GAIT AND MOTION ANALYSIS LAB

3D RUNNING ANALYSIS

BIOMECHANICAL STRATEGIES FOR PEAK PERFORMANCE AND INJURY PREVENTION

The Running Report

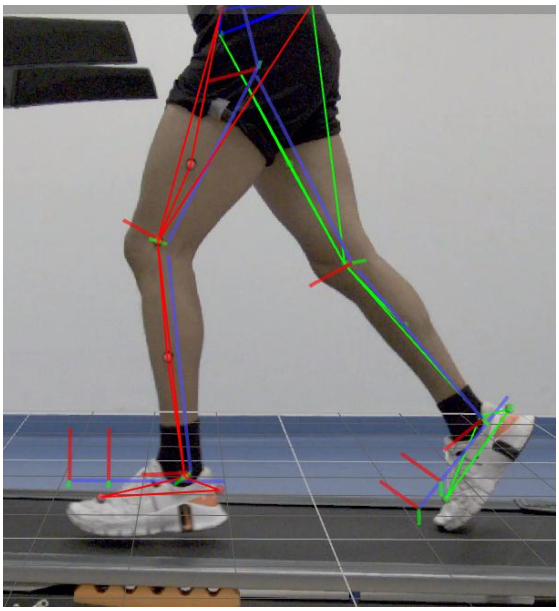
This report presents a comprehensive biomechanical analysis of running gait based on 2D and 3D kinematic assessments, and clinical parameters.

The analysis provides an in-depth view of the athlete's movement mechanics. All measured values are compared against established normative data from current scientific literature, ensuring a robust and objective evaluation.

By identifying subtle deviations or inefficiencies in the running gait, this report aims to:

- optimize athletic performance
- prevent potential injuries
- assist in the treatment of existing musculoskeletal issues.

The insights provided here are intended to guide targeted interventions, corrective strategies, and personalized training programs.



A complete 2 and 3-Dimensional Analysis

Note: Slow-motion videos from side and rear views are sent along with this report to help you better visualize and understand the described movement patterns.

Clinical Assessment

Date of Evaluation:	
Name: John Doe	**ID: 00XRun**
Age: years	**Gender:**
Height: cms	**Weight: Kgs**

Primary reason for visit:
History of running related injuries:

Any relevant medical history (Asthma, Cardiovascular, arthritis, LBP, others)**:**

Running History

- Years Running: -
- Typical Weekly Mileage: Kms
- Surfaces: ☐ Road ☐ Trail ☐ Treadmill ☐ Track
- Footwear Preference: Cushioned (Nike/Puma)
- Racing: ☐ Yes ☐ No – If yes, distance(s):

Subjective Complaints: Pain –
Location: *Severity* (0-10):
Aggravating factors: *Relieving factors*:

Clinical Assessment:
Posture: Forward head☐ Kyphotic ☐ Lordosis ☐ Sway ☐

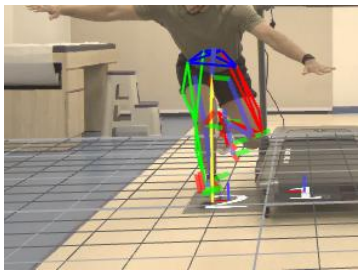
	Right	**Left**
Strength Assessment		
Gluteus Maximus		
Gluteus Medius		
Core		
Foot Assessment:		
Arch type	☐ High ☐ Neutral ☐ Low	☐ High ☐Neutral ☐ Low
Rearfoot alignment	☐ Varus ☐ Neutral ☐ Valgus	☐ Varus ☐ Neutral ☐ Valgus
Rearfoot alignment with Heel Raises	☐Varus ☐ Neutral ☐ Valgus	☐ Varus ☐ Neutral ☐ Valgus
Too Many toes Sign		
Plantar fascia Stretch test		
Special test:		
Ober Test		
Thomas Test		
Popliteal Angle (bilateral)		
Silfverskiöld Test		
Patellar grind (Clark test)		
Limb length		

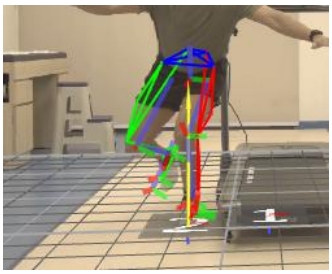
Other Comments:

Kinematic Assessment of Single Limb Squat

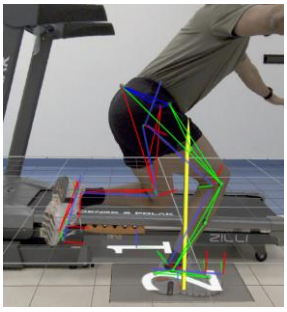
	Right	Left
Knee Flexion		
Dynamic Knee Valgus		
Hip Adduction		
Contralateral Pelvic Drop		
Knee adduction moment	Nmm/Kg	Nmm/Kg

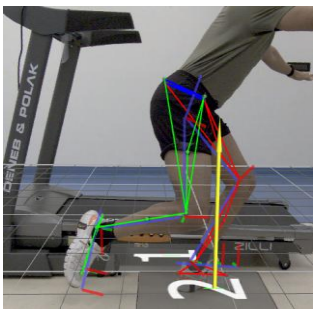
Coronal View



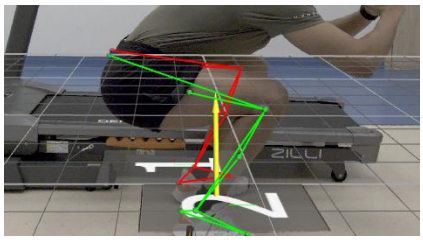


Sagittal View





Kinematic Assessment of Double Limb Squat



3-D Running Analysis Report

Spatio-tempral Parameters

Cadence

It is the number of steps per minute. It decides running speed and efficiency. Higher cadence decreases over-stride.

