

Hop analysis report

Subject	Session	Trial	Type
-	5f607aad	hop3_right	triple hop right

Hop metrics

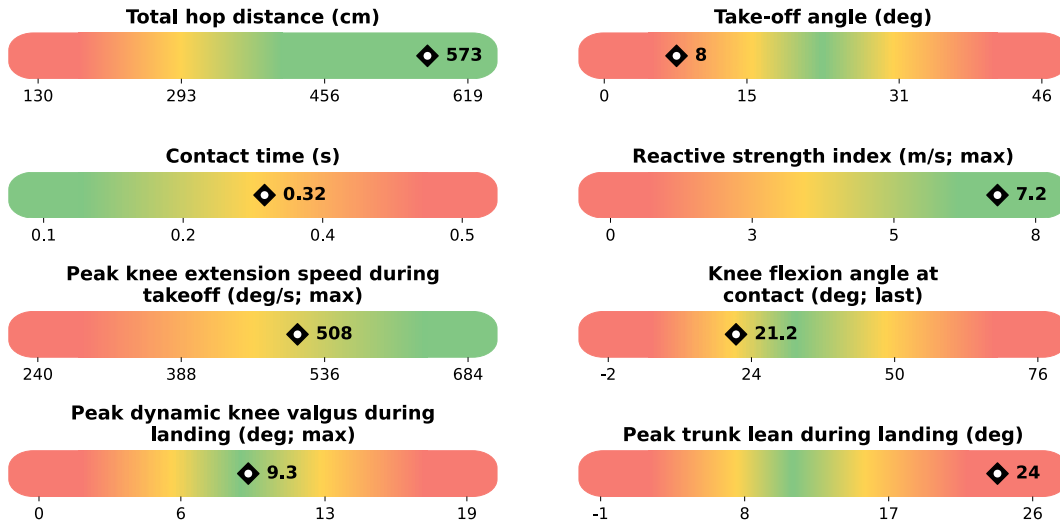


Figure 1: Colors indicate how results compare to normative data from healthy adult populations, comprising both males and females. For directional metrics (where higher or lower is universally better), the top 25% is green, the middle 50% yellow, and the bottom 25% red. For centered metrics (where both extremes are unfavorable), green represents the middle 40% (30th-70th percentile), red the outer extremes (below the 10th or above the 90th percentile), and yellow the transition zones in between. Expected metric values vary by hop type, as single, double, and triple hops have distinct biomechanical demands and normative values. Key events and phases are detected with a mean absolute error of <15 ms. **Lateral hop distance was 40 cm.** Lateral movement may affect total distance and other performance metrics.

Per-hop metrics

Metric	Hop 1	Hop 2	Hop 3
Hop distance (cm)	160	176	243
Take-off angle (deg)	8.7	8.8	5.2
Contact time (s)	—	0.30	0.34
Reactive strength index (m/s)	—	5.8	7.2
Peak knee extension speed during takeoff (deg/s)	360	442	508
Knee flexion angle at contact (deg)	22.3	12.4	21.2
Peak dynamic knee valgus during landing (deg)	6.9	9.3	4.5
Knee excursion during landing (deg)	32.4	49.4	45.9
Hip excursion during landing (deg)	0.8	7.1	18.9
Peak knee flexion angle during landing (deg)	54.7	61.8	67.1
Peak trunk lean during landing (deg)	25.3	18.3	27.8

