Ms. Robin Dorociak
Northwest Biomechanics, LLC
4817 SW Hamilton Ct
Portland, Or. 97221
(503) 292-5759
(503) 880-5180 c
rdorociak@nwbiomechanics.com

May 24, 2011

KINGETICS ORTHOTIC CASE STUDY:

Biomechanical testing and analysis of one subject was performed to evaluate the insole and outsole performance of the Kingetics orthotic. Data was collected for the right foot only. A pressure sensor (Tekscan Fscan) was placed inside the shoe above the footbed and another pressure sensor was taped to the outsole (since a force platform was not available). Data was collected in 2 shoes conditions: 1) Kingetics orthotic in an ASICS shoe (footbed removed) inshoe sensor above the orthotic; and 2) ASICS shoe only (footbed removed). During data collection, the subject performed the following activities on a treadmill (TM) and on concrete: walking (TM @ 3MPH & concrete freely selected); walking on 15 degree incline (TM only); walking backward (TM @ 3MPH & concrete freely selected); running (TM @ 6 MPH & concrete freely selected); and standing Jump (concrete only). Only the treadmill and jump conditions are reported here.

The data was collected @ 300Hz for 10 seconds. Gait cycles were averaged for each condition (6 strides for treadmill and 2 for concrete conditions). The foot was divided into areas of interest: Fullfoot (whole foot); Forefoot (including toes); Midfoot; and Heel. The following variables were calculated: heel shock absorption (loading rate), force, pressure, and energy (impulse). Differences within shoes (i.e. KDiff=Kout-Kin) and between shoes (i.e. In Diff = Kin-Ain) were calculated for the outside and inside for each variable.

Even though limitations (especially 1, 2 & 3 – seen on page 2) make it difficult to draw definitive conclusions, here are a few observations from this study:

- Loading rate @ the heel and the inside heel impulse are lower in Kingetics when compared to the modified ASICS shoe. These two results coupled together may show that at the body interface (where you want forces to be low) the Kingetics orthotic is doing a better job of cushioning at impact. Some researchers have speculated that higher loading rates are a contributor to injury. Even though limitations (see below) impact this conclusion, a previous study on Kingetics against a Nike Shox and an Army Boot showed a similar trend (see that study for specifics).

- The Kingetic orthotic has a higher inside forefoot impulse and a lower outside forefoot impulse. This was also shown for vertical jump tests (see Limitation 1 & 2).

- The inside peak timing variables show that for walking, the Kingetics orthotic timing occurs later in the stride cycle at the heel and midfoot. It nearly catches up in the forefoot. The slower timing may be a result of the design of the orthotic to

absorb the impact over a longer period of time. For running, the inside heel timing is similar to walling but the midfoot and forefoot timing for Kingetics occurs earlier in the stride cycle.

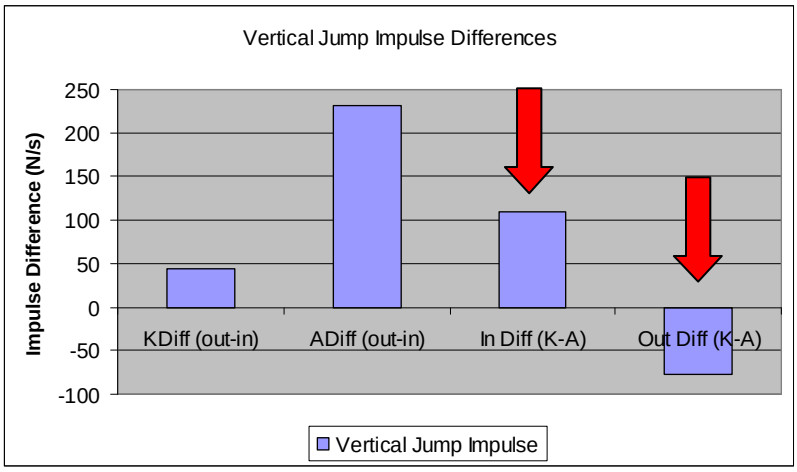
There are a few limitations for this case study. Limitation 1: We would expect the surface area of the outside (outsole) to be larger than the inside (insole). At the heel and somewhat at the midfoot, this is not always the case for this study. In some tests the outside forefoot surface area changed as well. The sensor may have slipped or a bubble occurred during data collection. Limitation 2: The surface area will affect impulse, loading rate, and the total force measurements since this sensor technology sums up the sensels (individual sensors) in contact. This will not affect peak sensel force or peak sensel pressure. Limitation 3: The modified ASICS shoe that we used to test had a previous fatigue point in the outsole that was patched up a bit. When used with the Kingetics orthotic inside, it popped up or out under force and caused a hot spot or saturation point on the outside sensor between the heel and midfoot. This may have caused a tripod effect in the heel area limiting the contact surface area of the heel. Limitation 4: To truly measure outside force (force on the outsole), force platform data will need to be collected simultaneously with the inshoe. Limitation 5: Variability will exist since this is a one person case study.

