Case Study: Marathoner

Problem:

- Runner experiences unilateral quadriceps (mainly VMO) and hip flexor's cramping during races.
- Problems are specific to the left side
- Nutrition and Hydration has already been assessed
- Under S&C advice, he has addressed flexibility issues in his hips and worked on strengthening VMO

Aim:

Use MotionMetrix Marker less 3D analysis to see if we can see any functional issues. Use the system to spot any missing links from previous 2D assessments.

Assessment Screens and Parameters:

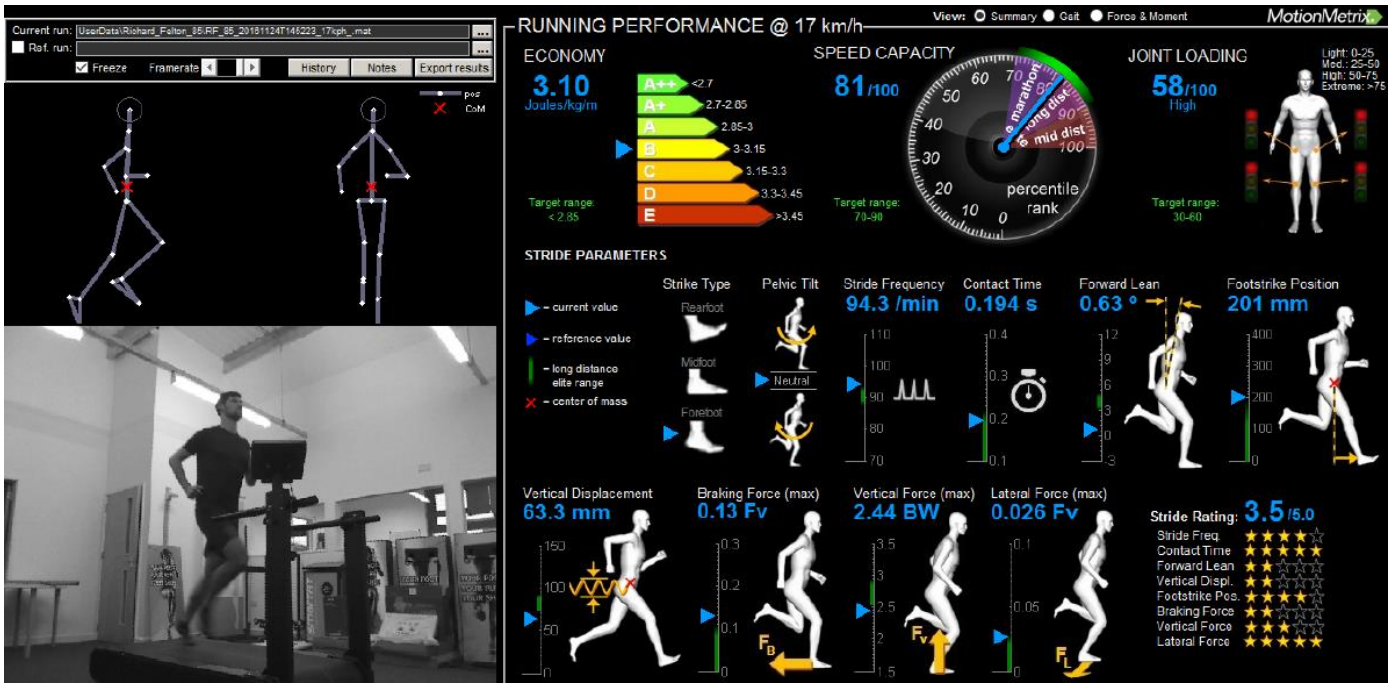

Fig1. Summary Screen. First page of the analysis. Text in light blue and the light blue arrows indicate the runners scores/values. The green areas are the target ranges based on height, weight and optimal ranges that have been gathered from 600 elite runners

