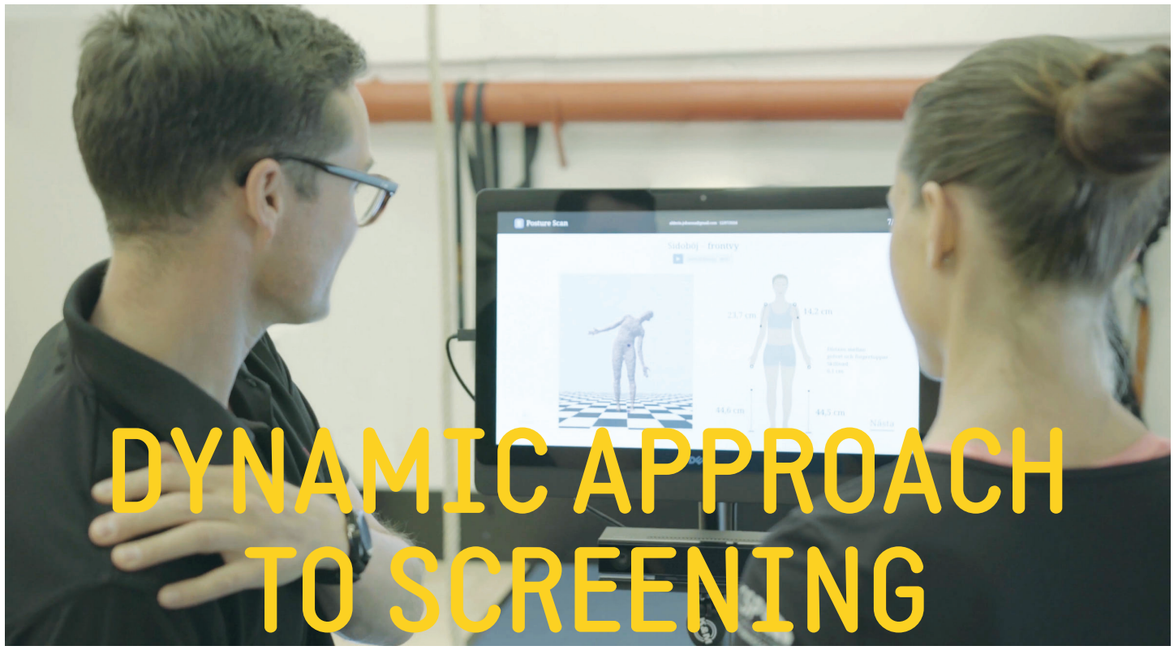


# DYNAMIC APPROACH TO SCREENING

QINEMATIC CEO AND PHYSIOTHERAPIST GLENN BILBY HIGHLIGHTS A DIGITAL APPROACH TO MOTION SCREENING AND ANALYSIS WITH REFERENCE TO THE KNEE.

Like most physiotherapists and sport scientists, I have spent much of my career observing, measuring and documenting function. It can be time consuming, and is often neglected to make more time for treatment, which I think is a mistake for a knowledge profession. In my experience, the ability to accurately identify existing or potential movement-related disorders, and to develop individualised strategies for prevention or rehabilitation, is what separates physiotherapy from personal training. I am fortunate to have had access to expensive digital technology for measurement and assistance in decision-making during decades of practice in sports medicine and insurance medicine. However, I have had my time working analogue in hospitals and private practice, ironically under the pretence of 'lean' healthcare (digital is lean), and mostly because of resistance to change. In our profession, 'observation' without objective measures is generally considered good enough, while other industries embrace the 'quantified-self'— supermarkets know when a woman is eight months pregnant from the data attached to her loyalty card. Qinematic® is an affordable service that brings health providers into the digital age, with 3D video recording, instant metrics, animated feedback for clients, instant documentation, and the opportunity for big data analysis.

The area of kinesiology and kinesiopathology is complex. It can be confusing for clients and difficult to communicate to colleagues using traditional text and imaging. Through digital services, we have the opportunity (and responsibility) to demonstrate to clients, funding agencies and each other, objective benchmarks, accuracy of diagnoses, intervention selection, client engagement, and economic benefit. With longitudinal data about individuals, aggregate data for populations of patients, and correlations with health provider choices, we can innovate and evolve as a profession. Digital measures enable unbiased and real time 'practice-based evidence', in addition to traditionally retrospective and often biased 'evidence-based practice'. Furthermore, we can introduce and monitor the health economic benefits of modern services such as telemedicine, collaborate diagnoses, and triage.

In sports medicine, I am primarily interested in enhancing performance and avoiding injury, followed by rehabilitation of the injured athlete. This attitude is somewhat different to the 'fix it when its broken' mandate of lean healthcare systems around the world. The only way we can transition from 'sick care' to 'healthcare' is to collect data that helps us communicate the value we add to the lives of individuals, employers, teams, healthcare systems, and payers before people get 'sick'. Therefore, we need data that reflects our expertise in human movement.