Description of the metrics

- **Total hop distance** is the straight-line distance from the toe-off position of the first hop to the contact position after the last hop, reflecting overall displacement across the sequence. This measure captures accumulated propulsive output and may differ from the sum of individual hop distances if the path deviates laterally.
- **Hop distance** is the straight-line distance between toe-off and initial contact positions. Greater distances reflect greater explosive power output; reduced values may indicate impaired propulsive capacity, pain avoidance, or neuromuscular fatigue.
- **Take-off angle** is the angle of the take-off vector relative to the horizontal plane. [Wakai and Linthorne (2005)] have shown that an angle between 19° and 27° is optimal for maximizing horizontal hop distance; deviations in either direction reduce distance and may reflect altered propulsive coordination or compensatory strategies.
- **Contact time** is the duration from initial contact to toe-off. Shorter values indicate a more reactive, stiff-spring strategy with greater neuromuscular efficiency; prolonged contact time suggests reduced explosive capacity, pain-related guarding, or impaired stretch-shortening cycle utilization.
- **Reactive strength index (RSI)** is the ratio of hop distance to contact time. Higher values reflect the ability to generate propulsive force rapidly with minimal ground contact, indicating strong neuromuscular power and stretch-shortening cycle efficiency. It is a sensitive marker of readiness and lower-limb explosive capacity.
- **Peak knee extension speed during takeoff** is the maximum angular velocity of the knee joint in the sagittal plane during the propulsive phase. Higher values reflect greater force generation capacity and are associated with increased hop distance and reactive strength; reduced values may indicate neuromuscular fatigue, pain avoidance, or impaired explosive capacity.
- **Knee flexion angle at contact** is the knee flexion angle in the sagittal plane at initial contact. Lower values indicate a stiffer landing strategy with reduced shock absorption capacity, increasing joint loading rates; higher values provide greater impact attenuation but may reduce propulsive efficiency in early contacts of a multi-hop sequence and can reflect pain avoidance or neuromuscular fatigue.
- **Peak dynamic knee valgus** is the maximum frontal-plane knee angle during stance. Positive values indicate knee valgus, negative values varus. Higher valgus angles are linked to increased iliotibial band (ITB) and patellofemoral joint loading and a greater risk of overuse injury, whereas more neutral alignment is generally associated with more favorable knee joint loading.
- **Knee excursion during landing** is the change in knee flexion angle from initial contact to peak flexion during stance. Larger excursions reflect greater knee contribution to impact load attenuation; smaller excursions indicate a stiffer strategy with reduced shock absorption, which may increase joint loading or reflect pain-related guarding.
- **Hip excursion during landing** is the change in hip flexion angle from initial contact to peak flexion during stance. Larger excursions reflect greater reliance on the hip for deceleration and energy absorption; smaller excursions indicate a more hip-stiff strategy, which may shift load to the knee or reflect limited hip extensor control.
- **Peak knee flexion during landing** is the maximum knee flexion angle in the sagittal plane during the contact phase. Insufficient flexion indicates a stiff landing strategy with limited shock absorption, increasing joint loading; excessive flexion may reflect quadriceps weakness, pain avoidance, or reduced capacity to efficiently transfer energy into the subsequent hop.
- **Peak trunk lean during landing** is the maximum angle of the trunk in the frontal plane during the contact phase. Positive values correspond to lean toward the hop leg. Excessive lateral lean may indicate hip abductor weakness or impaired lumbopelvic control, creating uneven load distribution across the lower-limb joints and elevating injury risk; while moderate lean toward the stance leg can aid balance, excessive lean during propulsive phases may reflect insufficient strength or neuromuscular coordination.

