

**Tekscan, Inc.**  
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**Foot Function & Gait Analysis with  
the Murphy 4P (parameter) Method**

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# Purpose of Presentation

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- **To expand the body of knowledge on data analysis and interpretation with F-Scan**
- **To present a specific method to analyze and interpret foot function and related gait**

# Specific issues to be addressed

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- **Two Wheel Drive (2WD) Analogy**
- **The 4 Parameters (P)**
  - **Timing**
  - **Trajectory**
  - **Symmetry**
  - **Integral / Impulse**
- **Step-By-Step Procedure Guide**

# Two Wheel Drive (2WD) Analogy

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- 1) A car has 2WD, either 2 front wheels, 2 back wheels, or one in front, the second in back.
- 2) Wheel drive means that there is a force exerted on the wheel to make it turn.
- 3) 2WD means that there are 2 wheels where one force per wheel is exerted to make these two wheels turn (just as the two ground reaction forces on the feet - one force per foot).
- 4) If the rotating (pivoting) speed of the 2 wheels are not in “time” (the same), the car steers.
- 5) If the wheels do not follow thru in the same “trajectory”, the car steers.
- 6) If the forces acting on the wheels are not in “symmetry” (same pattern), the car steers.

# Two Wheel Drive (2WD) Analogy...

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- 7) A steering car over time generates torque & stress, thus causing breakdown.
- 8) If breaking down has occurred, torque & stress accelerate and aggravate the breakdown.
- 9) To stop breakdown, and hopefully repair, the wheels need to be in “timing”, follow same “trajectory”, and in “symmetry”.
- 10) That is, the wheels need to be re-aligned to remove the torque & stress on the car.
- 11) To re-align the wheels, and remove the torque & stress, there is need to measure and know the “off-timing”, the “off-trajectory”, and the “off-symmetry”, then provide repair treatment accordingly, and then re-measure to determine if correct wheel alignment is now present.
- 12) Now, let us read points 4 to 11 above, but replacing the word ‘wheel’ with ‘feet’, and the word ‘car’ with ‘body.

# Two Wheel Drive (2WD) Analogy...

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- 4) If the rotating (pivoting) speed of the 2 feet are not in “time” (the same), the body steers.
- 5) If the feet do not follow thru in the same “trajectory”, the body steers.
- 6) If the forces acting on the feet are not in “symmetry” (same pattern), the body steers.
- 7) A steering body over time generates torque & stress, thus causing breakdown.
- 8) If breaking down has occurred, torque & stress accelerate and aggravate the breakdown.
- 9) To stop breakdown, and hopefully repair, the feet need to be in “timing”, follow same “trajectory”, and in “symmetry”.
- 10) That is, the feet need to be re-aligned to remove the torque & stress on the body.
- 11) To re-align the feet , and remove the torque & stress, there is need to measure and know the “off-timing”, the “off-trajectory” and the “off-symmetry”, then provide repair treatment accordingly, and re-measure to determine if correct feet alignment is now present.

## For the human body:

- When **timing**, **trajectory** or **symmetry** in foot function, gait and/or posture is off, torque is generated, and stress is transmitted along and within the tendons and muscles, ligaments and bones.

# The 4 Parameters (P)

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## 4 Parameters for using with F-Scan

- ☞ **Timing**
- ☞ **Trajectory**
- ☞ **Symmetry**
- ☞ **Integral/Impulse**



# What is meant by **Timing**?

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- ➡ **Timing refers to the amount of time the feet are in contact with the ground, and the speed with which they move, as the feet are in contact with the ground.**
- ➡ **Ideally, the left foot and the right foot (and segments such as rearfoot, midfoot & forefoot), should spend the same amount of time on the ground, and move with the same speed.**
- ➡ **Treatment should improve timing between the left and right feet, and to the normal.**

## Specifically, for Timing...

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It is that in the prescription, where the pivotal speeds of the left & right feet are made to match as close as possible, and to the normal!

**Now think of the 2WD analogy: If the two wheels (feet) are not rotating at same speed (mechanics), torque & stress is generated in the car (body) structure (biomechanics).**

# What is meant by Trajectory?

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- ➡ **Trajectory refers to the path that the CoF travels from heel strike to toe-off, as the feet are in contact with the ground.**
- ➡ **Ideally, the left foot and the right foot (and segments such as rearfoot, midfoot & forefoot), should have similar trajectories.**
- ➡ **Treatment should improve trajectories between the left and right feet, and to the normal.**

## Specifically, for Trajectory...

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It is that in the prescription, where the CoF trajectories of the left & right feet are made to match as close as possible, and to the normal!

