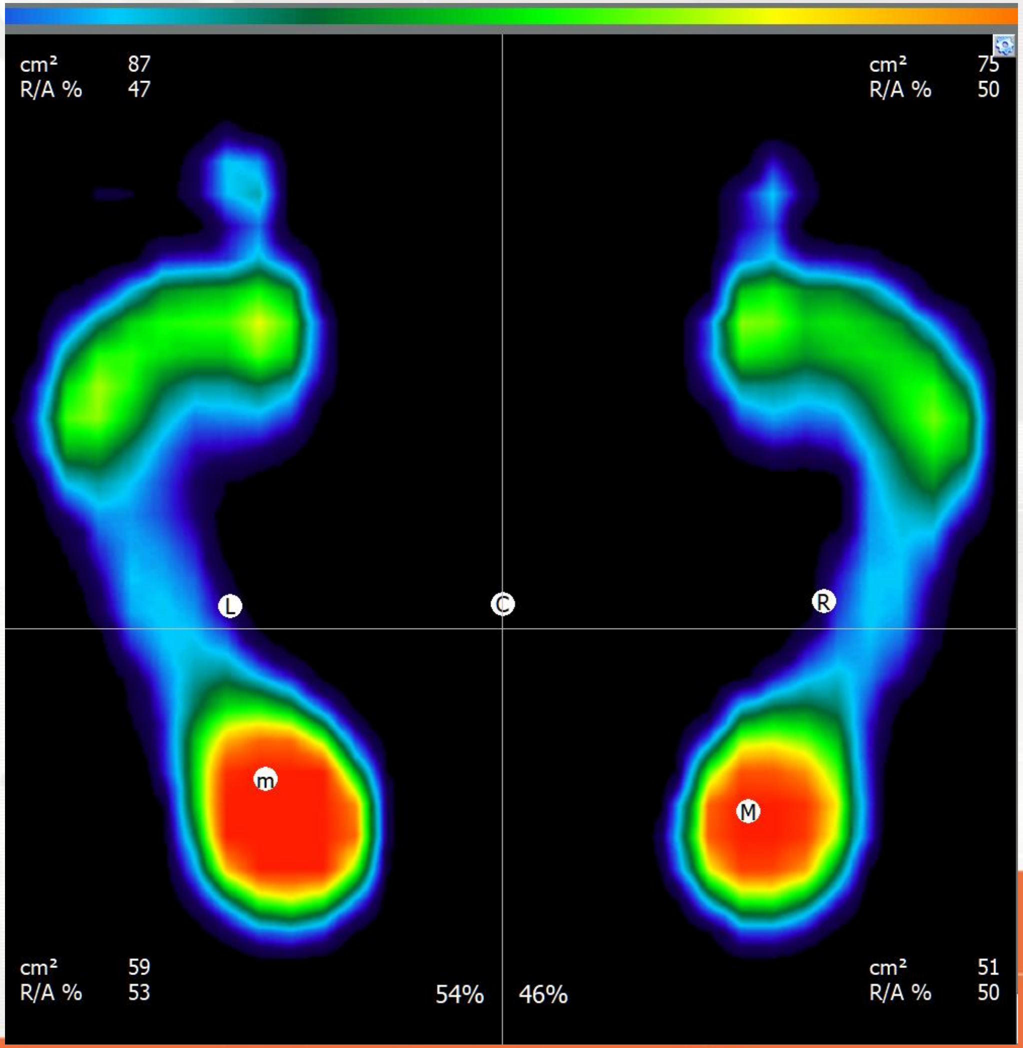
Comparison with normal values

STATIC analysis

Ideal condition



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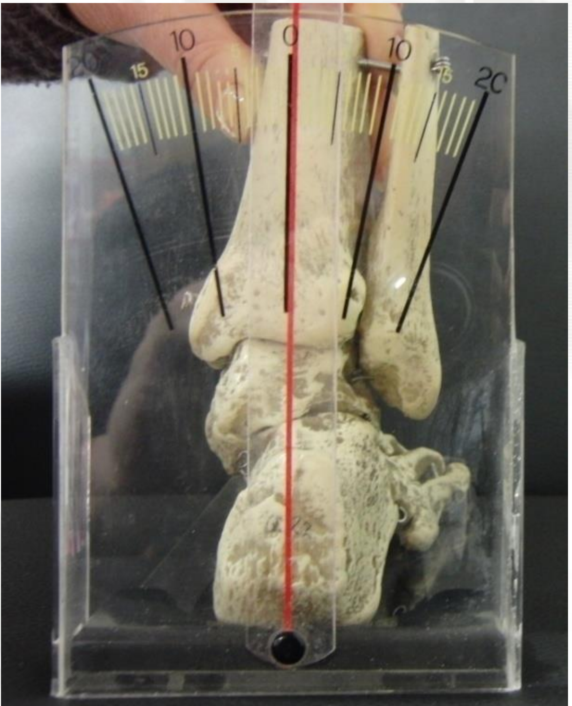
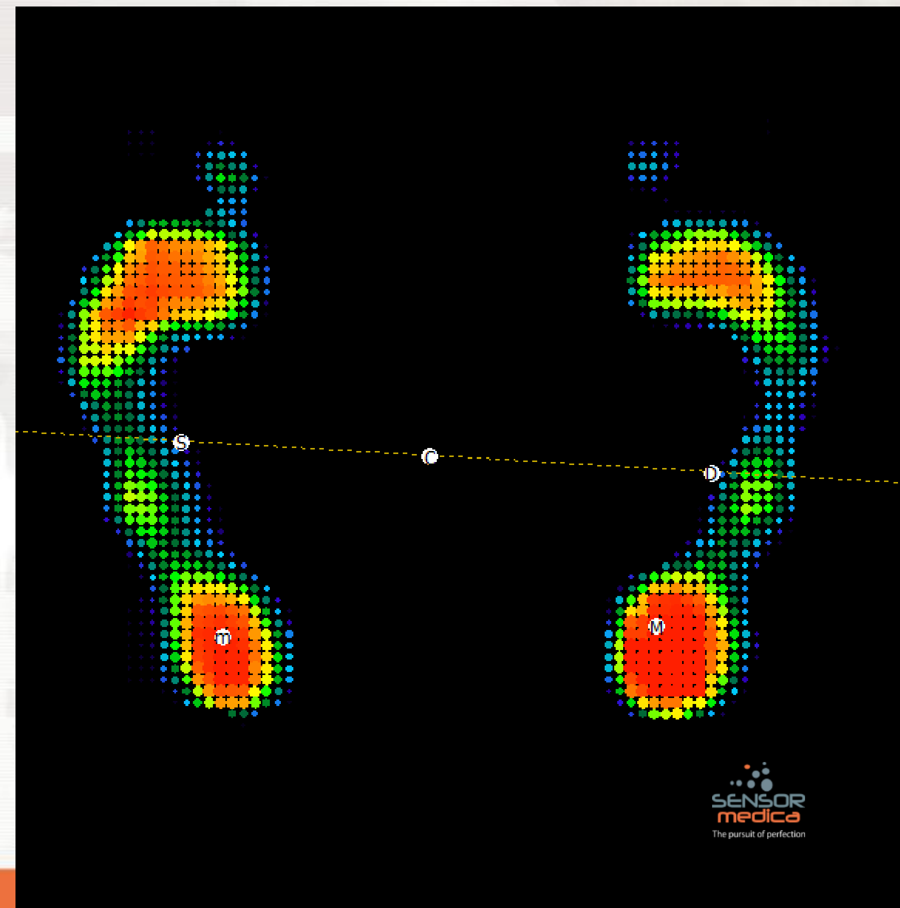
STATIC analysis