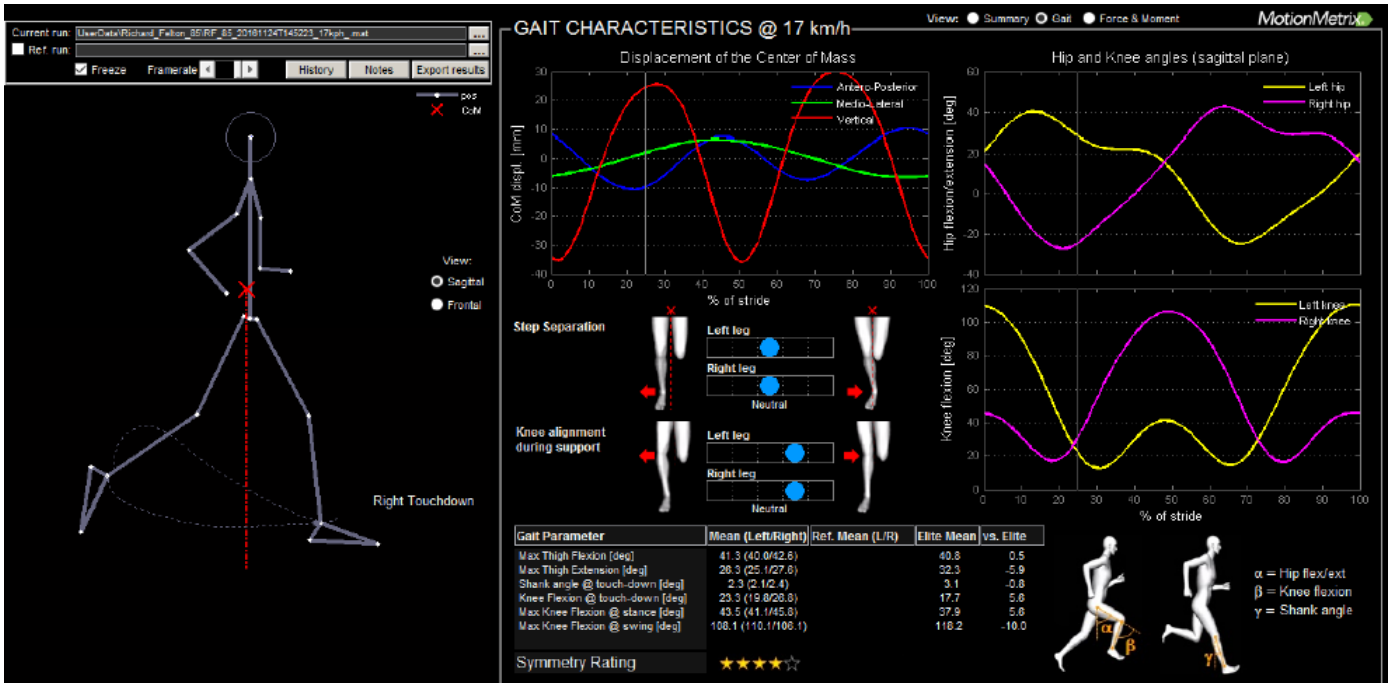

Fig2. Gait Characteristics Screen. 2nd page of the analysis. Assess flexibility and ranges of the knees and hips, the step alignment characteristic's and the ankle/foot angle at contact

Fig.3 Forces & Moments screen. 3rd page of the Analysis. Assess forces and moments in all 3 planes.