**Now think of the 2WD analogy: If the two wheels (feet) are not exerting force in same trajectory (mechanics), torque & stress is generated in the car (body) structure (biomechanics).**

# What is meant by **Symmetry**?

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- ➡ **Symmetry refers to the pattern exhibited by the gait curve from heel strike to toe-off, as the feet are in contact with the ground.**
- ➡ **Ideally, the left foot and the right foot (and segments such as rearfoot, midfoot & forefoot), should have similar gait curves.**
- ➡ **Treatment should improve symmetry between the left and right feet, and to the normal.**

## Specifically, for Symmetry...

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It is that in the prescription, where the gait curve pattern of the left & right feet are made to match as close as possible, and to the normal!

**Now think of the 2WD analogy: If the two wheels (feet) are not exerting the same force and pattern (mechanics), torque & stress is generated in the car (body) structure (biomechanics).**

# What is meant by Integral?

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- ➡ **Integral (impulse) refers to the relationship between the amount of force, and the amount time, that the force is acting on plantar surface of the feet, as the feet are in contact with the ground.**
- ➡ **Ideally, the left foot and the right foot (and segments such as rearfoot, midfoot & forefoot), should have similar integrals, and with lowest pressure values as possible.**
- ➡ **Treatment should improve integrals between the left and right feet.**

## Specifically, for Integral...

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**It is that in the prescription, where the integrals of the left & right feet are made to match as close as possible, and with lowest pressure values as possible!**



# Using F-Scan with Murphy 4P Method

## - A Step-by-Step Procedure Guide

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**For before (pre) and with (post) treatments;**

- 1<sup>st</sup> - Determine if trial (data) is acceptable,**
- 2<sup>st</sup> - Analyze for Timing (speed during stance),**
- 3<sup>rd</sup> - Analyze for Trajectory (CoF path),**
- 4<sup>th</sup> - Analyze for Symmetry (gait curve),**
- 5<sup>th</sup> - Analyze for Integral (force-time), and**
- 6<sup>th</sup> - Interpretations:  
Formulate personal / professional assessment.**

# **1<sup>st</sup> - To determine if trial (data) is acceptable:**

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- 1) Select (open) patient movie for before treatment,**
- 2) Select 2D Contour View,**
- 3) Select (activate) left window (foot),**
- 4) Select Multi-Peak/Phase,**
- 5) Exclude the first and last phases, and verify presence of repeatability in pressure profiles, and in gait curve within Graph1,**
- 6) If the graph is not in Force units, go to graph, properties, and select Force for the Y-axis scale,**
- 7) Except for Phase 2, close all Phase windows & graph,**
- 8) Repeat steps 3 thru 7, but this for right window,**
- 9) Select Show Tiles,**
- 10) Select OK for Create a new graph, re-verify repeatability with both curves.**
- 11) Accept or reject trial.**

## **2<sup>nd</sup> - For Timing:**

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- 12) Select (activate) left window (foot), ensure on Phase 2**
- 13) De-select Peak,**
- 14) Select Center of Force,**
- 15) Play the movies frame by frame until toe-off, and observe/note if the feet mapping and CoF are moving with similar time and speed (distance CoF travels),**
- 16) Select Peak/Phase (will now be at next phase 3),**
- 17) De-select Peak,**
- 18) Play the movies frame by frame until toe-off, and observe/note if the feet mapping and CoF are moving with similar time and speed (distance CoF travels), and**
- 19) Repeat steps 16 thru 18, and this for desired number of phases, except last phase.**

## **3<sup>rd</sup> - For Trajectory:**

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- 20) Select Peak/Phase,**
- 21) Return (playback) to Phase 2,**
- 22) Select Center of Force Trajectory, and observe/note if the trajectories for the CoF follow similar paths,**
- 23) Advance to next move Phase, and observe/note if the trajectories for the CoF follow similar paths, and**
- 24) Repeat step 23 for the remaining phases, except last Phase.**

## 4<sup>th</sup> - For Symmetry:

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- 25) Return (playback) to Phase 2,
- 26) Select (activate) Graph1 window, and
- 27) Excluding the first and last phases, observe/note if the gait curves within the graph follow similar paths.

## 5<sup>th</sup> - Integral:

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- 28) Select (activate) left window,
- 29) Select Legend, set lower value to 0 PSI (0 kg/cm<sup>2</sup>), and upper value to 36 PSI (2.5 kg/cm<sup>2</sup>),
- 30) Select Add Box, position cursor over area of high pressure concern (red color), and click,
- 31) Select Create a new graph, de-select Graph1, select Ok, and set Graph2 Y-axis to Contact Pressure,
- 32) Re-size box accordingly,
- 33) Repeat steps 30 & 32 as desired,
- 34) In graphs, observe/note time & pressure values, and Imp. (integral) value (in legend) per box color.

**Now:**

- 35) Formulate personal / professional assessment, and
- 36) Repeat steps 1 thru 35, and this for movies with treatments.

# Thank You ...

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