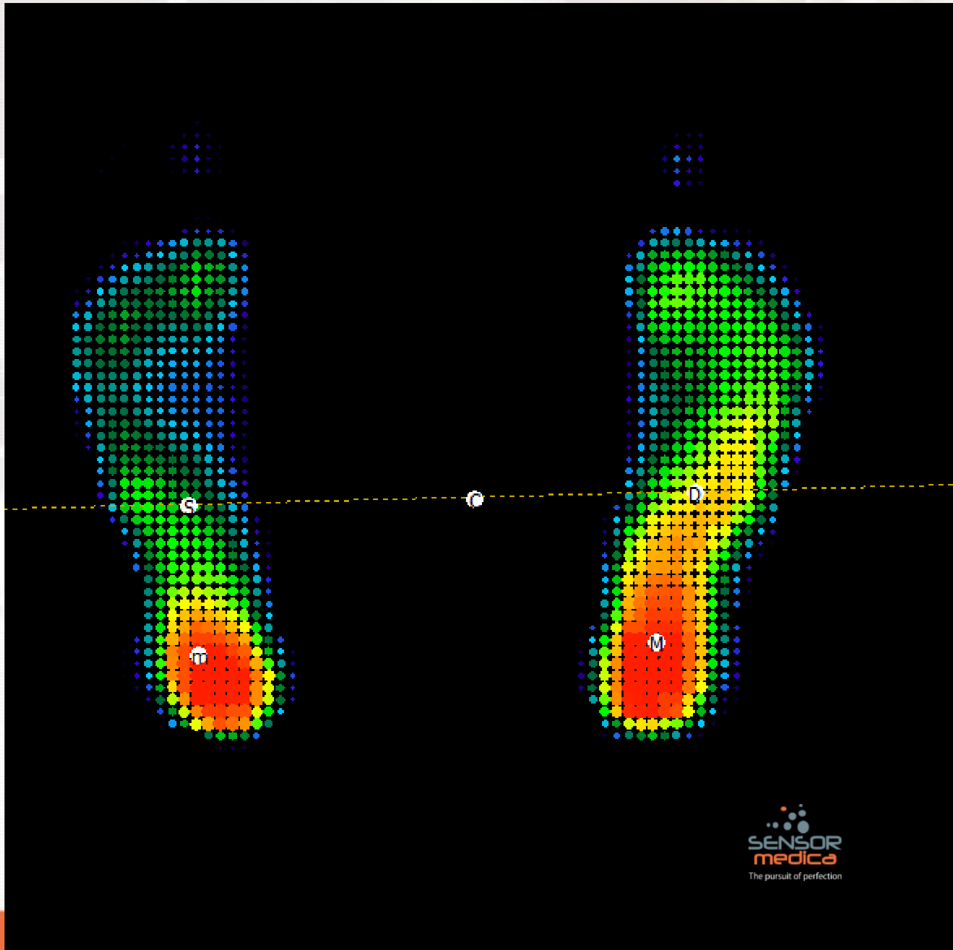
Calcaneus varus and foot supination





STATIC analysis

Calcaneus valgus and foot pronation



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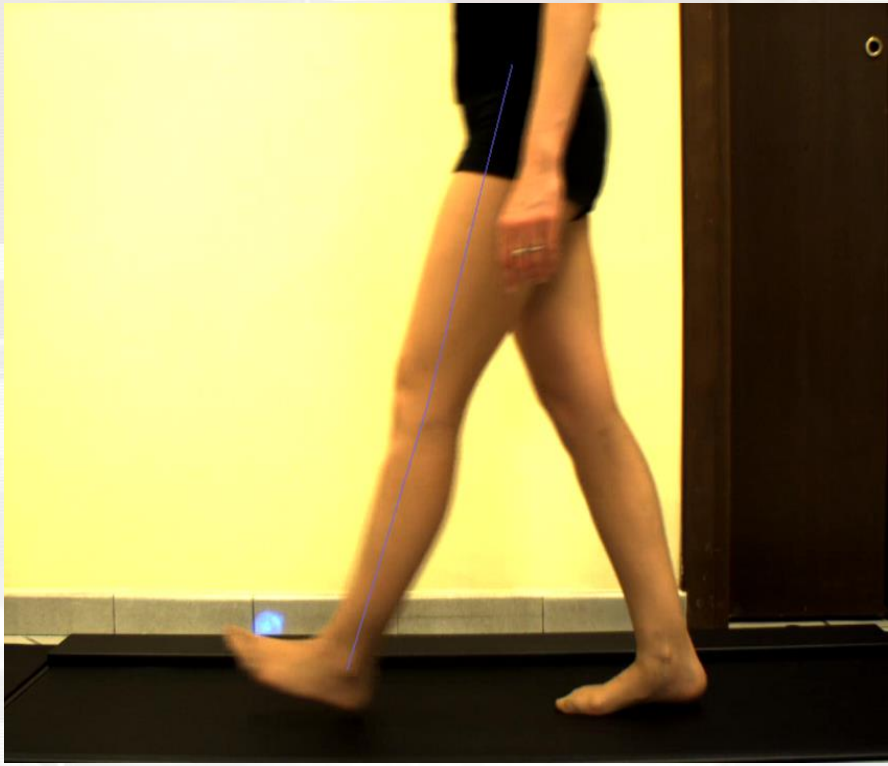
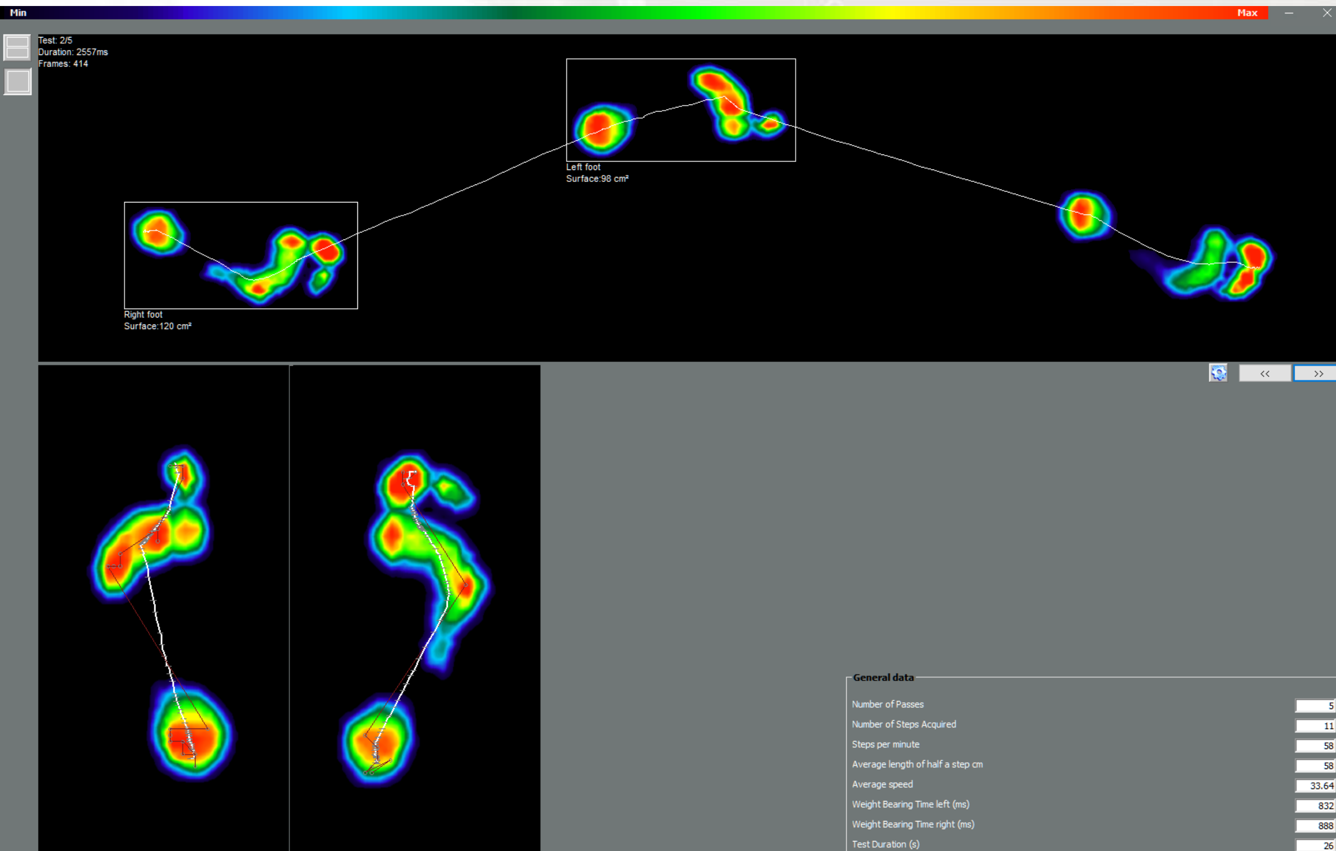
DYNAMIC analysis on platforms

1. Start acquiring patient data.
2. Ask the patient to walk without shoes on the platform. Make him walk at least 2-3 times, to get used to the contact with the platform.
3. Start the motion acquisition for capturing at least 8-10 footsteps.
4. You can repeat the acquisition with shoes and with shoes and custom insoles.



It offers information about the function of the muscular chains on foot loading during a dynamic movement

Biomechanical analysis, Gait line, Max line



Pay attention to:

Shape of the feet.
Areas of higher load.
Abduction of feet.
Width between the footsteps.
Movement of the CoF (white line).
Variability in footprints.

Global assessment

Pay attention to:

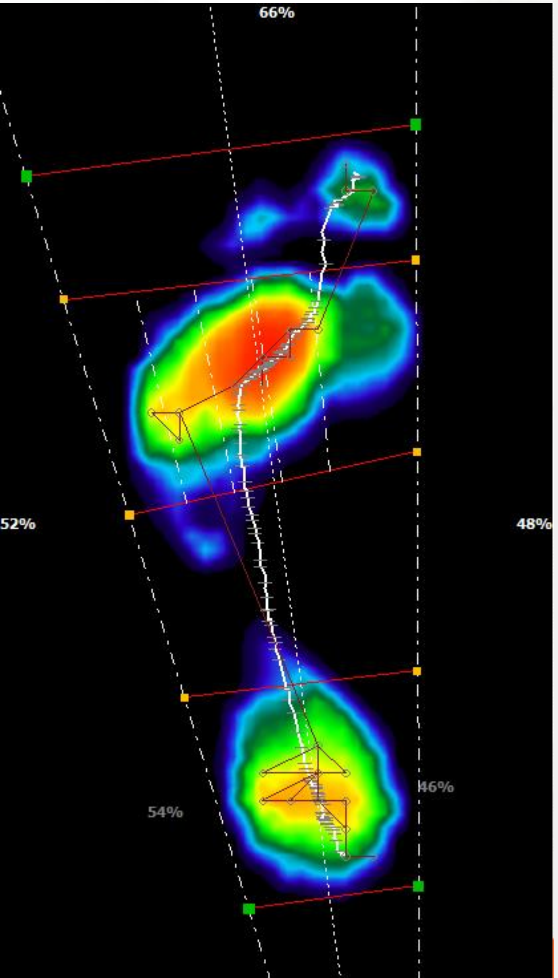
1. Shape of the feet
2. Movement of the CoF line (white line)
3. Areas of changing of direction
4. Movement of the red line (maximum pressure points)
5. Pressure between the 1st and 2nd toe
6. Pressure distribution between right and left

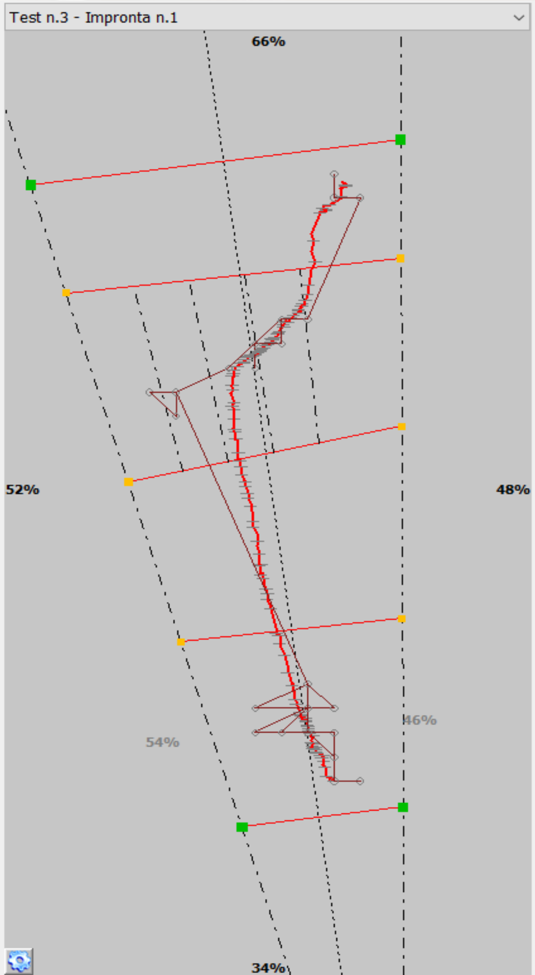
Progression of CoF (Gait Line)

The center of gravity projected on the ground (center of pressure) is considered ideal if the support follow this trend:

a) starting centrally on the heel
b) moving forward in the direction of V
c) then goes on IV
d) continues on III
e) then on II
f) ends on the big toe

Curves, graphs, geometric analysis, medial-lateral load distribution





Pay attention to:

1. Foot shape
2. CoF length (Gait line)
3. CoF progression should not medialize
4. Index of flex-extension

Global CoF index	91%	80-99
Start CoF index	5%	
End CoF index	4%	
Angolo podalico	7	9-15

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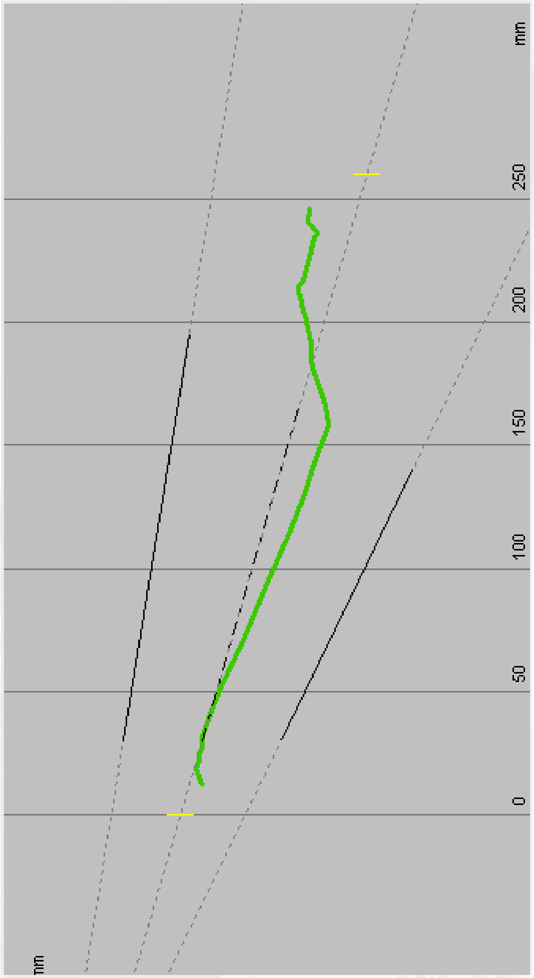
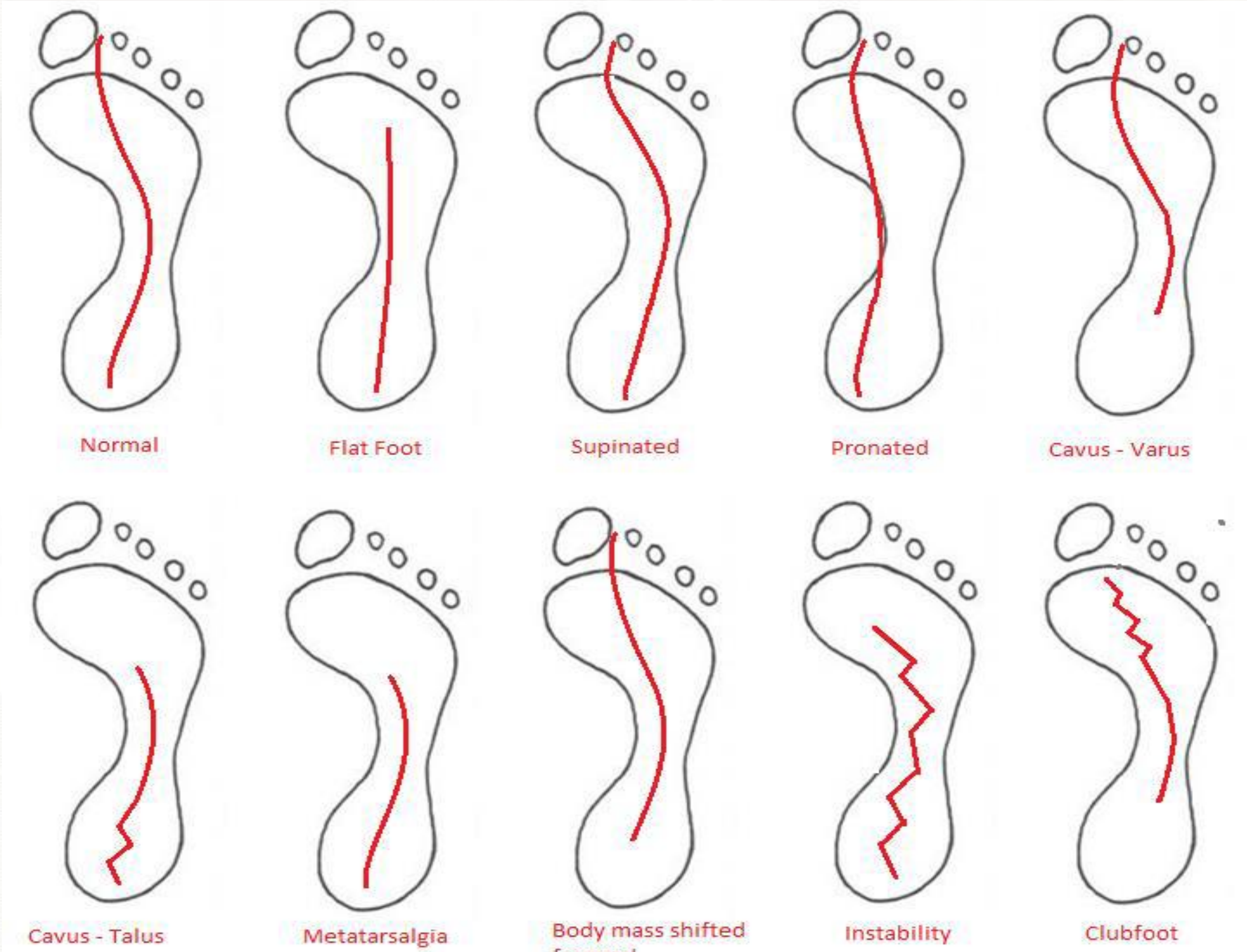
CoF progression