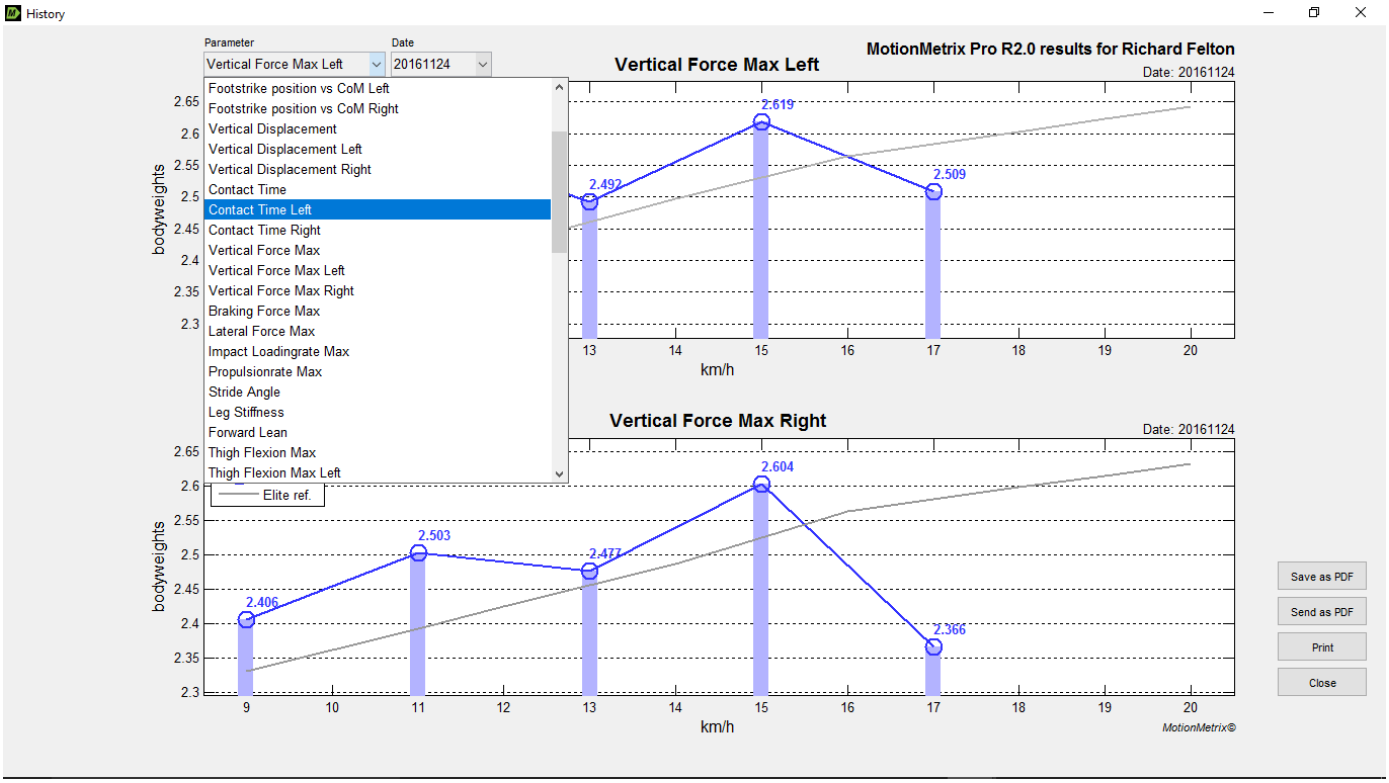

Fig4. Customisable analysis and reports screen featuring 61 measured parameters that can be used to assess the runner at different speeds. The Blue bar is the runner, the black line is the optimal data based on 600 elite runners.

Findings:

- Vertical Force difference between left and right immediately stands out as being significantly different and showing big asymmetry **(See Figures 3 and 5)**
- As the pace increases closer to the runners marathon race pace (17kmph) the right side has a big drop in force application. The left side has to begin to overcompensate for this**. (See Figure5)**
- At race pace the left leg is contributing 5.7% more than the right side. This can be a huge contributor to the left side VMO and hip flexor issues
- Right side displays higher knee flexion at contact (8 degrees higher) and during mid-stance (4 degrees higher). A further indicator of weakness on the right side. Further asymmetry. **(See Figures 2 and 6)**
- Ground contact time is longer on the right side at a slower speed but once the runner hits race pace this then switches to the left side. Further adding to the runners overload on the left side at race pace **(See Figure 7)**
- Stride frequency is very high at marathon pace when compared to optimal elites and his height (188.6 steps per minute) **(See Figure 1)**
- Braking and lateral forces are also high and continue to increase as the runner approaches race pace. This Suggest the runner's eccentric control and strength is too low or inefficient **(See Figure 1 and Figure 8)**