CONCLUSIONS

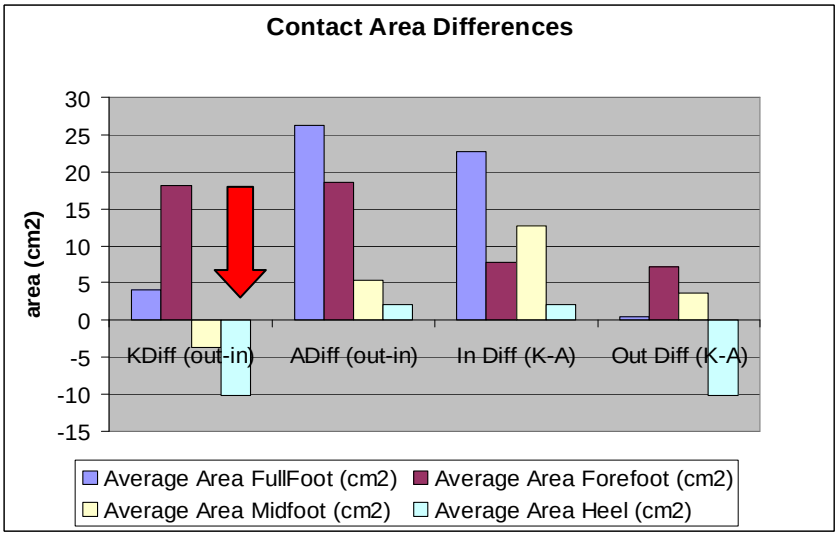
While limitations and small subject size in this and a previous study make it difficult to draw definitive conclusions, these results do show that further study is warranted to evaluate the effectiveness of the Kingetics orthotic. It is recommended that additional tests be performed on walking, running, and jumping while wearing the Kingetics orthotics to further evaluate the loading rate, energy storage & transfer, and propulsive characteristics of the orthotic. These additional tests would include inshoe foot pressure measurement collected simultaneously with a force platform as well as 3D kinematics, kinetics, and surface electromyography. Energy consumption tests could be done as well to evaluate the energy expenditure of the subjects while performing activities in the Kingetics orthotic.

APPENDIX A: Vertical Jump

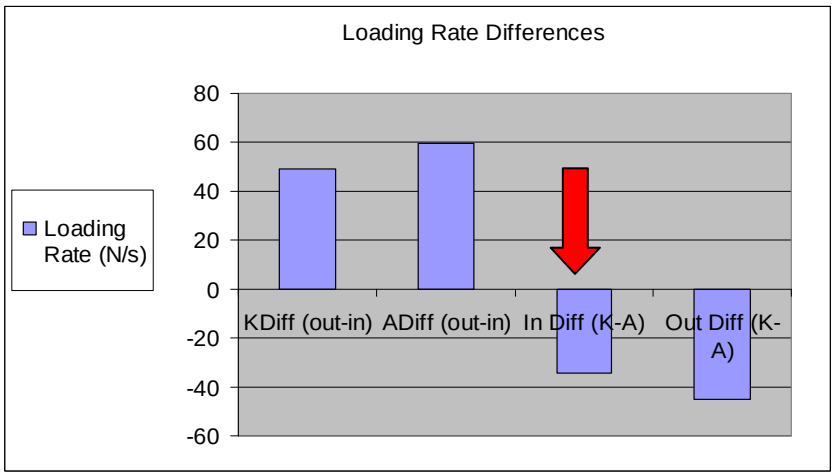
Vertical jump trends show higher inside impulse and lower outside impulse for Kingetics