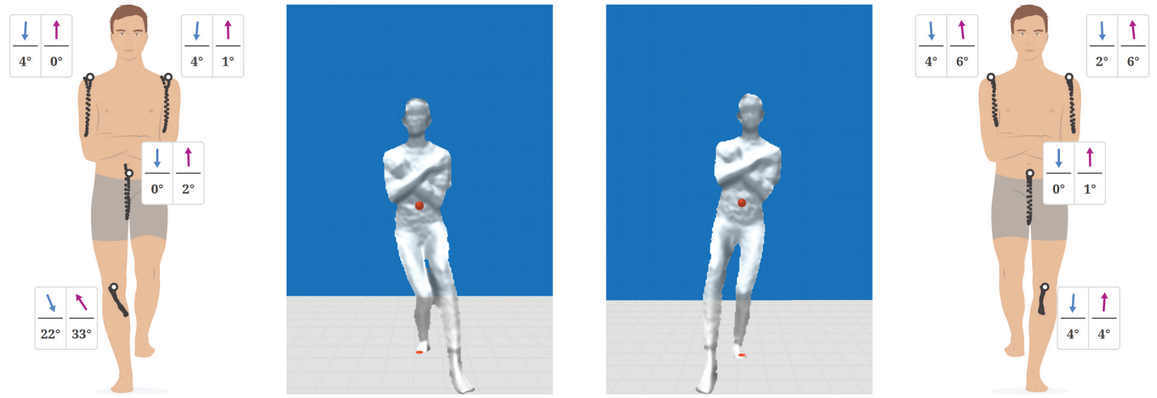
Let me illustrate my point by showing a few simple examples of how digital assessment can assist in quantifying movement patterns, identifying compensation strategies, and communicating findings that involve the knee. Many lab studies involving intersegmental kinematics of the single leg squat (SLS), such as Crossley et al (2011), have inspired the Qinematic protocols.

Subject one is an adult athlete demonstrating a significant difference in the way he uses his body during SLS. The right knee trajectory is excessive at 22 degrees, and travels medially and in a relatively straight line in the fontal plane, landing 4.5 cm medial to the start position. Current consensus is that 10–12-degree frontal plane trajectory is normal; however, we have yet to investigate this using big data. Many would say that the right knee is exposed to an increased risk

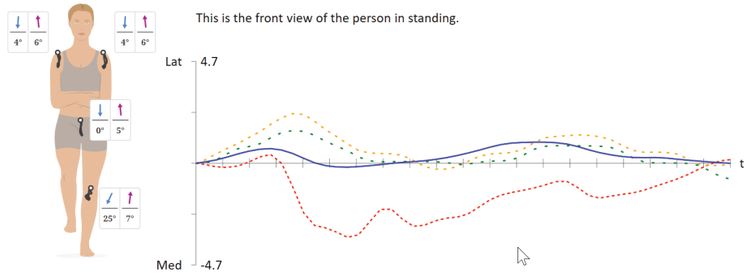




**Subject one:** basic feedback screen after SLS




**Subject two:** biomechanics reporting showing only 1.3 cm medial drift of the knee, but significant oscillation (red line).

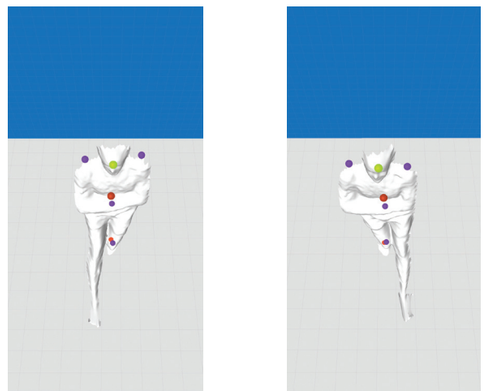



| Segment | | Vertical Shift | | Lateral Shift | Trajectory Angle | |
|---|---|---|---|---|---|---|
| | | cm | % diff | cm | deg | diff |
| Left shoulder | down | 9.9 | 3% | 0.5 | -4 | -10 |
| Left shoulder | up | 9.7 | | -0.6 | -6 | |
| Right shoulder | down | 9.4 | -6% | 0.2 | -4 | -10 |
| Right shoulder | up | 9.9 | | -0.9 | -6 | |
| Left knee | down | 7.6 | -9% | -1.3 | -25 | -18 |
| Left knee | up | 8.4 | | 1.5 | 7 | |
| Hips | down | 9.8 | 4% | 0.9 | 0 | -5 |
| Hips | up | 9.5 | | -0.9 | -5 | |

of degenerative or traumatic injury. Looking at the 3D video in the Qinematic Movement Lab software, the movement is predominately right hip adduction, and would probably respond quickly to simple closed chain hip abduction exercises.