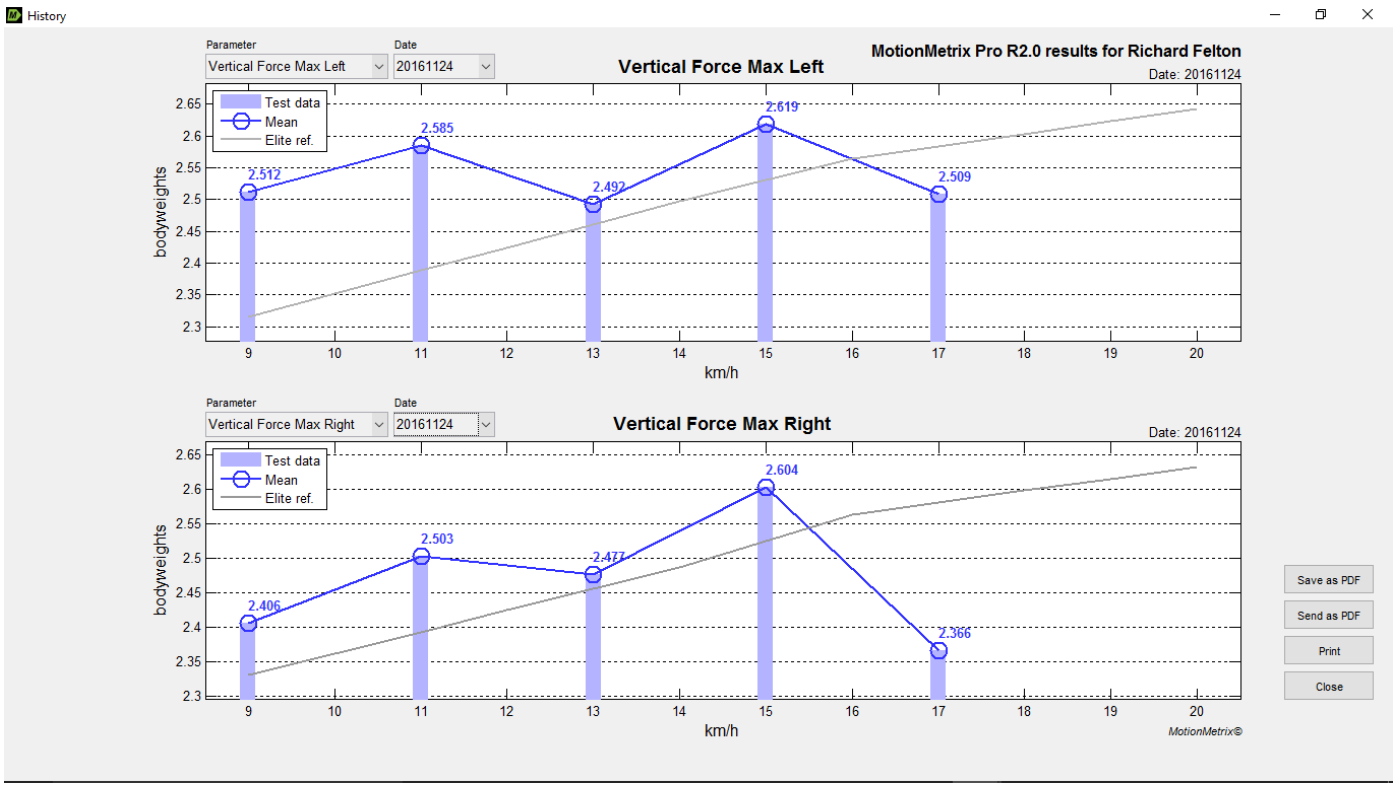

Fig5. Vertical Forces (blue bar) at each tested speed. Black line is the optimal elite target. Significant drop in force on the right side at 17kmph.