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Gait cycle

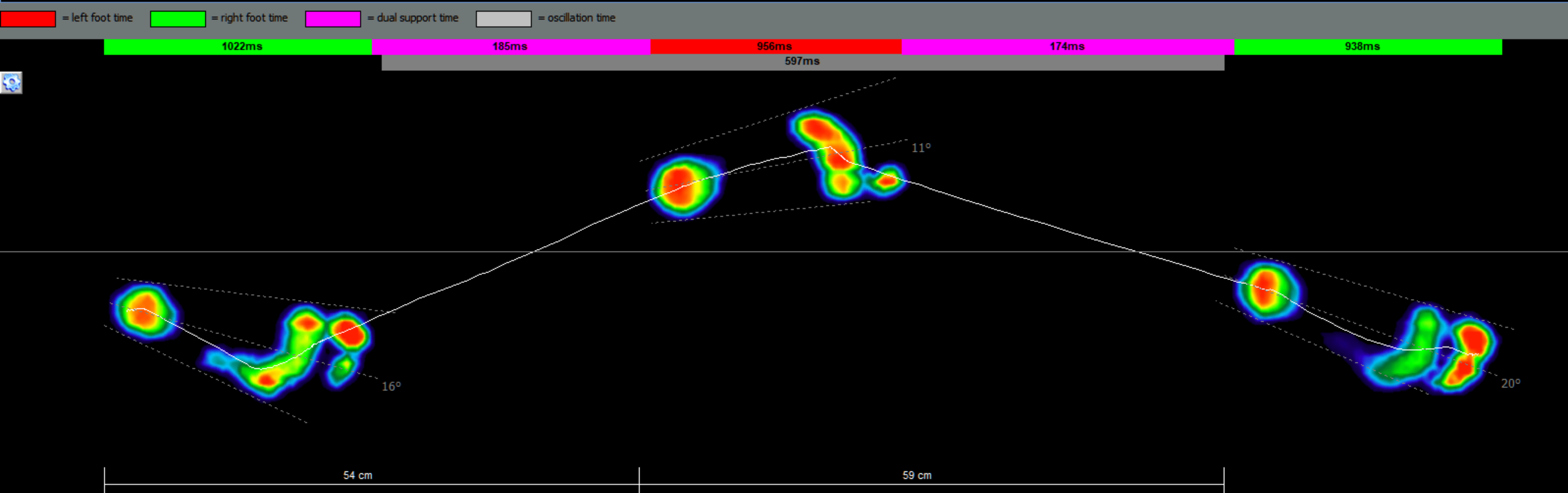
Pay attention to:

1. time of double support
2. time of oscillation

Min — Max

Gait Line | **Gait Cycle** | Frameset | Average Footprint

	Initial Contact (2%)		Loading Response (10%)		Mid Stance (30%)		Terminal Stance (50%)	
Left foot	Frames	0-5	Frames	5-26	Frames	26-77	Frames	77-128
	Duration ms	29	Duration ms	120	Duration ms	313	Duration ms	326
	Avg. speed mm/s	245	Avg. speed mm/s	145	Avg. speed mm/s	981	Avg. speed mm/s	220
	Max surf. cm²	14	Max surf. cm²	34	Max surf. cm²	65	Max surf. cm²	66
	Max load %	10	Max load %	46	Max load %	70	Max load %	100
Right foot	Frames	0-6	Frames	6-30	Frames	30-90	Frames	90-149
	Duration ms	32	Duration ms	133	Duration ms	338	Duration ms	346
	Avg. speed mm/s	170	Avg. speed mm/s	148	Avg. speed mm/s	1063	Avg. speed mm/s	202
	Max surf. cm²	10	Max surf. cm²	28	Max surf. cm²	66	Max surf. cm²	76
	Max load %	6	Max load %	30	Max load %	60	Max load %	100



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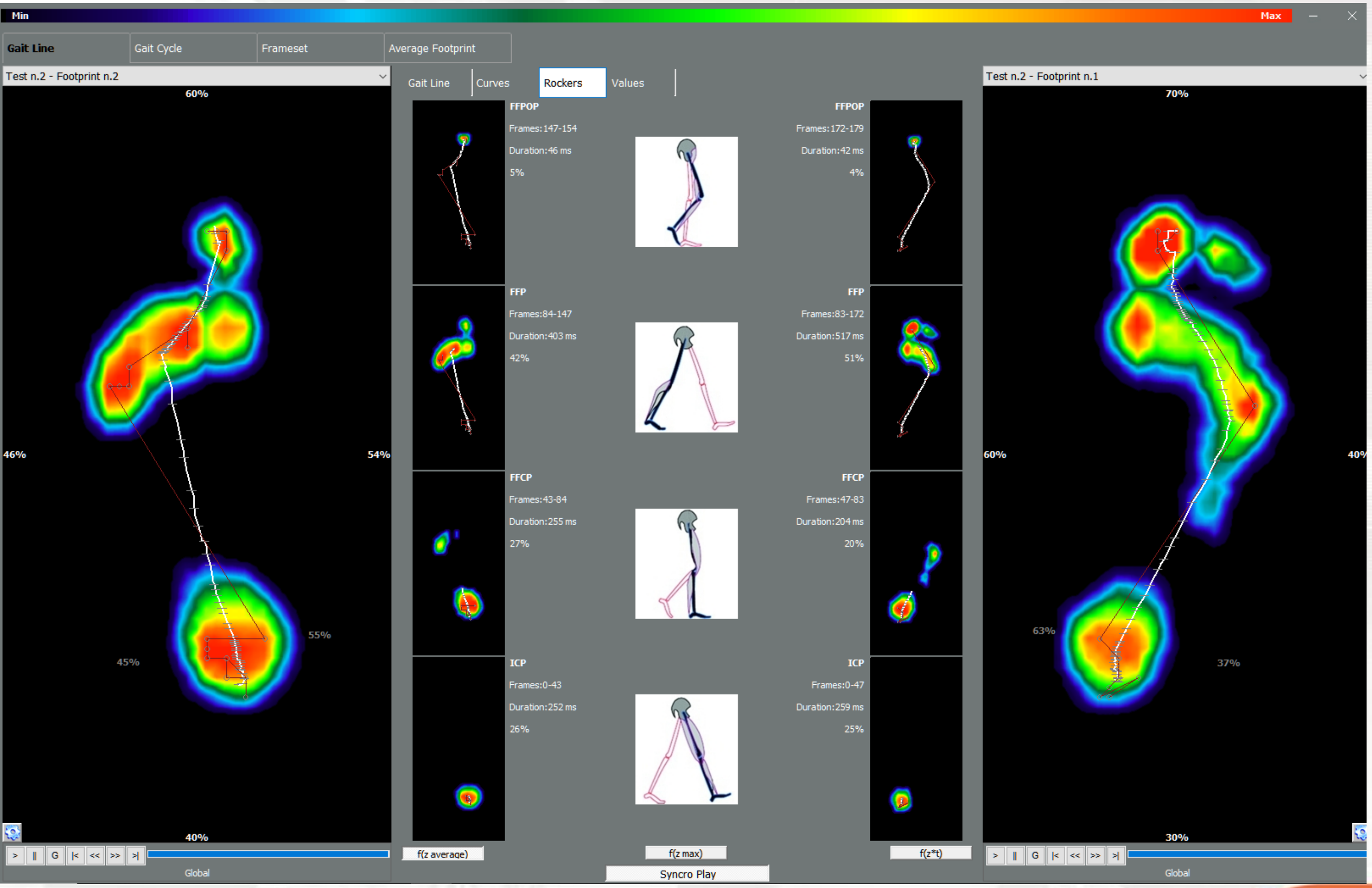
Global

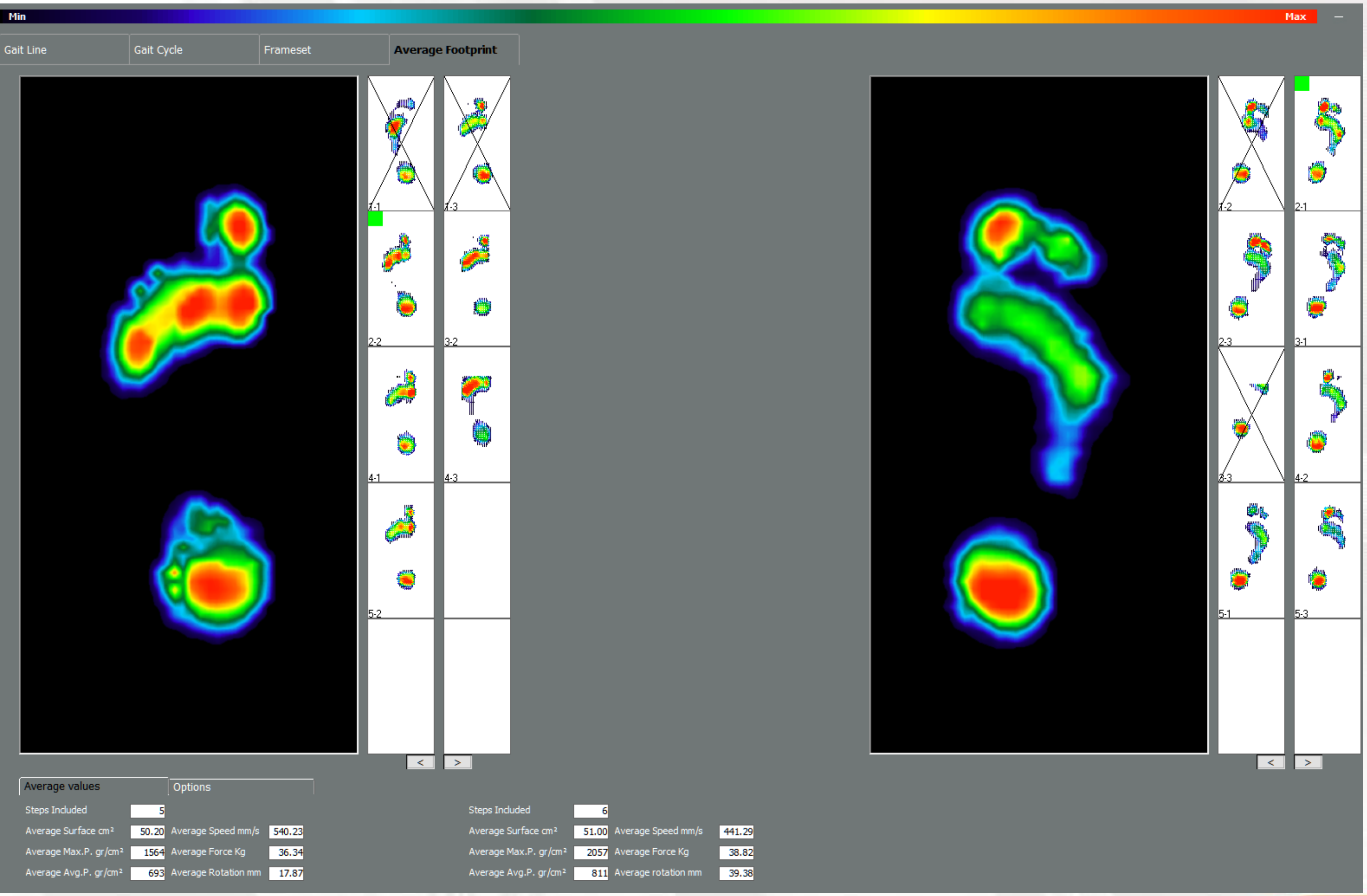
Rockers



Analysis of the step rockers allows a detailed study of the four main steps of pressure distribution:

- Heel rocker
- Ankle rocker
- Forefoot rocker
- Big toe rocker

Avarage footprints

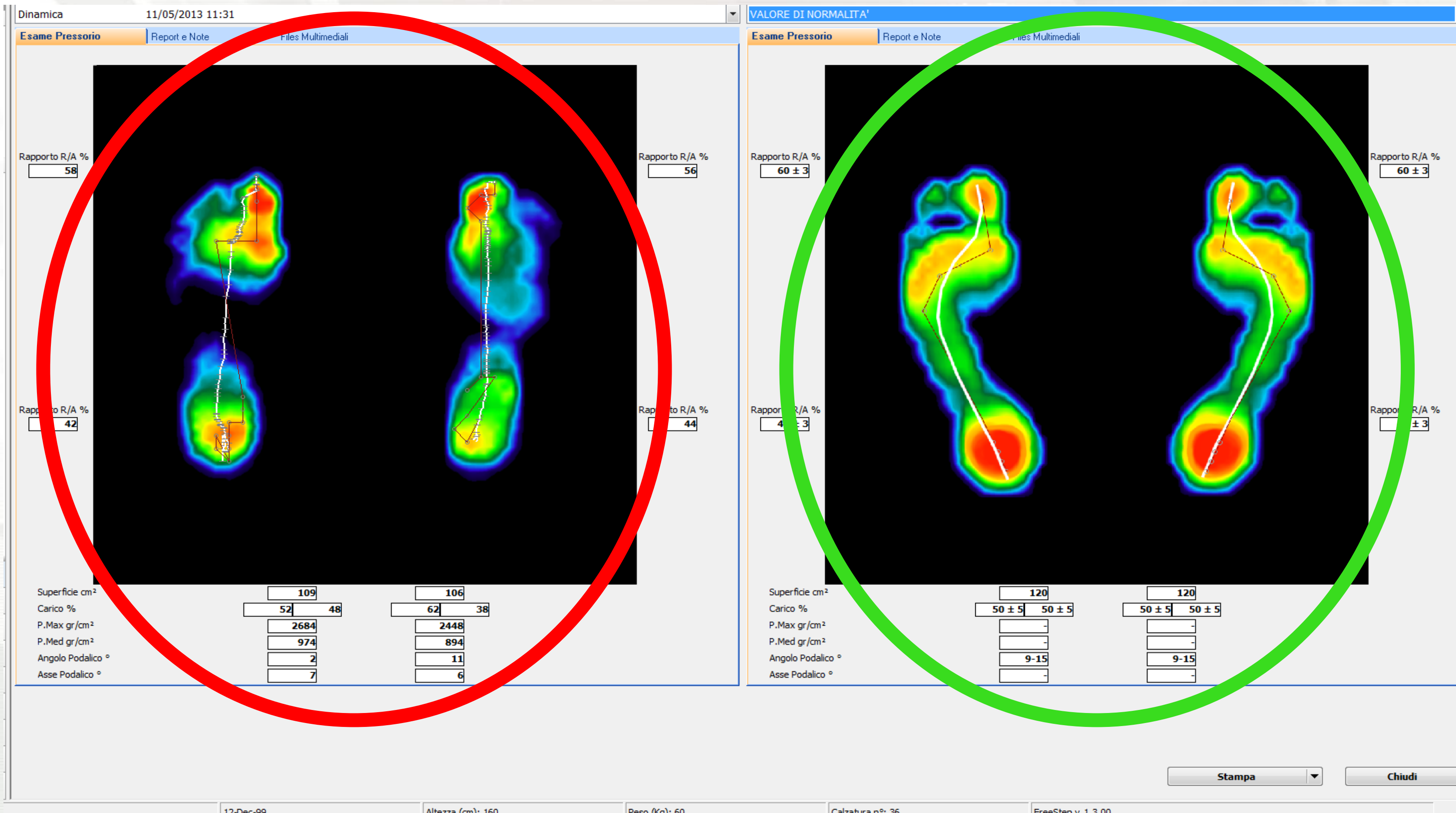


The average is a mathematic overlap of all the footprints. Are not the reality of the walking, but they offer a good point of view on the variability of the steps.

Pay attention to:
- Contours to the heel
- Contours of metatarsal area
- Contours of toes

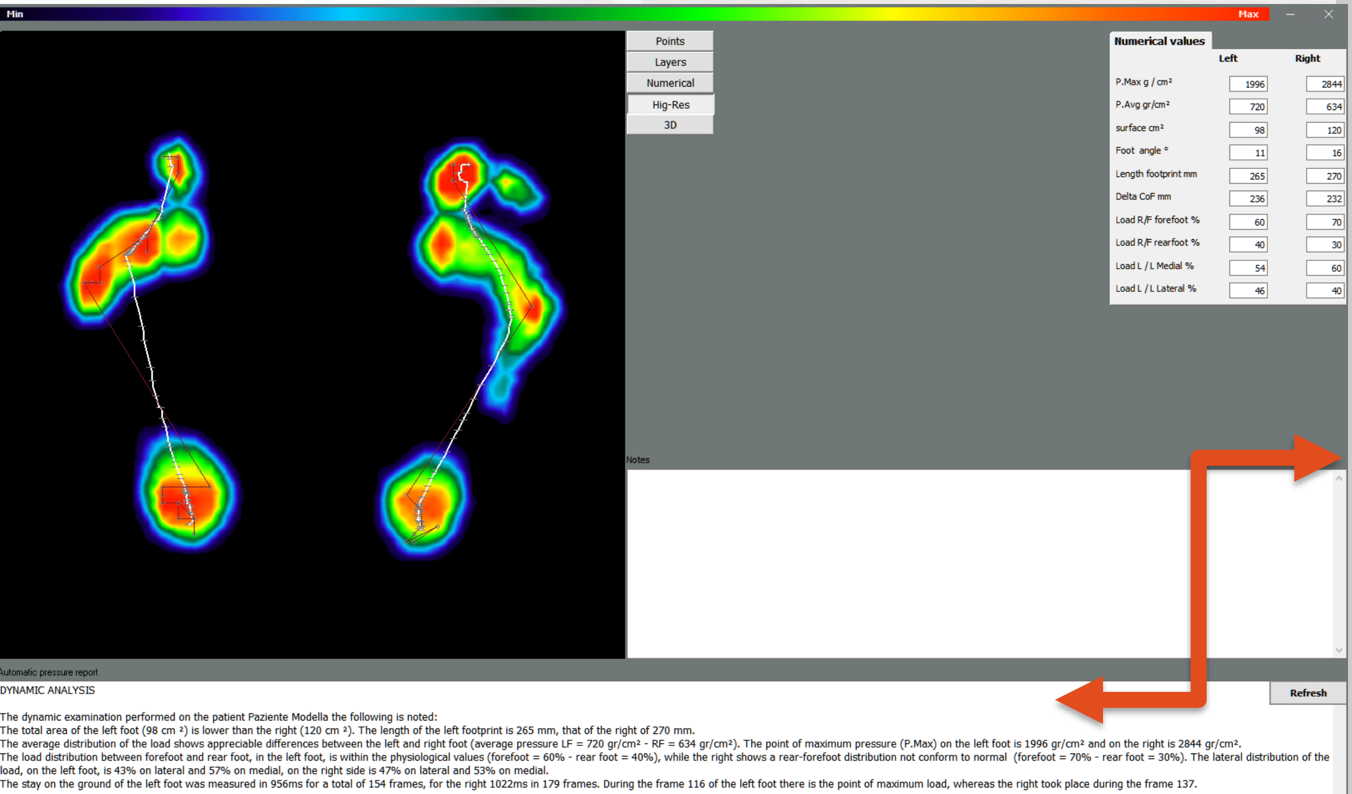
Dynamic Analysis on platform

Comparison with normal values



Dynamic Analysis on platform

Automatic Analysis Report

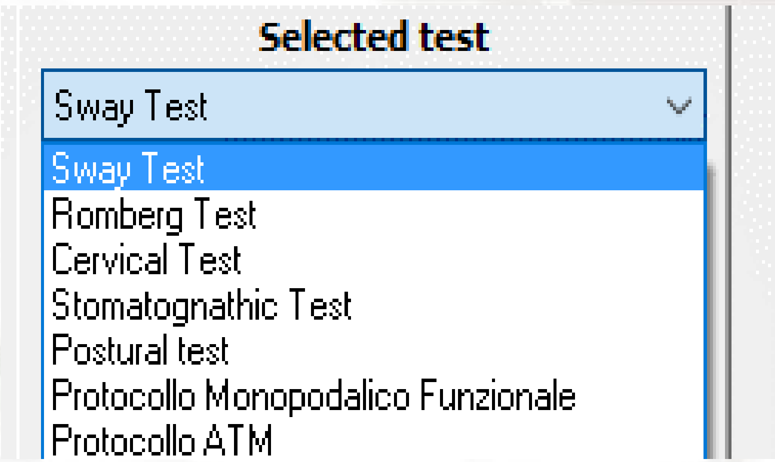


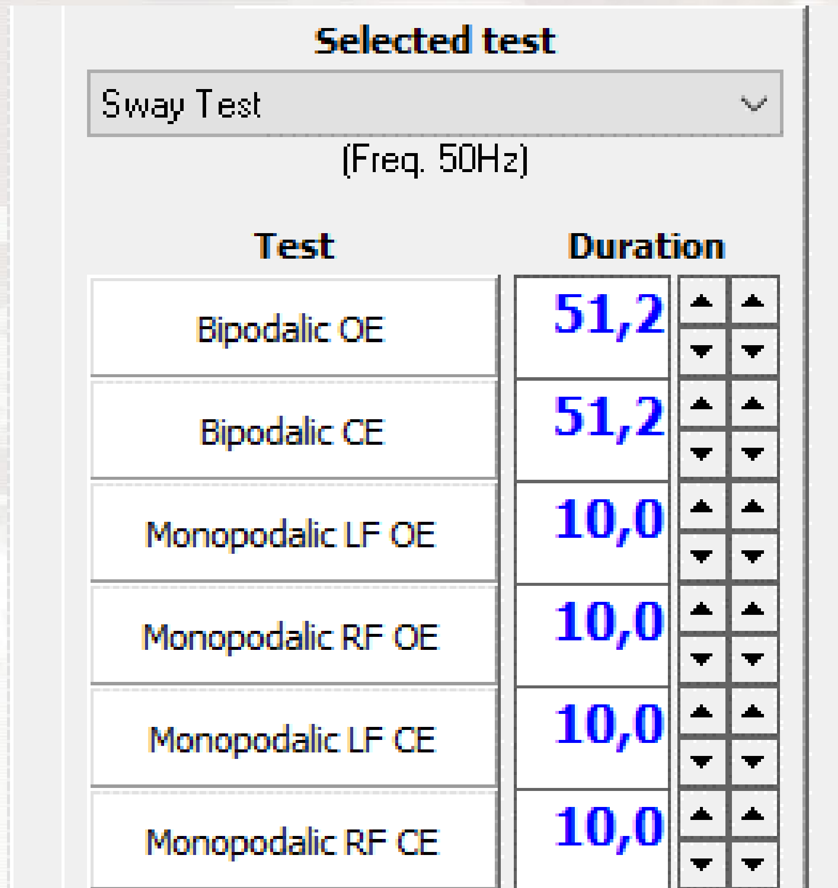
Pressure detection during dynamic shows the following:
feet surfaces are similar to each other (SX = 109 cm2 - DX = 106 cm2).
Length of the left foot is 230 mm, right is 221 mm.
Load average distribution shows differences between the left foot and the right (Left = 974 g/cm2 - Right = 894 g/cm2).
Load point (P Max) in the left foot is 2684 g/cm2 and in the right is 2448 g/cm2.
Left load distribution between forefoot and rearfoot is in the physiological values (forefoot = 57% - rearfoot = 43%), while the right shows a nonconformity distribution with the standard values (forefoot = 55% - rearfoot = 45%).
Latero-lateral load distribution for the left foot is 52% in lateral and 48% in medial, for right foot is 38% in lateral and 62% in medial.
Speed of the left foot is 723ms for a total of 153 frames, right is 664ms in 155 frames.
Step 104 of left foot registers the maximum load, while step 45 of the right foot.

BALANCE analysis on platform

1. Place the patient on the platform
2. Put patient data inside the software
3. Make sure that the feet are aligned on the horizontal axis
4. Open the patient feet of 30 degrees and separated the heels of 2 cm.
5. Select the acquisition protocol and begin the analysis