APPENDIX B: Treadmill (TM) Walking

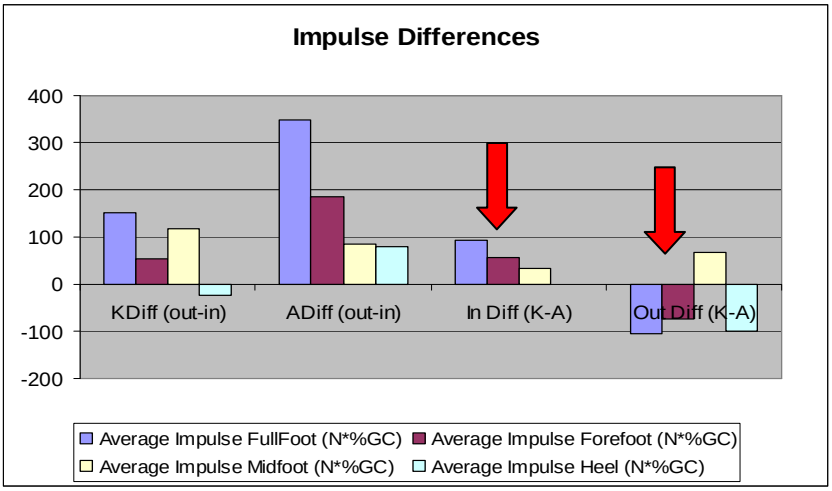


Limitation 1 & 2 are violated for the outside of the Kingetics shoe since contact area is smaller



Loading Rate @ Heel Contact

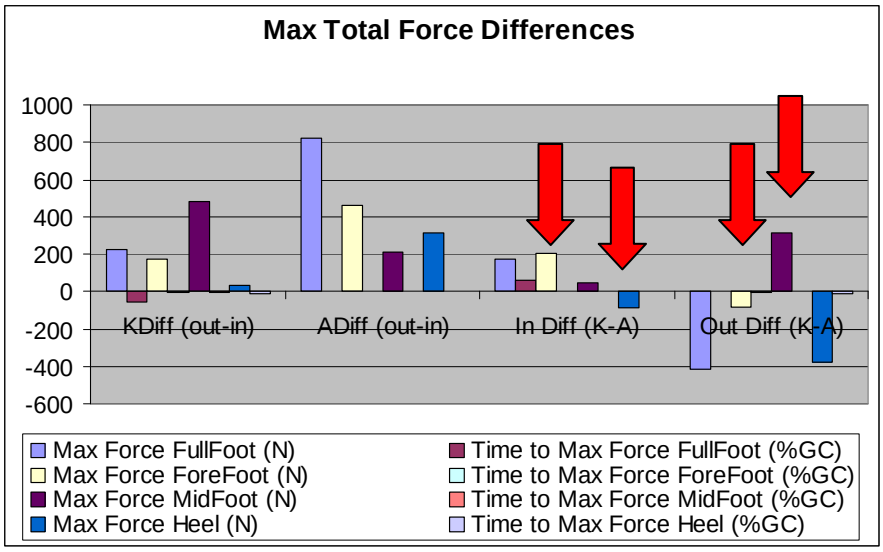
- Inside is much lower for Kingetics
- Outside is lower for Kingetics (see Limitation's 1 & 2)



Impulse

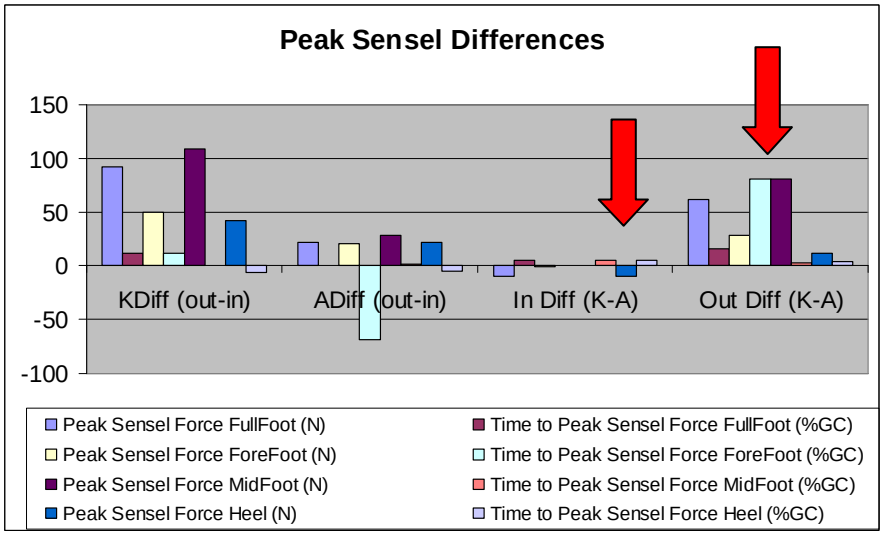
- Inside - No difference for heel but higher impulse at forefoot, midfoot, and fullfoot for Kingetics
- Outside – Lower impulse for forefoot for Kingetics
- Heel and fullfoot lower as well (see Limitation's 1 & 2)