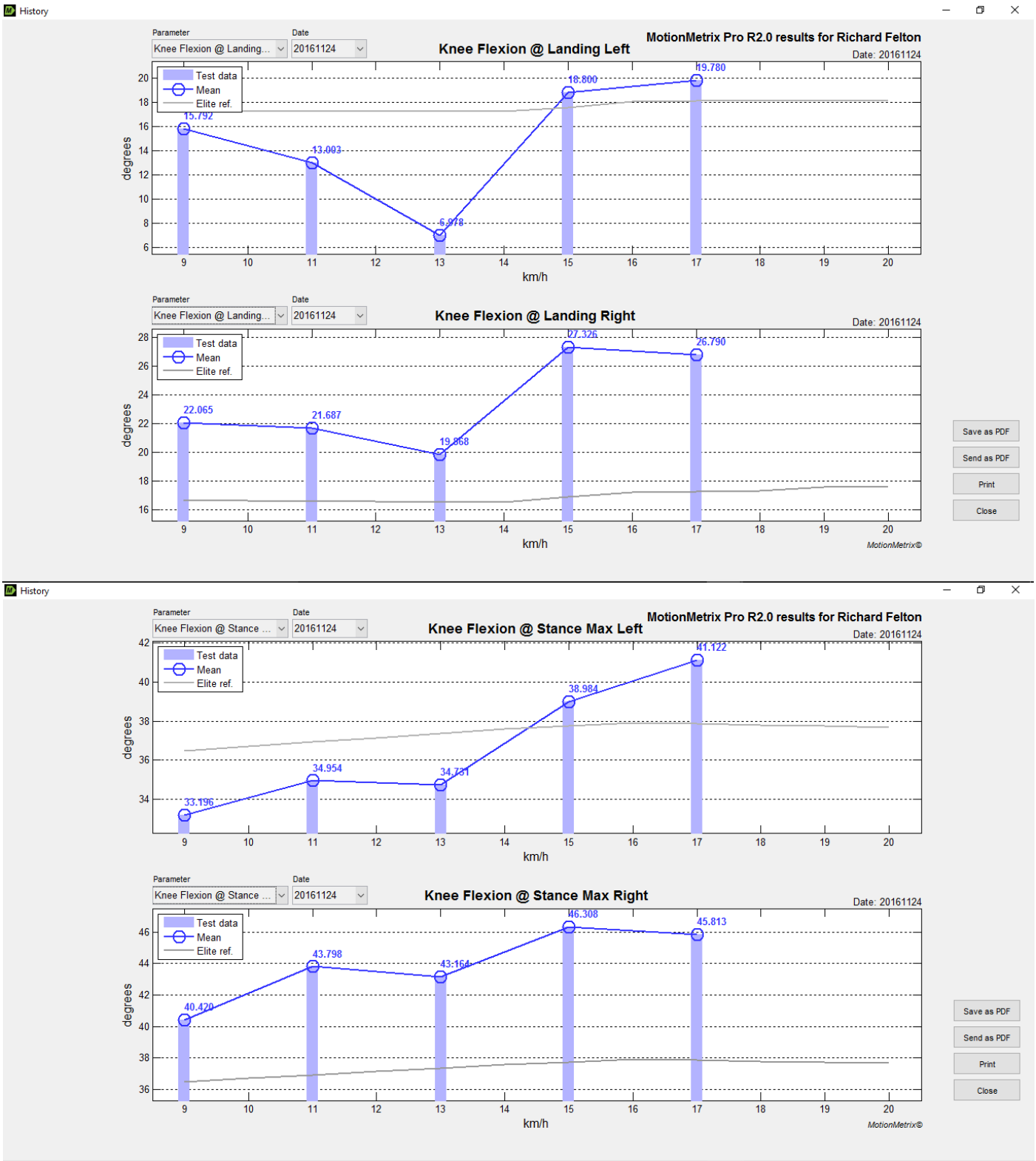

Fig6. Knee flexion degrees at different speeds during initial contact (top two graphs) and stance phase (bottom two graphs).