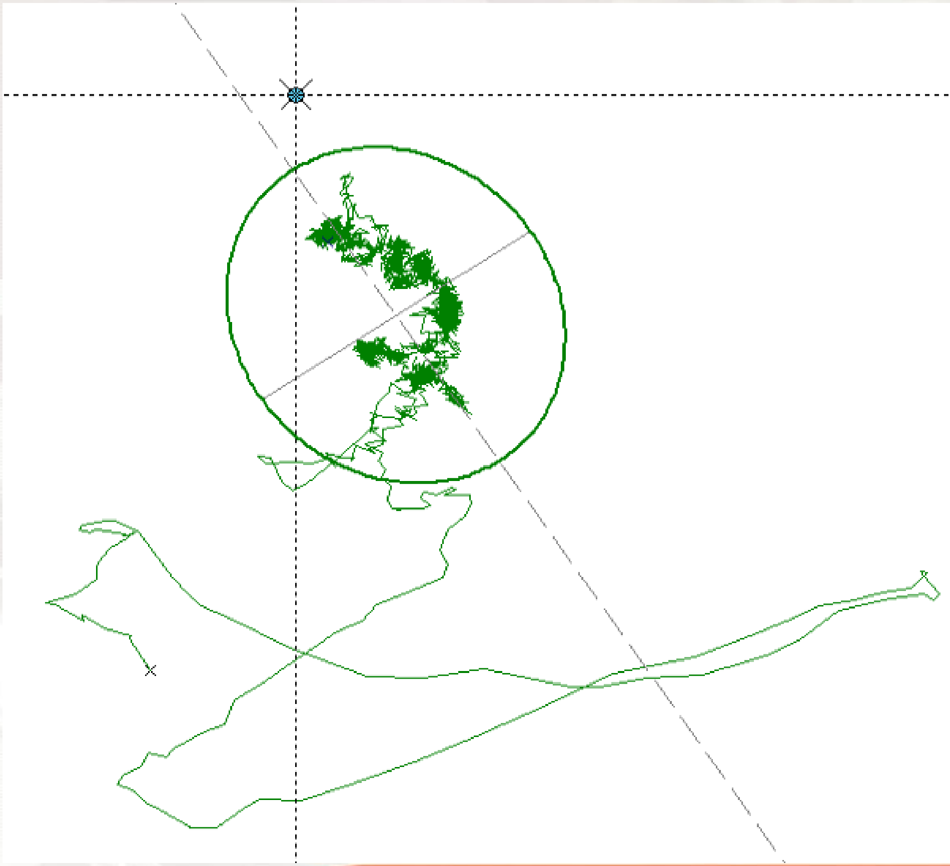
Protocols of Posturographic analysis



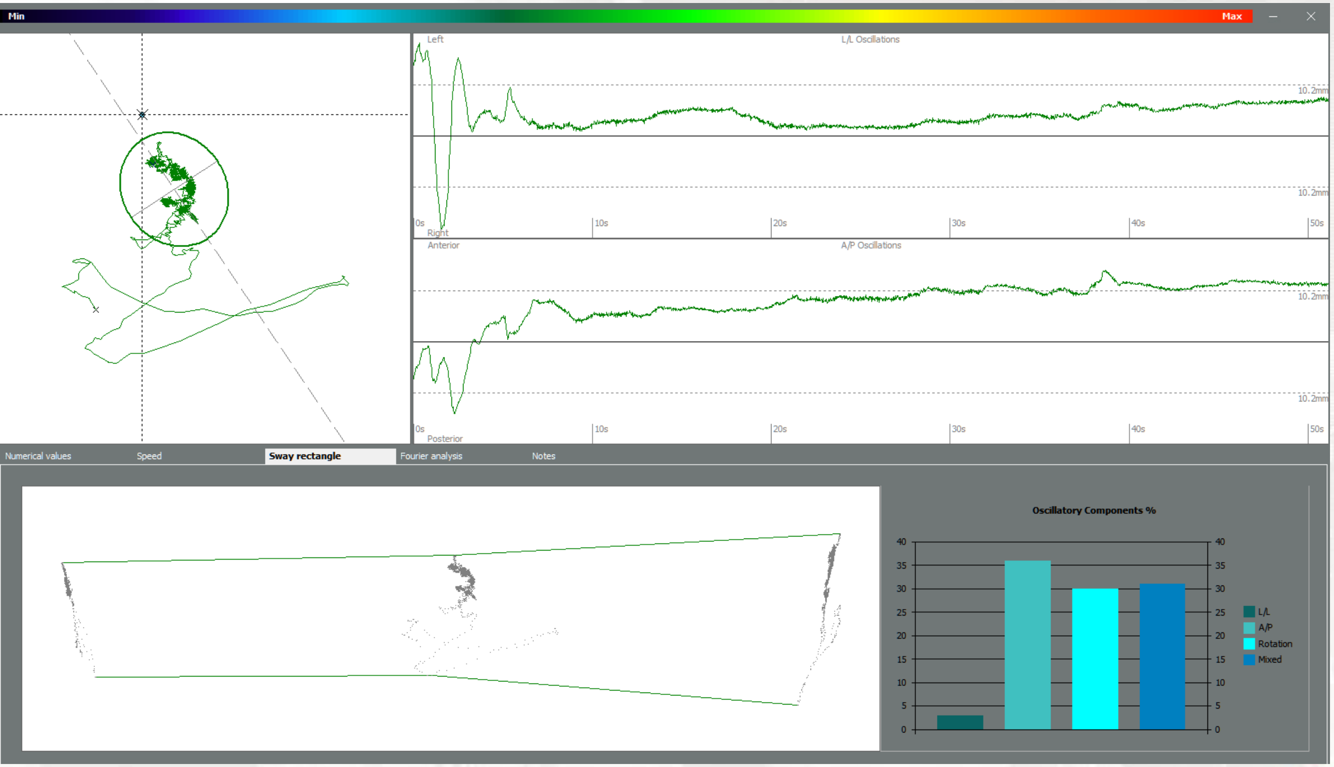


Stability test: measure COP movements

The COP trace is shown in 2D (left-right on X-axis, back-forward on Y axis) for explaining the patient instability during the test.
The ellipse automatically include the 90% of the total trace.
Ellipse surface gives information on the efficiency and the balancing of the tonic-postural system.



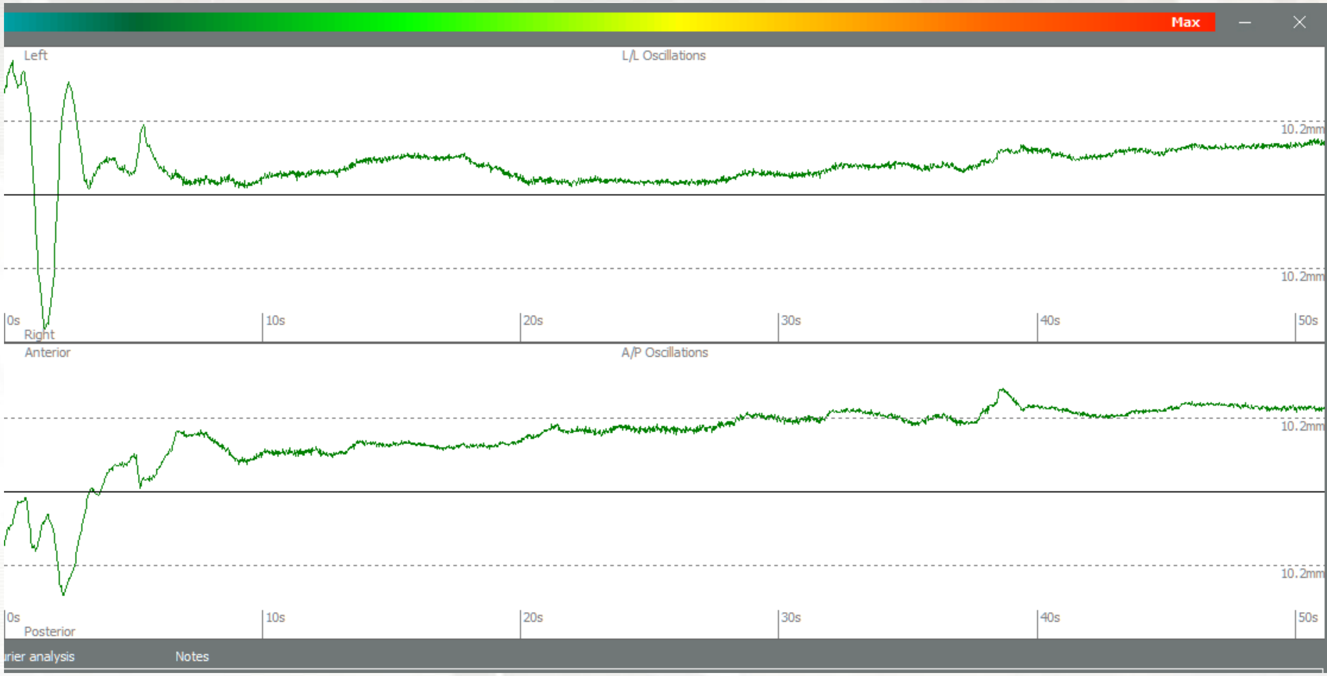
Stability test: measure COP movements central, left and right



The COP tracking, in foot pressure platforms, is the result of right lateral and left lateral center of gravity swing.
With this evaluation, we can study not only the global postural attitude but also the dynamic behaving of the two legs.

STABILITY test

Stabilometric analysis measures the COP path in function of the time on X-Y coordinates.
Latero-lateral and anterior-posterior movements.
All measurements are mathematical calculations and geometric derivatives



RunTime

Pressure Sensor Treadmill

Acquisition techniques and main indications

Dynamic analysis on **RunTime** treadmill

1. Place the patient on the treadmill
2. Put the patient data in the software
3. Start slowly the treadmill
4. Increase the speed until you reach the desired speed
5. Let the patient run or walk for at least 2 minutes
6. Start the acquisition, normally for minimum 30 sec

Total Test duration s	10,92		
Number of analyzed footprints	15		
Average speed Km / h	2,16		
Cadence Steps per min	82		

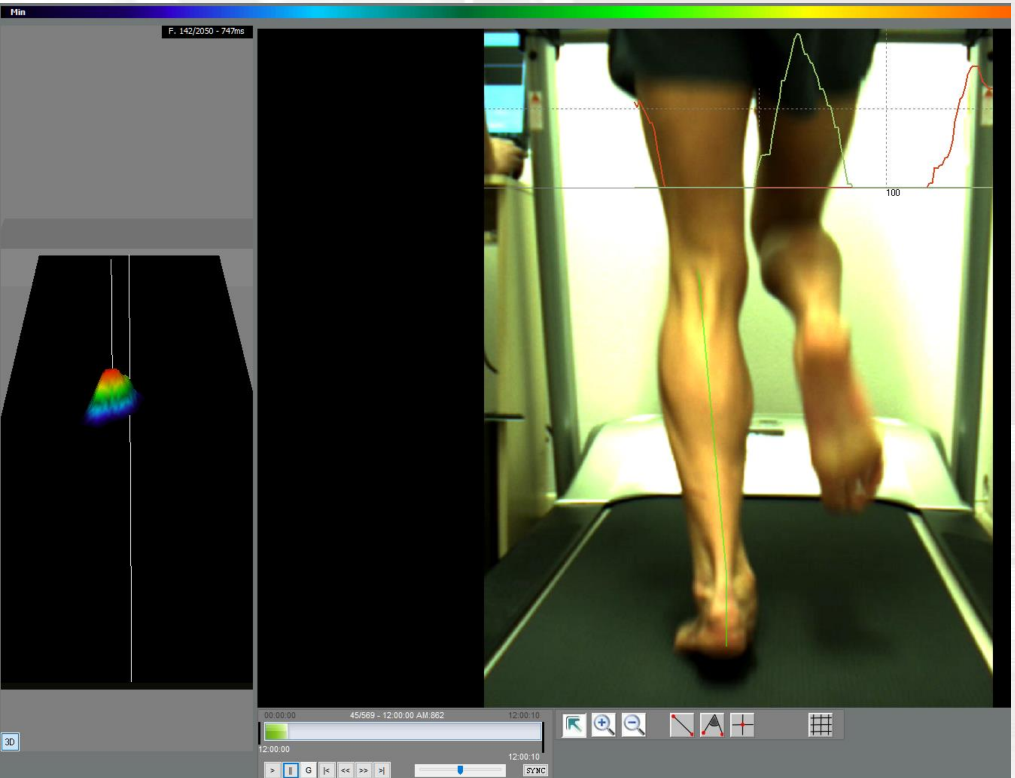
	LF	RF	Simmetry Index
Length Half/Step cm	44,94	47,25	95%
Stance time ms	927	1009	92%
Dual load/flight Time ms	244	269	90%
Rocking Time ms	527	502	95%
Rockers ICP MS	134	151	89%
Rockers FFCP ms	520	578	90%
Rockers FFP ms	262	277	95%
Surface cm²	192	203	95%
P.max gr / cm²	838	755	90%
Average P. gr / cm²	806	734	91%
Fore-foot Load %	82	81	99%
Rear-foot Load %	18	19	97%
Medial Load %	41	47	89%
Lateral Load%	59	53	91%
Podalic Axis °	6,38	3,86	61%

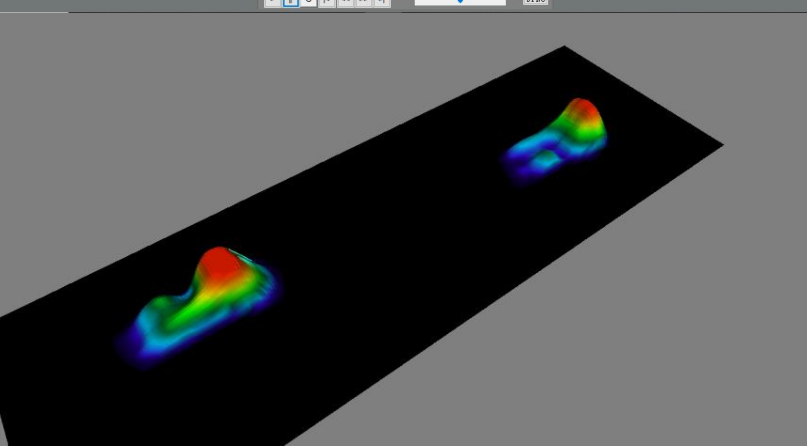
Avarage global value

Automatic comparison between left and right steps are displayed with percentages index.

Green indicators display a good balance inside the range of 10%

From orange to red there is an incremental asymmetry.