APPENDIX B: Treadmill (TM) Walking (continued)



Max Total Force

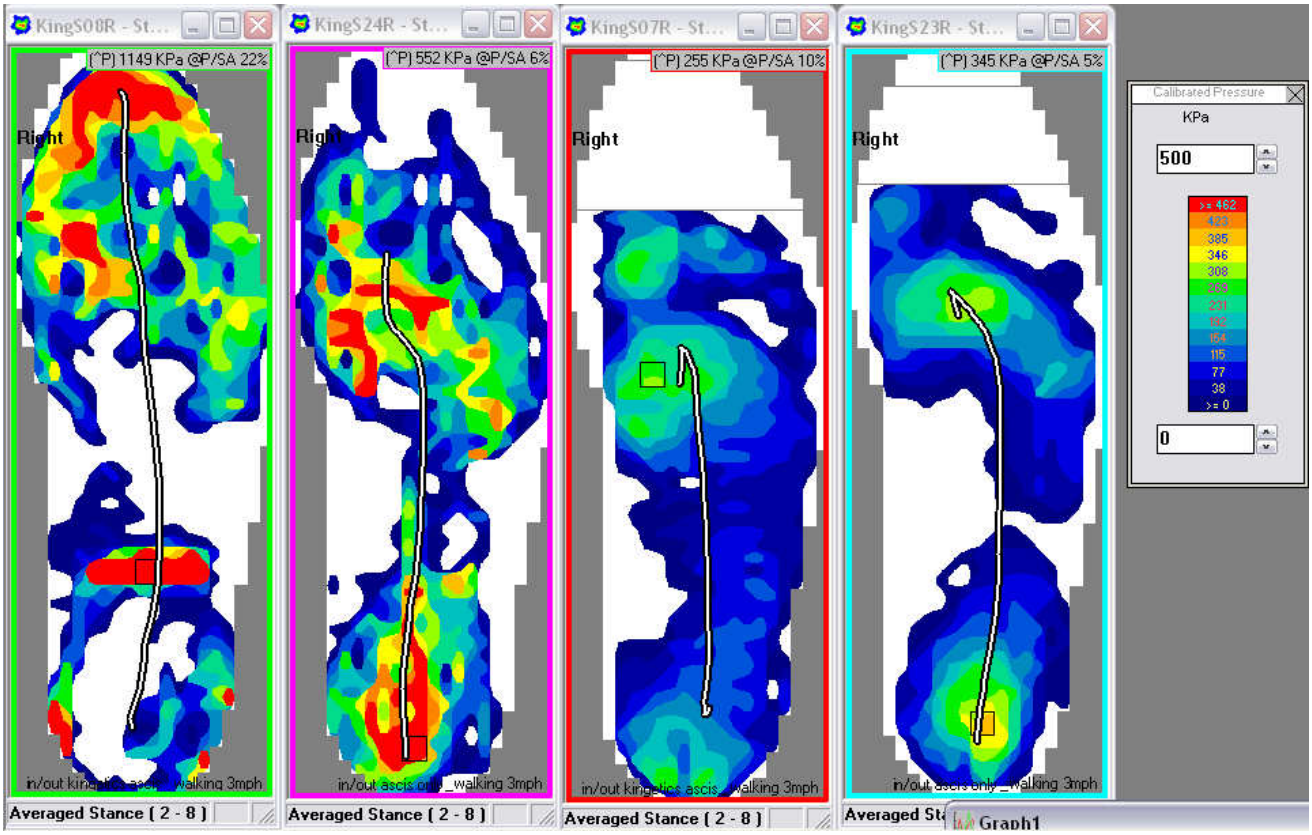
- Kingetics occurring earlier in the gait cycle or all areas of the foot
- Kingetics inside higher @ the forefoot and lower @ the heel
- Kingetics outside lower @ forefoot and higher @ midfoot
    - Lower at heel and fullfoot (see Limitation's 1 & 2)