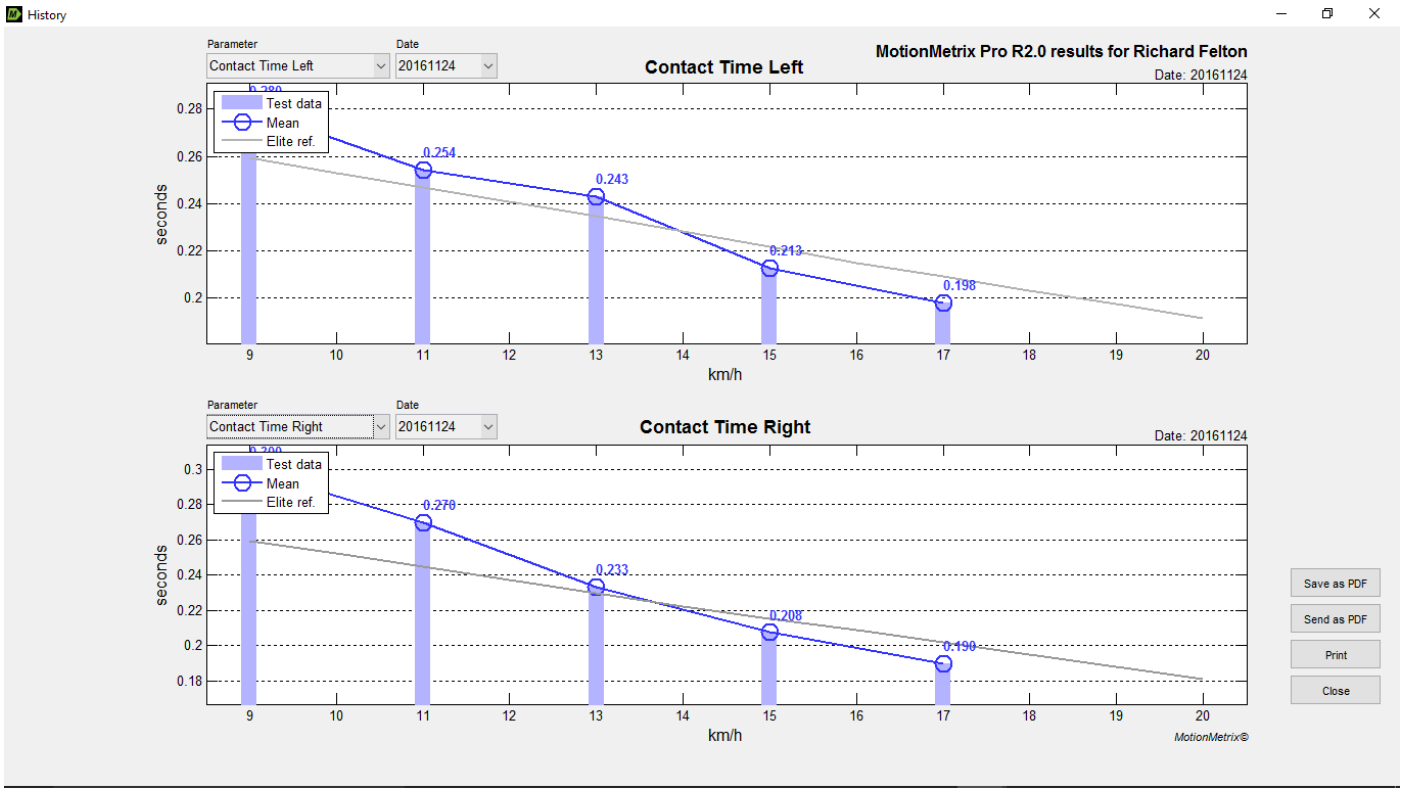

Fig7. Ground contact time changes as the speed changes. Left side spends longer on the ground at higher speeds (15 & 17kmph)