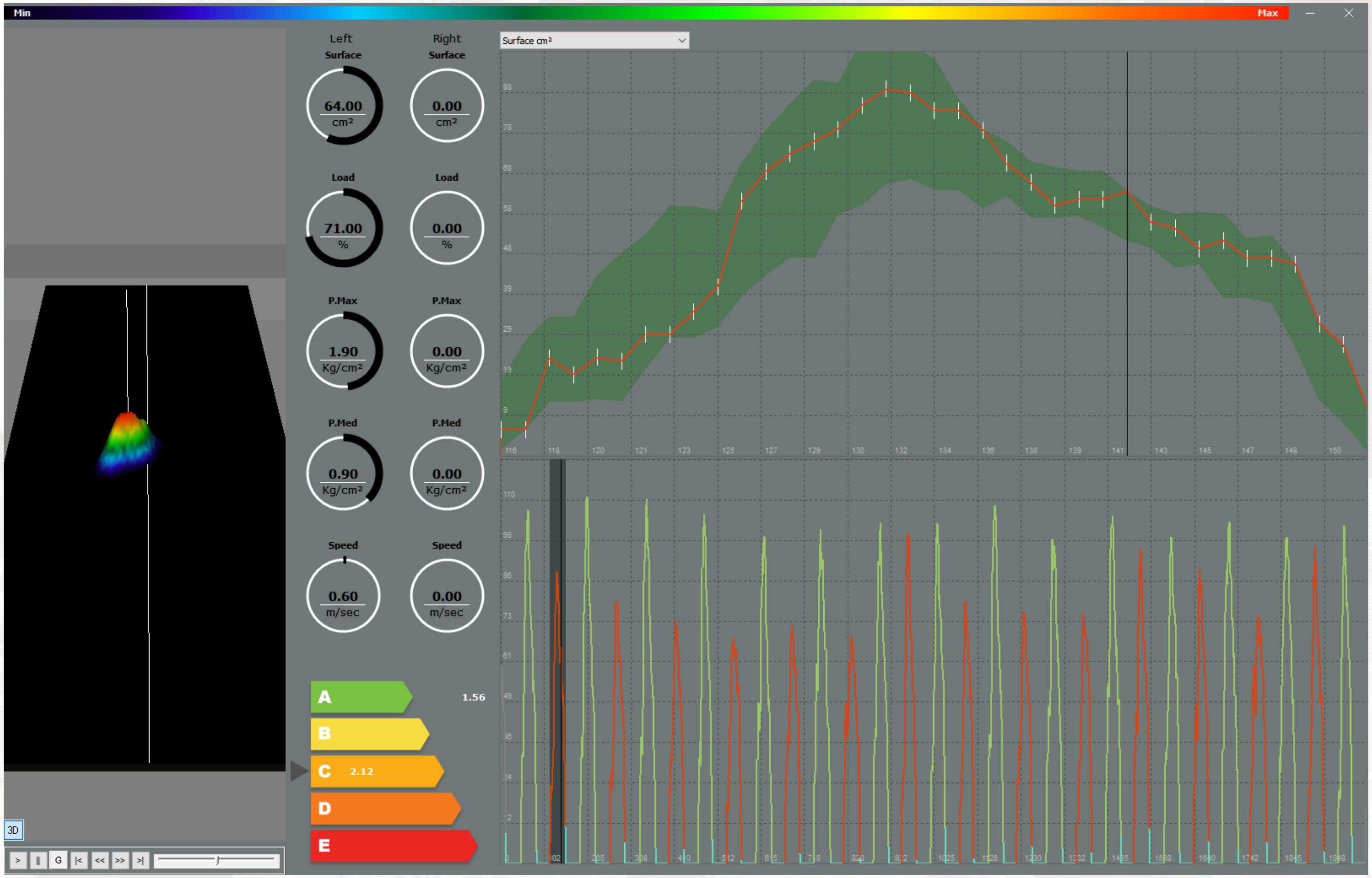
Biomechanical Analysis

- Time of left and right foot support, time of double support.

- Butterfly chart, for the study of the centers of dynamic pressure.

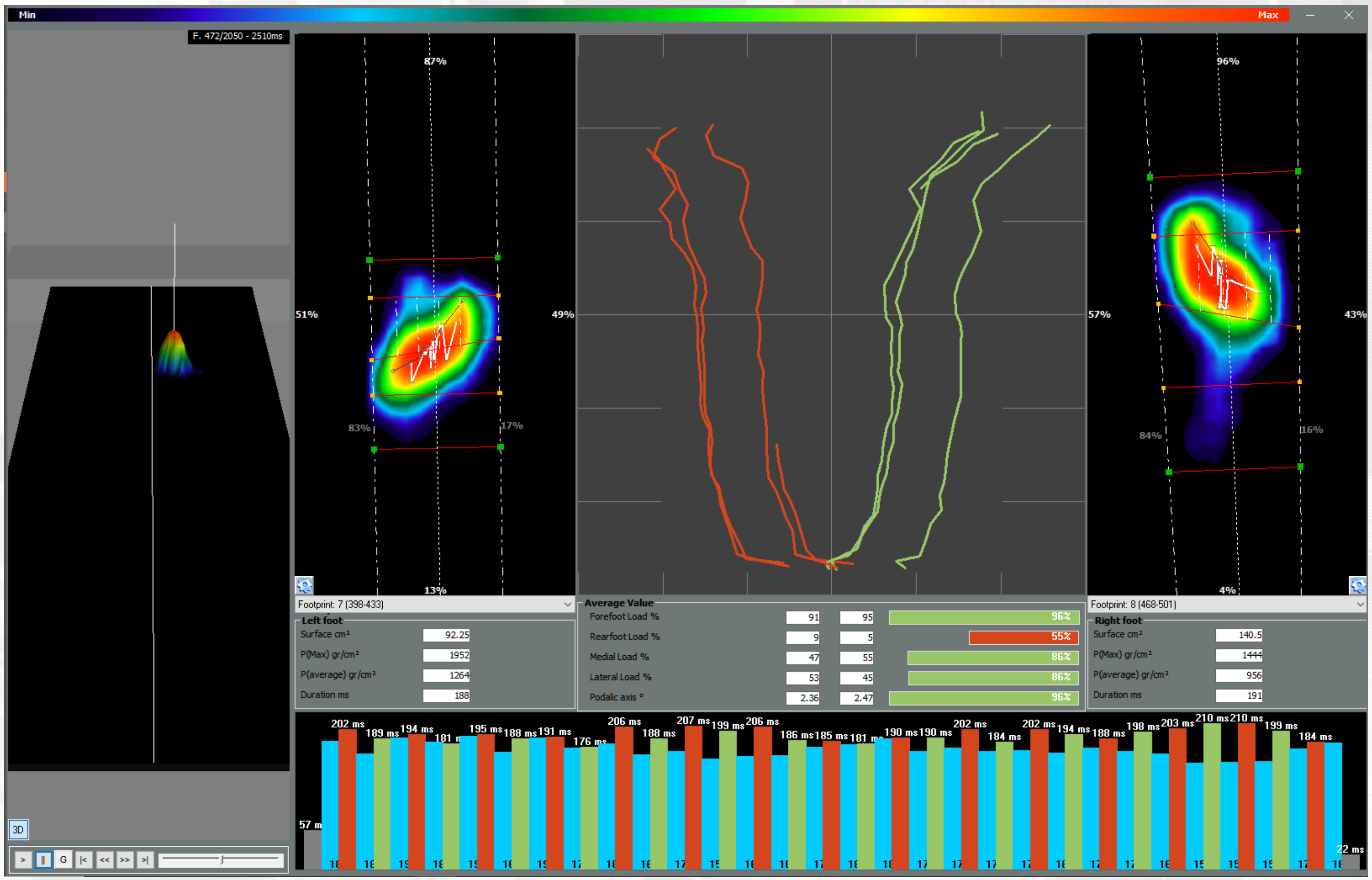
- 3D animation in slow motion allows to analyze frame-by-frame the distribution phases synchronized with cameras.

Indicators



Trend of the main values of feet support

Comparison between right and left



Gait-line of each single step

1. Medial-lateral loads
2. Length of footprint and of the gait line
3. Feet angles and axis

FlexInFit

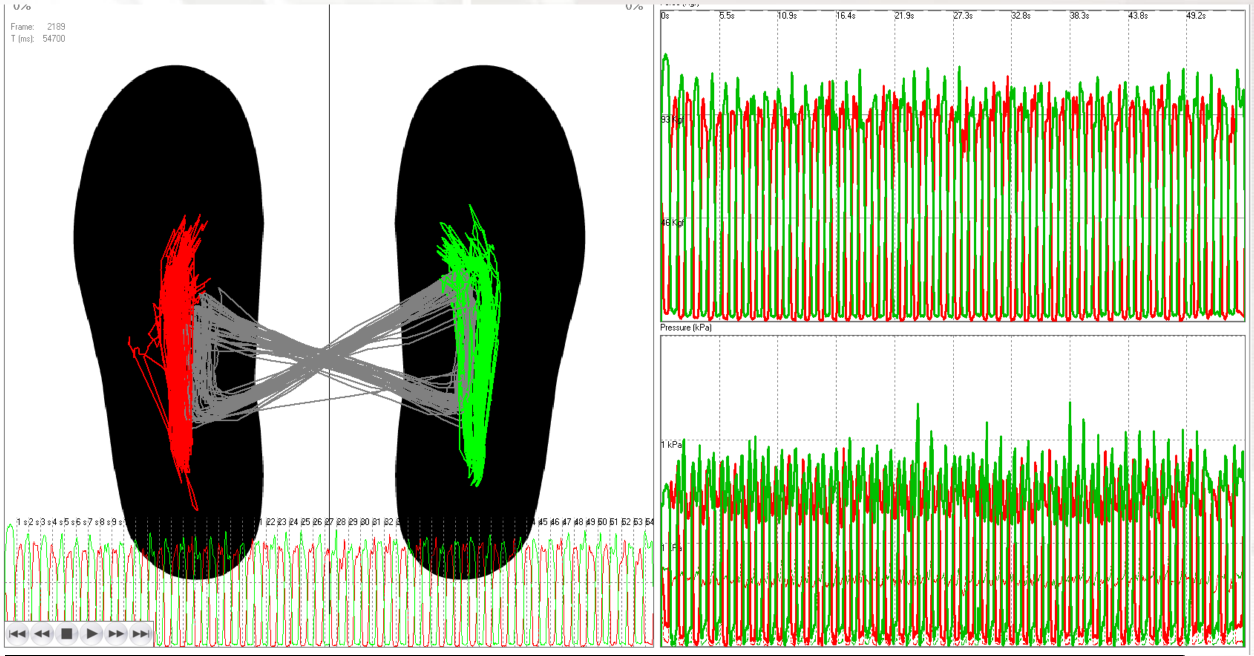
Bluetooth Sensor insoles

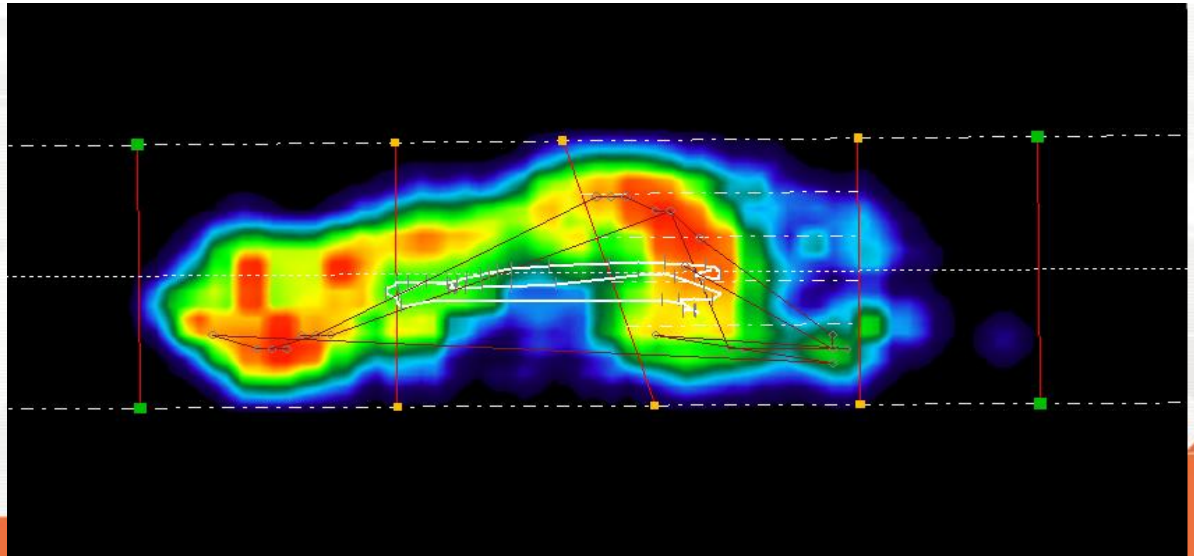
Acquisition techniques and main indications

Dynamic Analysis with FlexInFit

1. Select the proper insoles size
2. Insert the insoles in the shoes and connect the electronic transmitters
3. Switch on the 2 device, wait the activation of Bluetooth connection
4. Let the patient walk naturally
5. Start the acquisition, normally for minimum 30 sec

Gait-line and Butterfly





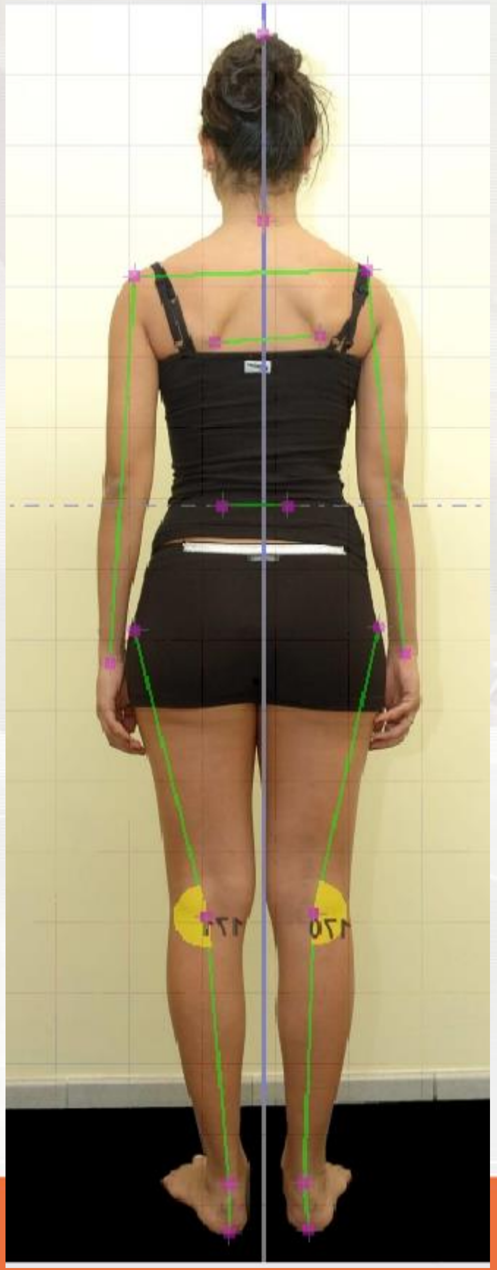
Videography

Acquisition techniques and main indications

2D Videography

Videography allows measuring the morphological posture of the patient for the identification of asymmetries in static and in dynamic.