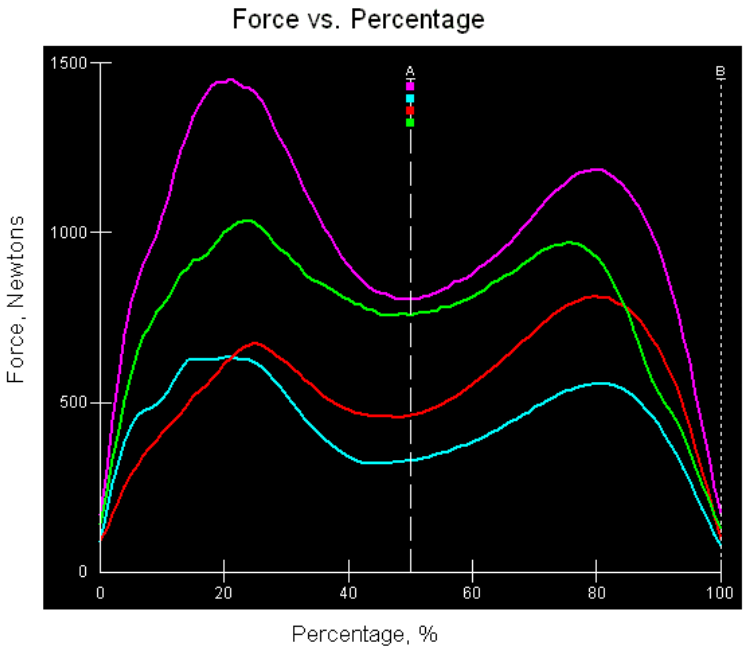


Peak Sensel Force

- Heel inside is lower for Kingetics
- Outside - Forefoot, Midfoot & Heel higher for Kingetics
- Outside - Kingetics occurring later in stance

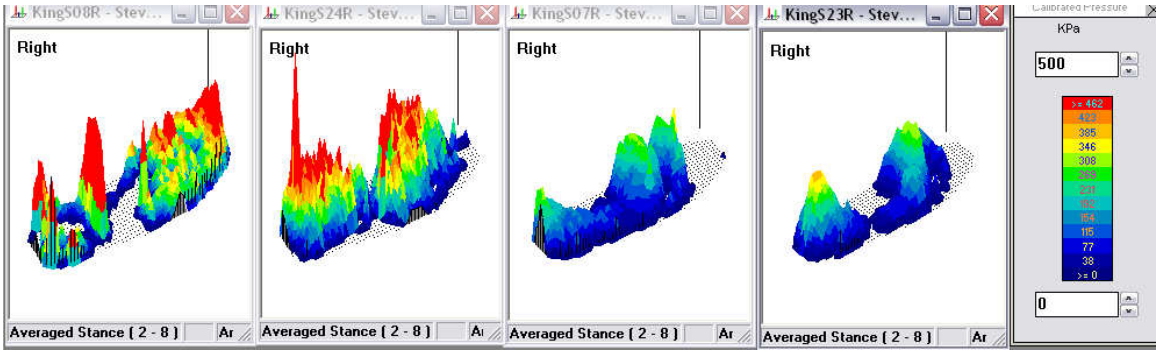
APPENDIX B: Treadmill (TM) Walking (continued)





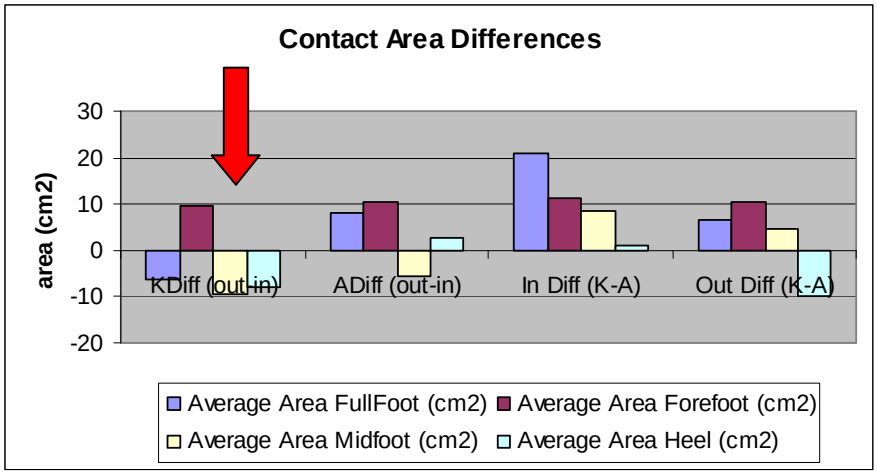
Green – Kingetics Outside
Purple – ASICS Outside
Red – Kingetics Inside
Light Blue – ASICS Inside

APPENDIX B: Treadmill (TM) Walking (continued)