Joint kinematics

Lower-body and lumbar joint angles

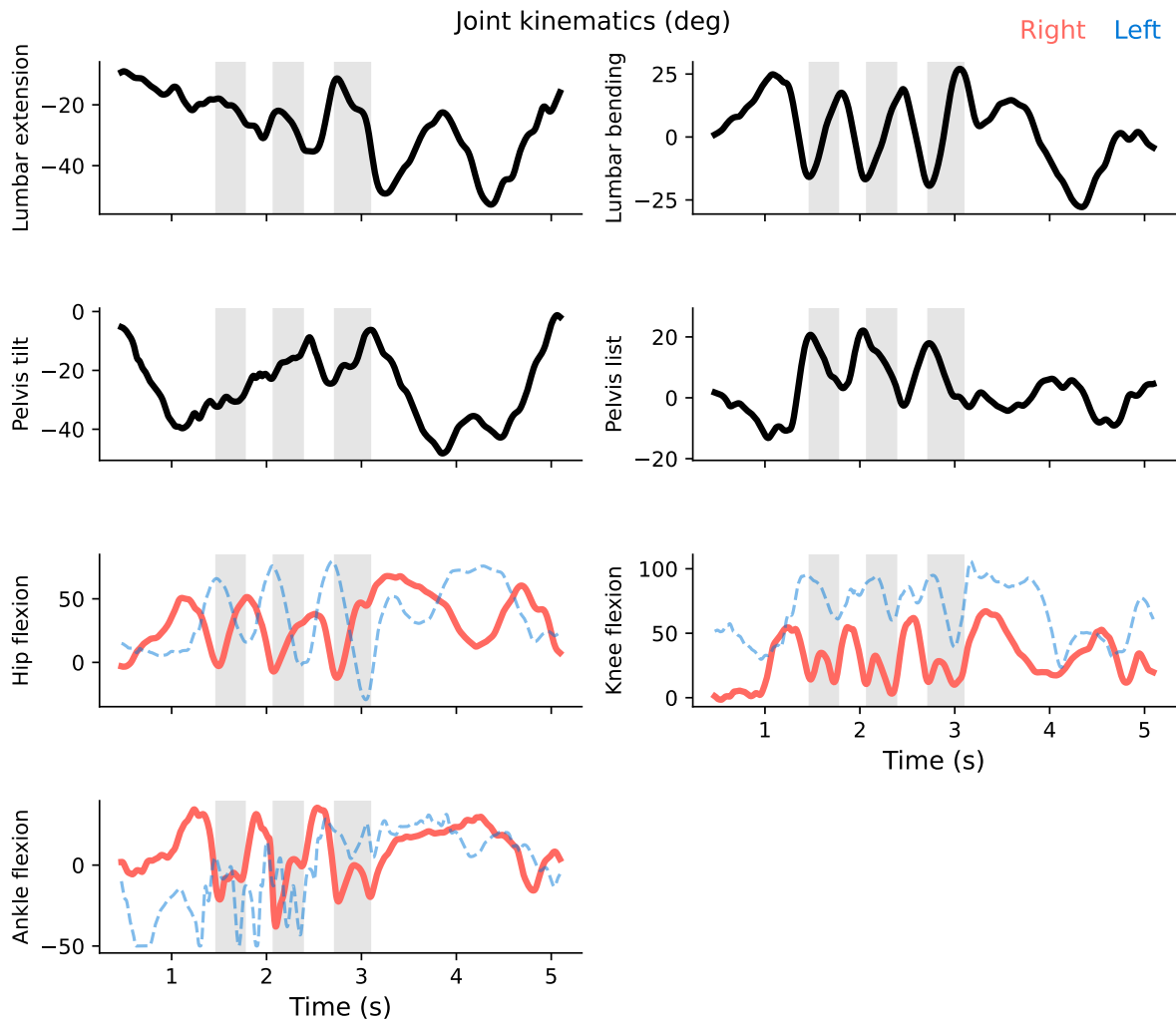


Figure 2: Joint angles (shaded areas indicate air time). Red and blue curves indicate right and left leg, respectively. Typical coordination involves transitioning from deep knee and hip flexion to extension for takeoff. During air time, the knee flexes again before extending for landing.

- Lumbar extension (sagittal plane) is positive when the trunk extends posteriorly.
- Lumbar bending (frontal plane) is positive when the trunk bends toward the right side.
- Pelvis tilt is positive when the pelvis tilts posteriorly.
- Pelvis list is positive when the left side of the pelvis moves upward.

Pelvis translations

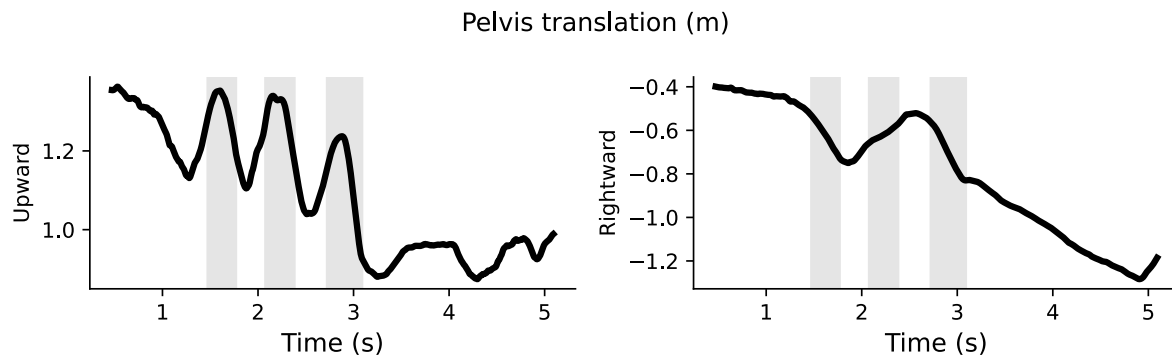


Figure 3: Pelvis vertical and lateral translation (shaded areas indicate air time).