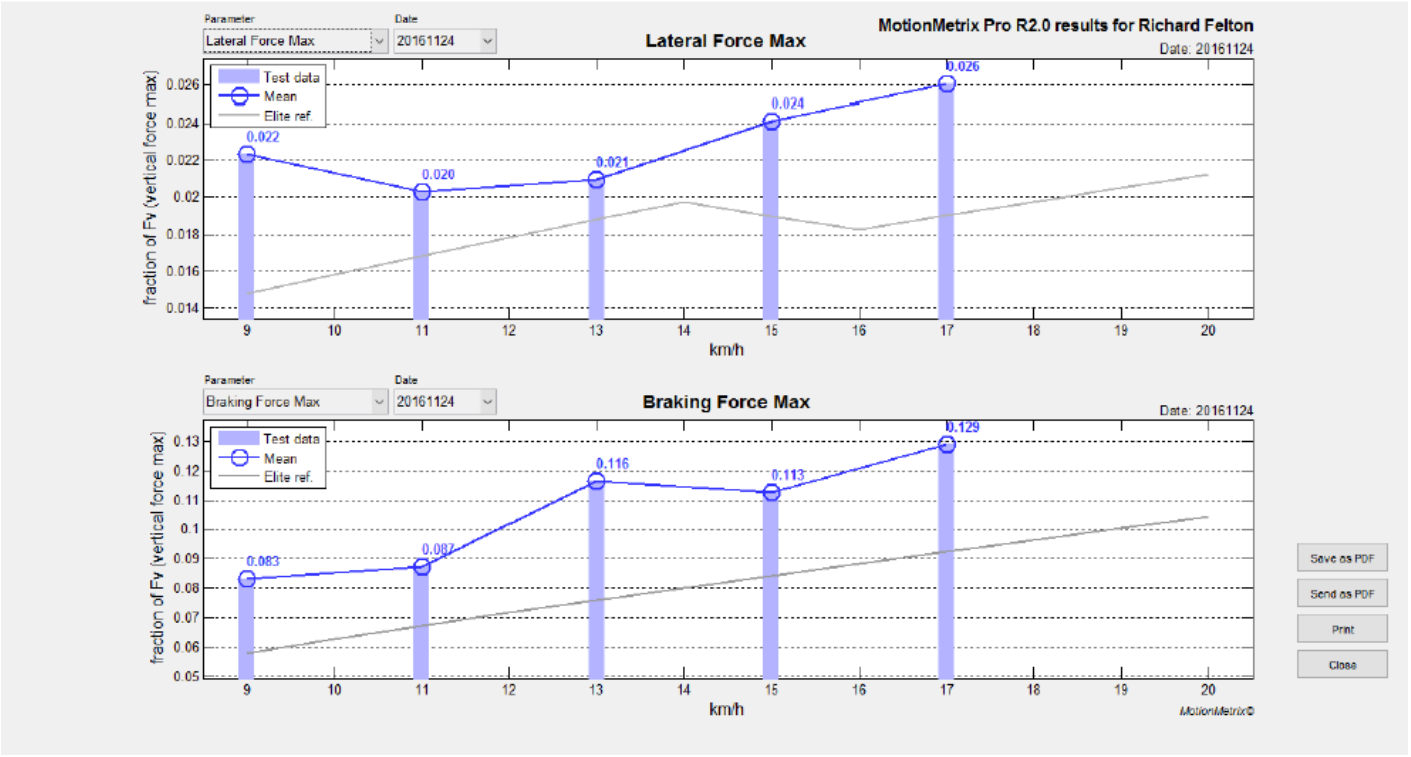

Fig8. Lateral force and braking force changes at different speeds

Summary and Recommendations:

- The majority of issues actually appear to be left side related particularly when looking into vertical forces

- At higher speed, the runners right side has a huge drop in power and force and creates a lot of asymmetry in frontal plane mechanics

- We recommend the runner works on Right side strength and power, with exercises that can be done single leg. Some introductory plyometric exercises would be a great starting point. Once the strength and functionality has improved we can re-test on MotionMetrix to track overall changes and assess what further work may be needed

- We also recommend the runner works on the eccentric phase of the posterior chain muscles in order to help control the braking forces and prevent the knee from excessively flexing during the contact phases of the gait cycle.

- Have a second analysis done in 6-8 weeks. We would want to address some of the other issues that we spotted at slower speeds to, hopefully the strengthening work will help this too but it is worth another look to assess this.

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