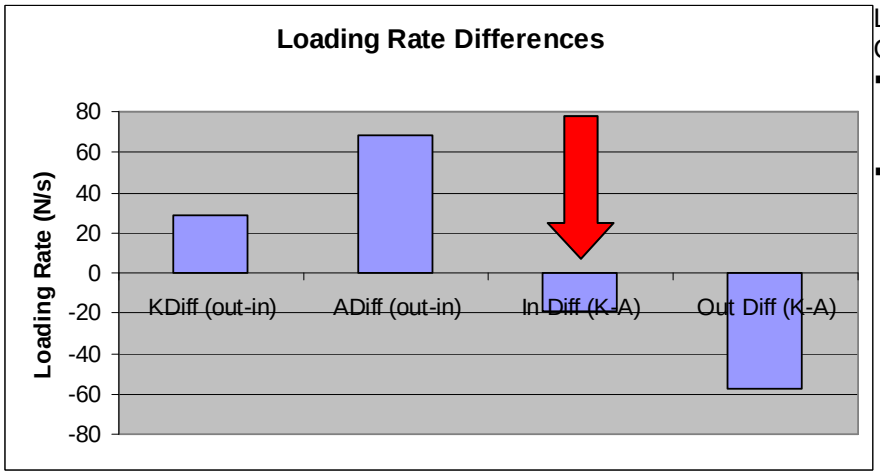


Kingetics Outside ASICS Outside Kingetics Inside ASICS Inside

APPENDIX C: Treadmill (TM) Running

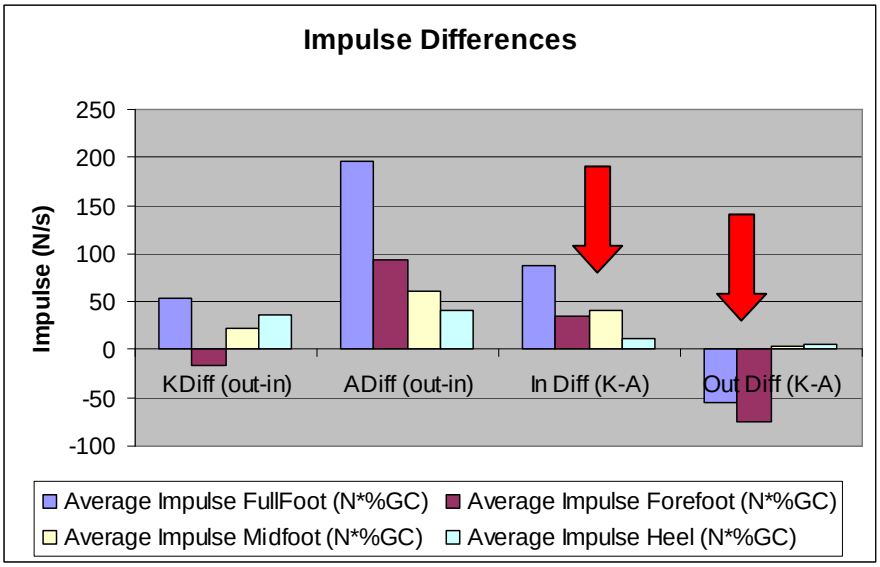


Limitation 1 & 2 are violated for the outside of the Kingetics shoe since contact area is smaller



Loading Rate @ Heel Contact

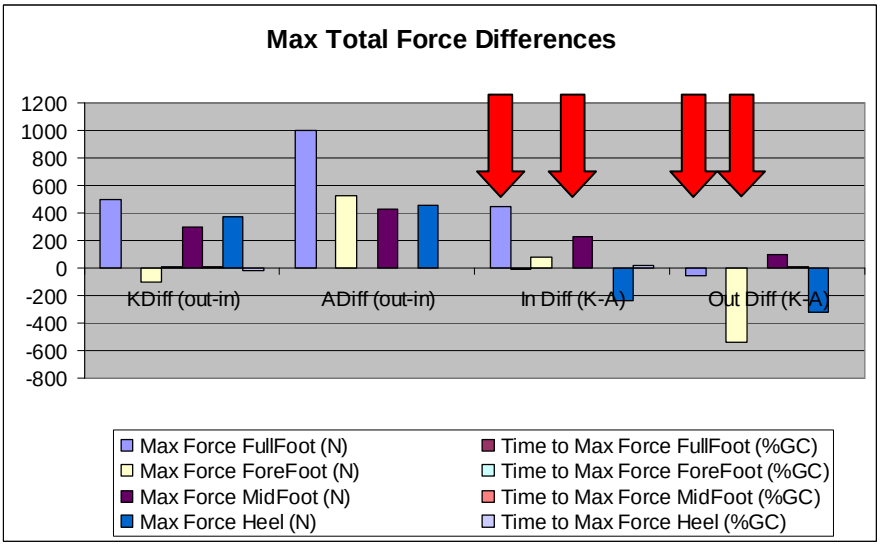
- Inside is much lower for Kingetics
- Outside is lower for Kingetics (see Limitation's 1 & 2)