An automatic protocol guide the positioning of markers for the calculation of lengths and angles of the body segments.

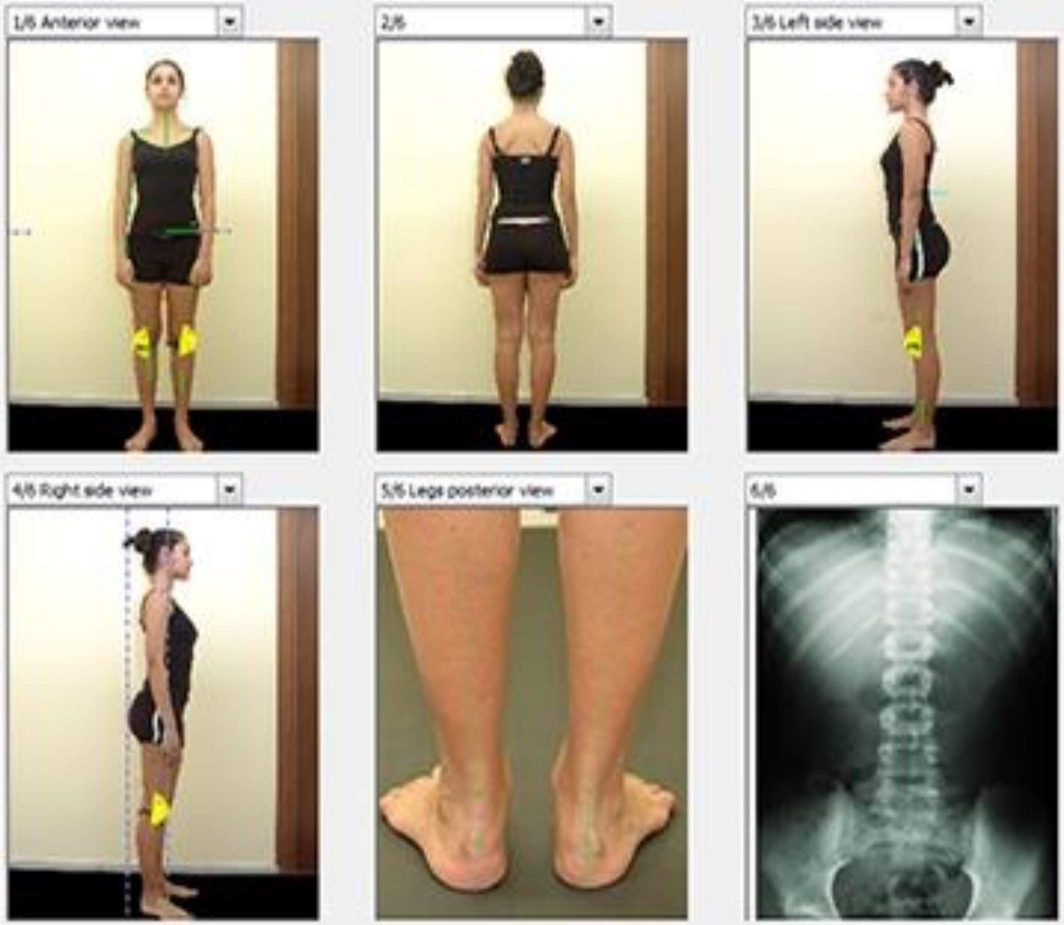


2D VIDEOGRAPHY: morphological asymmetries

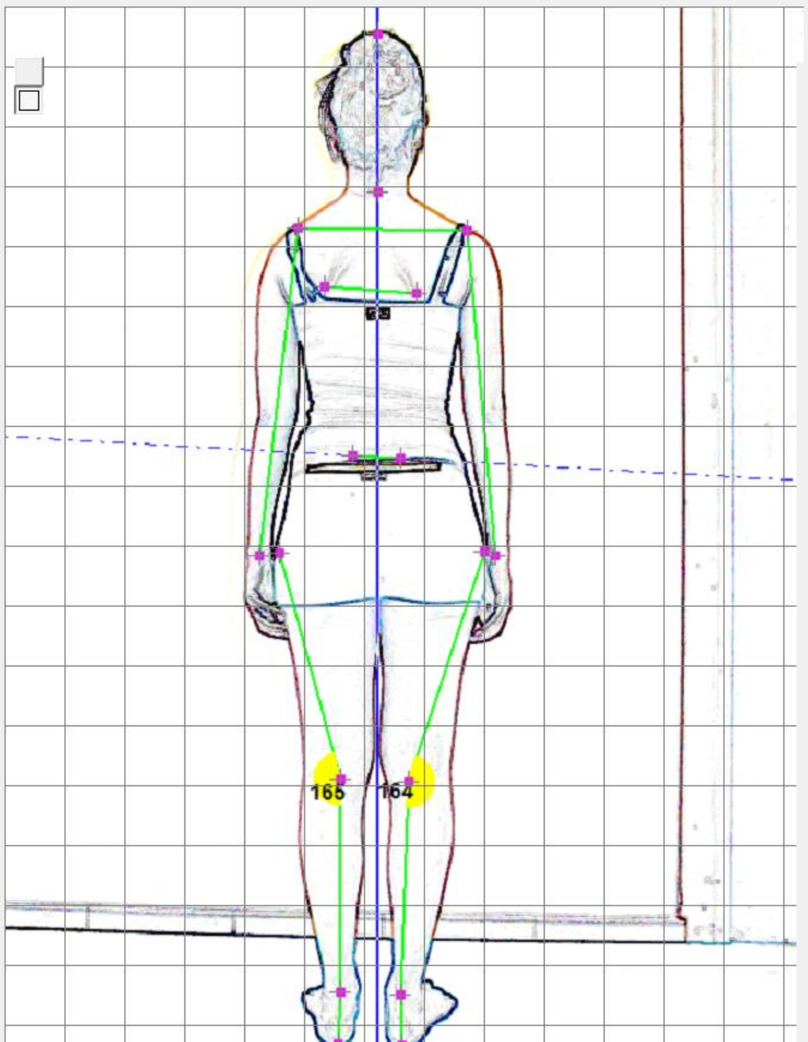
2D videography allows the complete morphological measurement of the subject for the identification of body asymmetries.

The analysis is facilitated by a guided marker protocols.

Also free measurements are allowed.



2D VIDEOGRAPHY: morphological asymmetries

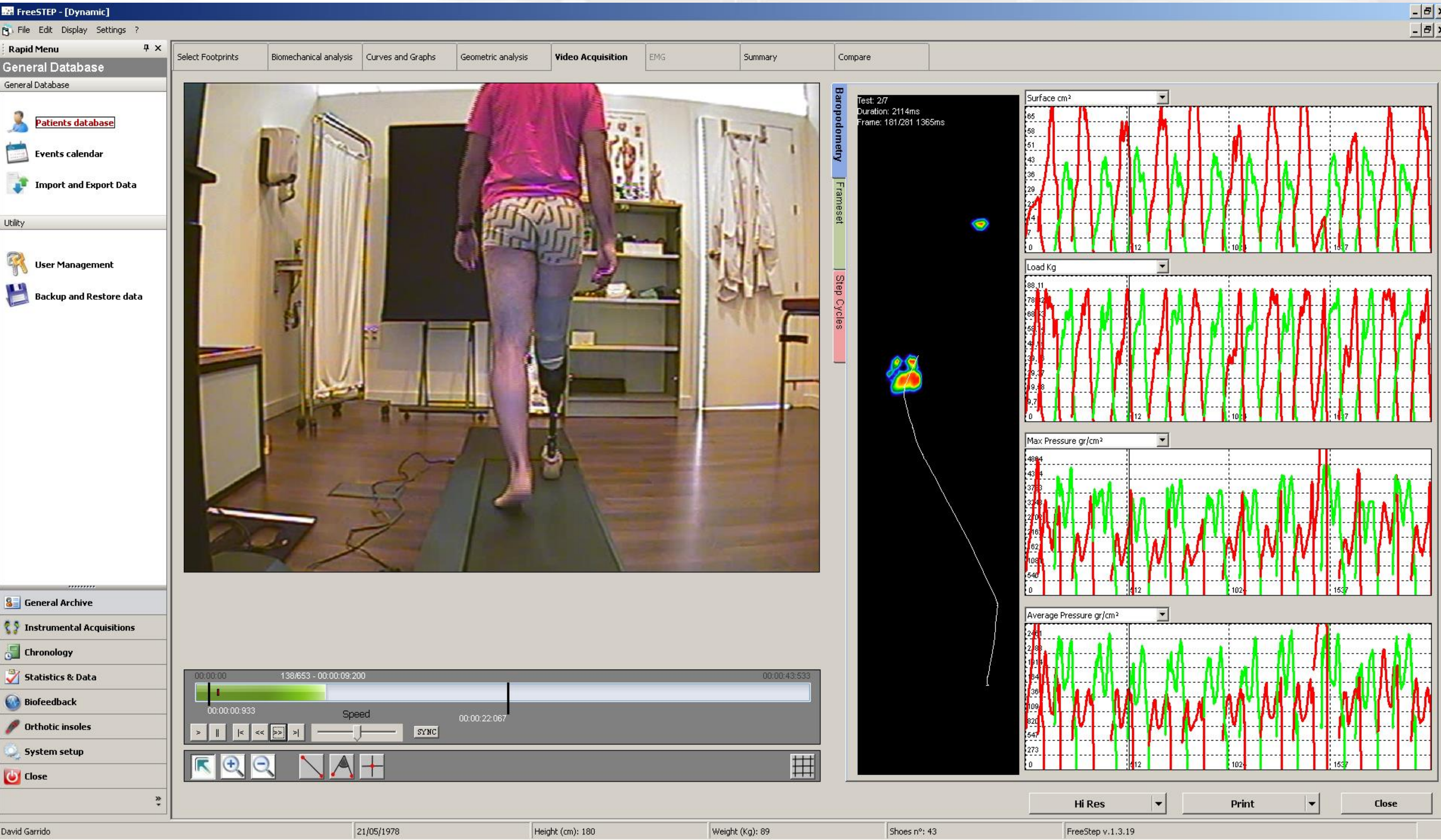


Point
Apex of the patient
C7 vertebra
Right shoulder
Left shoulder
Right scapula
Left scapula
Right sips
Left sips
Right wrist
Left wrist
Trochanter right
Trochanter left
Right popliteal
Left popliteal
Right Achilles tendon
Left Achilles tendon
Right heel
Left heel

Results	
Shoulder tilt	1°LF^
Ground distance left shoulder mm	1369
Ground distance right shoulder mm	1373
Scapulae tilt	4° LF^
Sips tilt	3° LF^
Angle varus/valgus knee rg	164°
Angle varus/valgus rearfoot rf	176°
Angle varus/valgus knee lf	165°
Angle varus/valgus rearfoot lf	177°