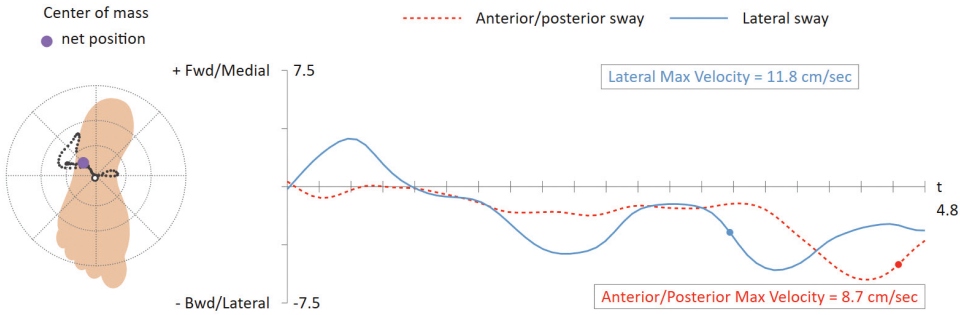
Subject two also has an inward angle of 25 degrees, but the nature of the movement is less controlled. Although the absolute knee position at the bottom of the squat is only 1.3 cm medial to the start position, the path of the knee is oscillatory. 3D video shows that she has poor control of hip internal/external rotation in the eccentric phase. A potential candidate for patellofemoral problems? Probably responsive to some simple hip rotation control exercises.

Subject three is a 50+ year-old sedentary worker, and very active as a recreational marathon runner. He gets knee pain that is unrelated to the volume or intensity of running. During his animated feedback, he was surprised to see the inwards trajectory of his knees (left = 39 degrees, right = 50 degrees), and recognises that he needs to address the issue— the first phase in getting patient compliance. Overhead 3D video shows



**Subject three:** helicopter view 3D video shows the right hip rotating the knee medially, beyond the foot and the centre of mass shadow (red dot) on the floor. The left hip is mostly adducting with some pelvis/trunk rotation.

t significant oscillation (red line).




| Right leg stance (Center of mass) | Sideways | | Forward | |
|---|---|---|---|---|
| | Med | Lat | Fwd | Bwd |
| Displacement (%) | 13.3 | 86.7 | 0.4 | 99.6 |
| Sway area (cm²) | 28.0 | | | |

**Subject four:** showing a very unstable right stance, with foot pronation, hip adduction, and excessive lateral flexion of the trunk. 4.8 seconds of balance resulted in 28 cm2 of sway, largely in mediolateral direction.

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the left knee adducting and the right knee internally rotating—features easily missed in frontal plane analysis. The feet remain neutral, and the upper body compensate slightly, suggesting that he simply needs to improve hip function; the left leg needs to improve hip ab/abduction control, and the right leg needs to improve hip rotation control.

Subject four is a complex example of the knee being slave to the hip and foot. He is a 50+ year-old sedentary office worker, with a knee replacement. He performed his post-surgical rehabilitation, and was satisfied with the outcome, until he was shown the animated feedback of his performance. Having a communication platform is very important for compliance, patient empowerment and measuring outcomes that are more objective than self-reporting. Slow motion 3D video footage allows us to see the temporal (sequencing) characteristics of his whole body. It is evident that foot pronation and tibial torsion, coupled with poor hip control is compromising the knee, and he could easily become a candidate for a knee revision, and falling. He compensates with his upper body to maintain balance, and this excessive trunk pattern could explain his persistent back pain during walking. The choice of intervention will of course depend on the bias of the health provider—it could be a foot orthotic or retraining of the foot and hip, or both. Regardless, physiotherapy will be far less expensive than a revised knee replacement.

We are well overdue for an easy to use and affordable human 'roadworthy test' that helps us to 'fix things before they are broken' and show outcomes after the 'mechanic' has been under the bonnet. The vehicle industry and the health of individual cars have benefited from digital assessment for many years, and so too can the allied health professions, along with the millions of people with symptomatic and pre-symptomatic movement-related disorders. To better understand human movement, 'big data' analytics must be applied to baseline and post intervention data from all patients, gym members, athletes, elderly people and employees. Putting numbers to a 'good' or 'bad' performance, and relating it to our expertise is the difference between a profession and a craft.

**Glenn Bilby is an Australian physiotherapist and sport scientist who lives in Sweden, ranked the second most innovative country in the world. Glenn is a health innovator, entrepreneur, and course manager of the master's course, Transforming Healthcare, at the prestigious Karolinska Institute. He presented his technology, Qinematic—Dynamic Posture Scanning, to physiotherapists and sport scientists at the APA, in Sydney, in March 2017.**