Impulse

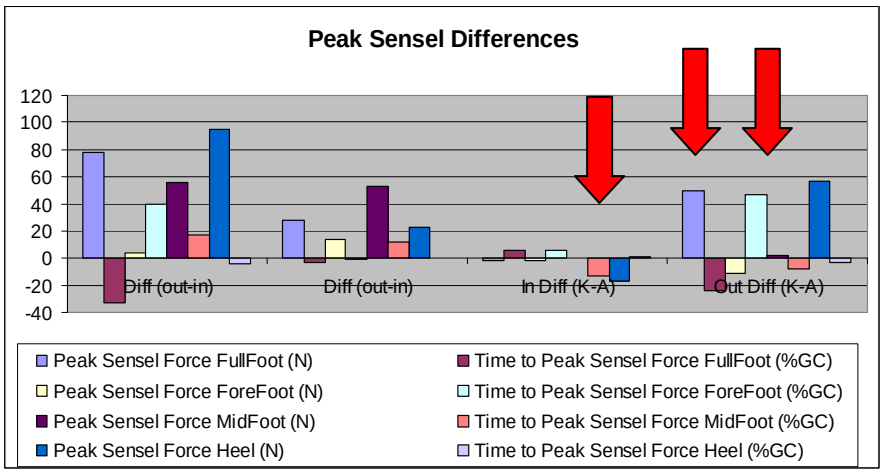
- Inside - small difference for heel but higher impulse at forefoot, midfoot, and fullfoot for Kingetics
- Outside – Lower impulse for forefoot for Kingetics

APPENDIX C: Treadmill (TM) Running (Continued)



Max Total Force

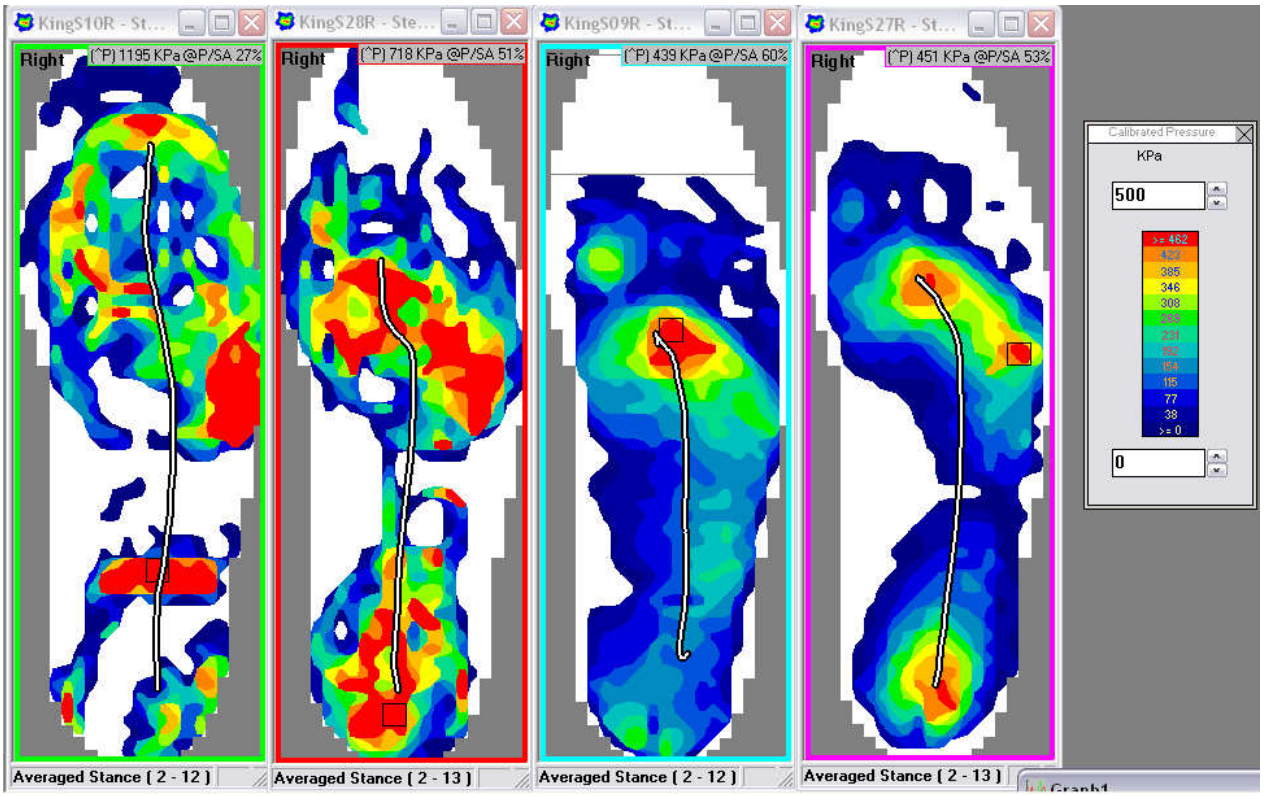
- Kingetics inside higher @ the forefoot and lower @ the heel
- Kingetics outside lower @ forefoot and higher @ midfoot
  - Lower at heel and fullfoot (see Limitation's 1 & 2)