2D Videography

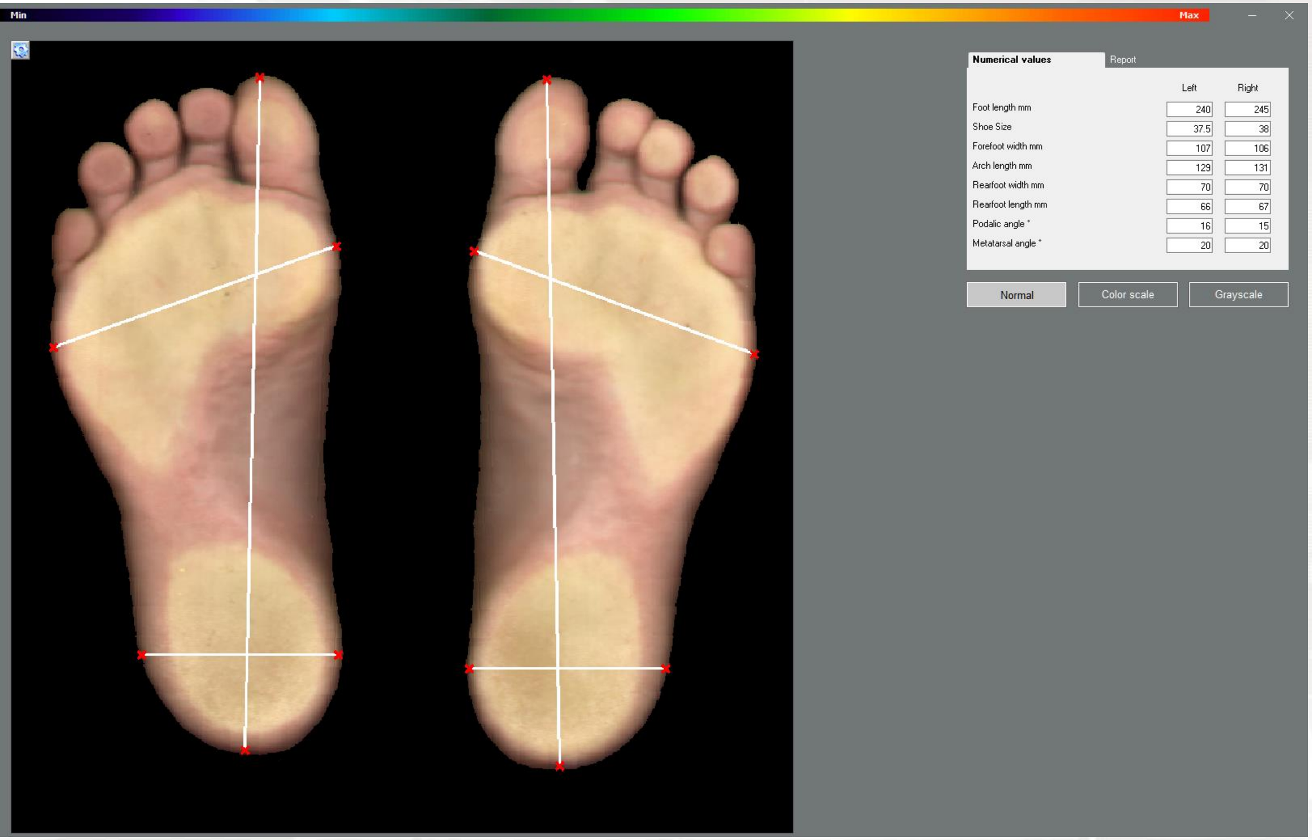
Start the motion capture during the walking.
Image capture in static is instantaneous, in dynamic is automatically stopped at the end of the movement.



2D PodoScan

Acquisition technology and main indications

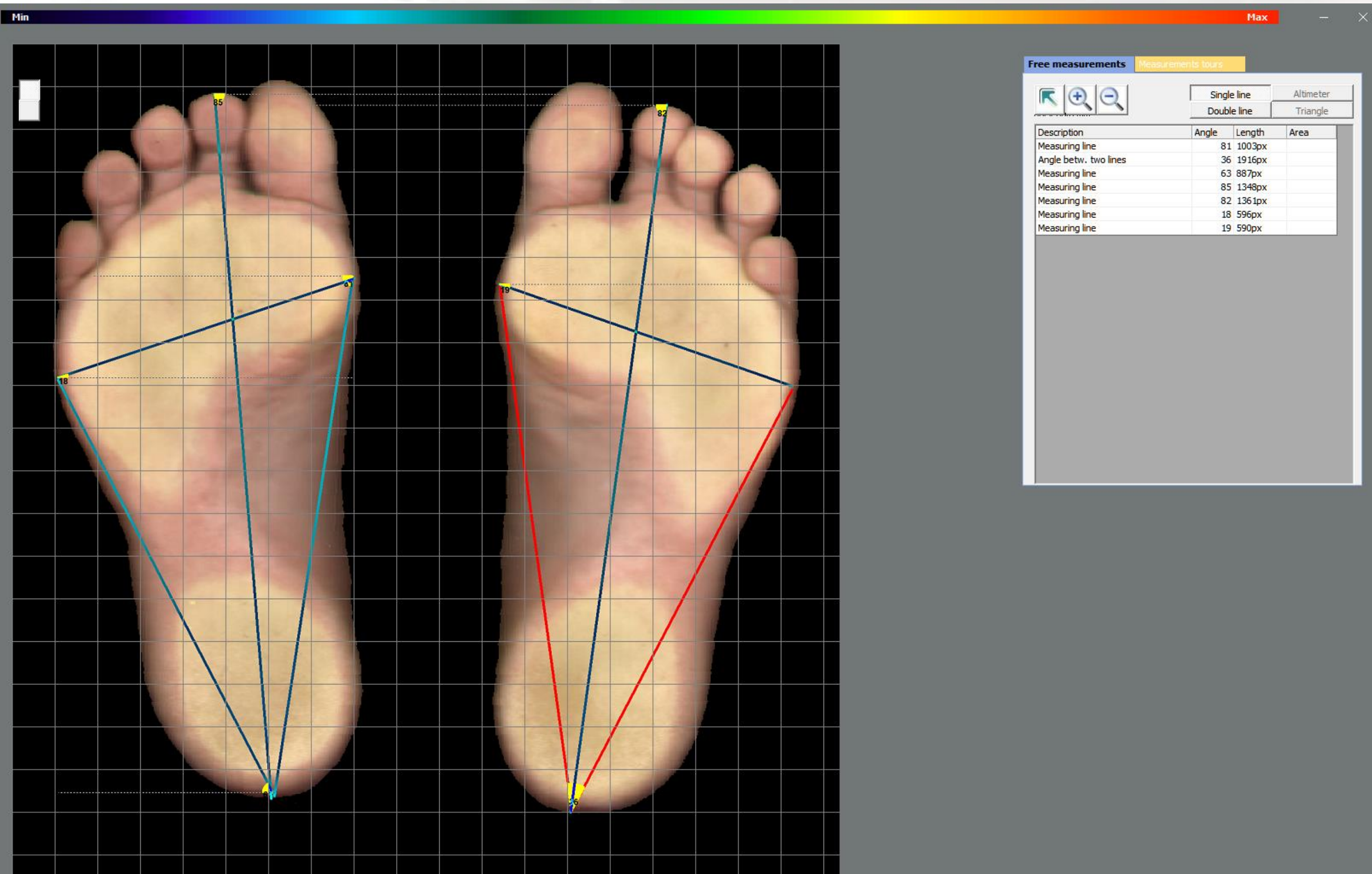
1. Place the patient on the scanner, with both feet on the glass
2. Start the capture interface of the program
3. Wait until the scanning is complete (2-3 sec)
4. Get out patient from the scanner



Automatic calculations

Foot length
Foot size
Forefoot width
Arch length
Heel width
Heel length
Angle of the feet
Angle of the metatarsals

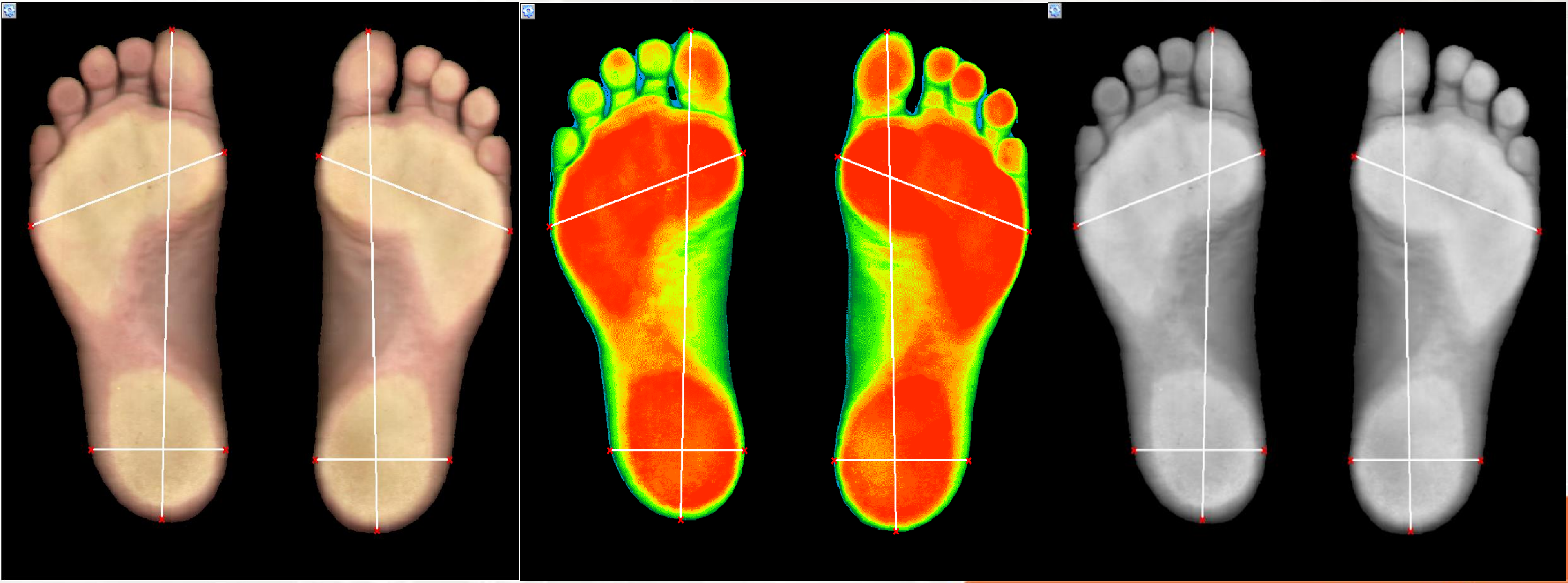
Other automatic measurements



A protocol wizard facilitates the measurement of the foot. Measurement free hand tools ensure full independence

Different images

1. Natural image
2. Color Image to highlight contact areas
3. Gray image that recalls the podographic paper

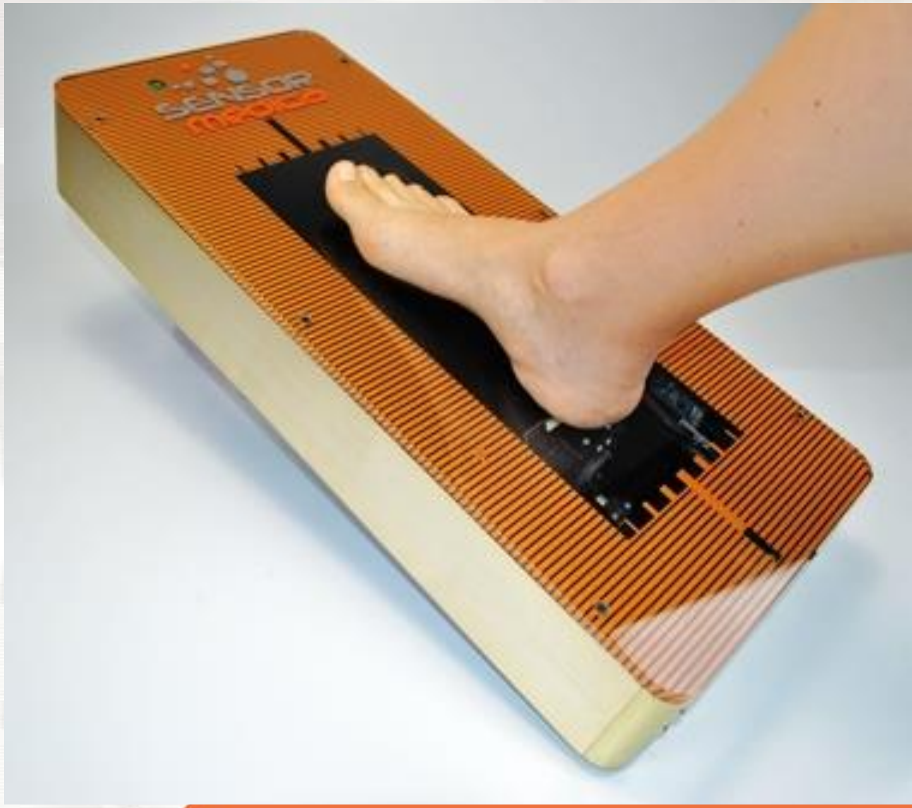


3D Laser PodoScan

Acquisition technology and main indications

Acquisition

1. Place the subject on the scanner with the barefoot in half load
2. Start the acquisition in **freeStep**
3. Wait until **laser** scanning is completed (2 seconds)



Collecting data for orthotic design

Allowing the height measurement 3D PodoScan ensures a perfect, three-dimensional reconstruction of the foot arch, wrapping the heel and the area of the forefoot.