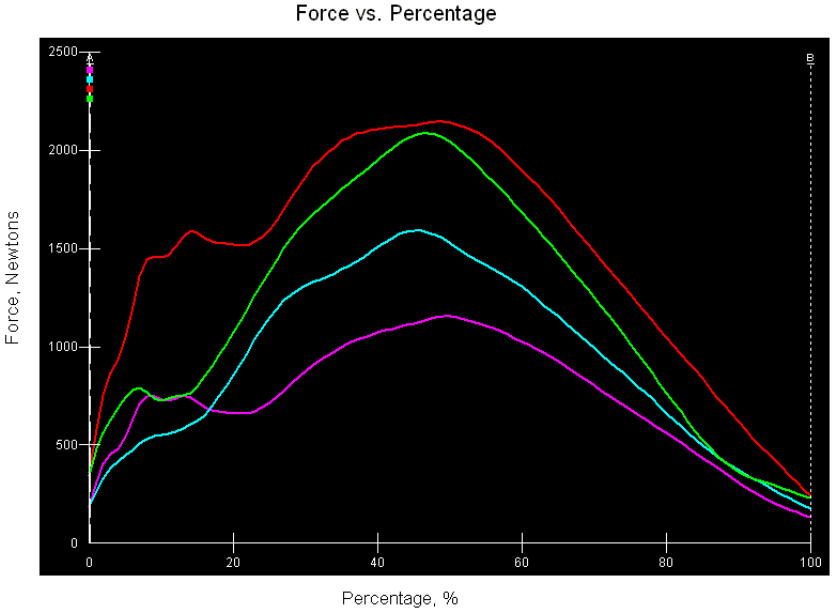


Peak Sensel Force

- Inside - heel and forefoot are lower for Kingetics
- Outside - Midfoot & Heel higher and forefoot lower for Kingetics

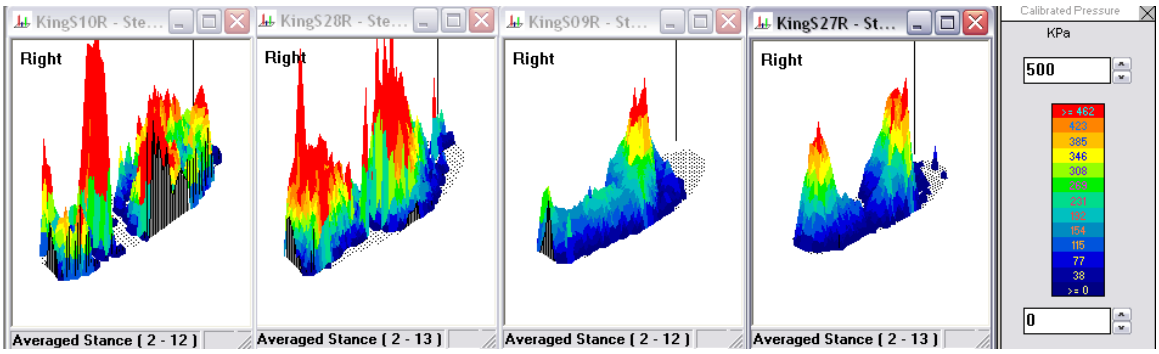
APPENDIX C: Treadmill (TM) Running (Continued)





Green – Kingetics Outside
Red – ASICS Outside
Light Blue – Kingetics Inside
Purple – ASICS Inside

APPENDIX C: Treadmill (TM) Running (Continued)



Kingetics | ASICS Outside | Kingetics Inside | ASICS Inside