Subject value:

Normal values: >165

Stride Width

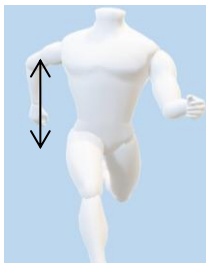
It is the distance between your feet while running. Very narrow or very wide steps suggest hip abductor muscle and IT Band dysfunctions.

Subject value:

Normal values: 0.5 to 6 cms

Vertical Displacement of Center of Mass

This is the amount of up and down movement of your body. Excessive amount could cause reduced efficiency and speed. Also, excessive vertical displacement increases force impacts over joints.



Subject value: cms

Normal values: 6-10 cms

Foot Progression Angle

This describes the knee toe alignment

Subject value: R-°, L-° toe out

Normal values: 5° to 13° out-toeing

Ratio of Stance and Swing phase

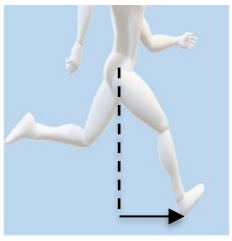
This describes the ratio of foot in contact and flight time.

Subject value:

Normal values: <40 for stance and > 60 for swing

Distance between strike and COM

This indirectly measures over-striding

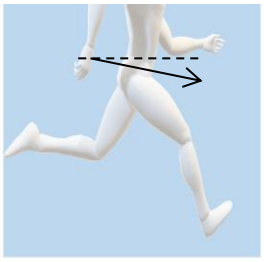


Subject value: R- cms, L-cms

Normal values: Increased values suggest over-striding

Pelvic Movements

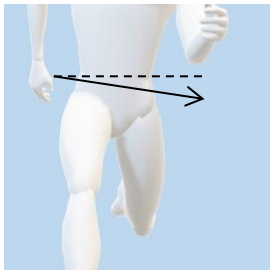
Anterior pelvic Tilt



It is the forward and backward movement of the pelvis. Athletes with tight hip flexors have anterior tilt that reduces gluteal efficiency and hip extension during strides.

Subject value: **R-° ,L-°**
Normal values: 4° to 6°

Lateral Pelvic Drop

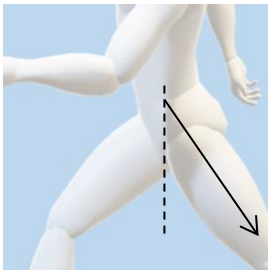


It describes the up and down tilt of the pelvis sideways. Excessive pelvic drop suggests hip abductor weakness.

Subject value: **R-°, L-°**
Normal values: 0- 5° for males; 7° for females

Hip Joint Movements

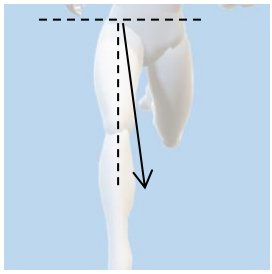
Hip extension at Toe-off



It is the backward movement of the hip just before your foot comes off the ground and increases with increasing running speed.

Subject value: **R- °, L- °**
Normal Values: 1° to 3°

Hip adduction



It is the side-to-side movement of thigh. Abnormal movements are associated with several running related injuries.

Subject value: **R-°, L-° abducted**
Normal Values: 8° to 13°

Hip internal rotation

It is the axial rotation of the thigh. Excessive internal rotation is associated with hip adduction and suggests hip abductor weakness

Subject value: R- °, L- °
Normal Values: 4°-15°Internal rotation

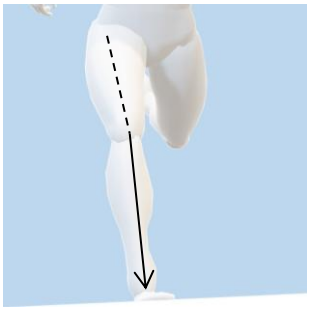
Knee Joint Movements

Knee Flexion at foot strike

It is the amount of bending of knee at contact that decides ideal shock absorption. Reduced values suggest over-striding.

Subject value: **R-º, L-º**
Normal Values: 9°-17°

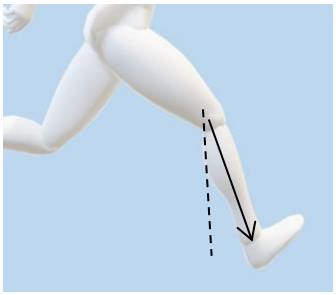
Knee Varus/Valgus-



It is the amount of knee collapsing inwards while running. It is associated with lateral pelvic drop, hip adduction and internal rotation. Excessive drops suggest hip muscle weakness.

Subject value: **R-° valgus, L- ° valgus**
Normal Values: 3°-10°

Tibial Inclination-

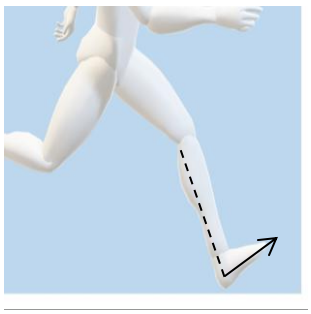


It is the angle between the shin and the vertical. A higher angle suggests greater knee extension at heel strike and breaking forces.

Subject value: **R-º, L- º**
Normal Values: 0-10º

Ankle Joint Movements

Dorsiflexion at Foot Strike



It is the up and down movement of ankle. This indirectly suggests the striking pattern - hindfoot, midfoot or forefoot strike. Excessive dorsiflexion suggests heel striking that causes inefficiency and poor shock absorption.

Subject value: **R-°, L-°**
Normal Values: variable

Eversion
(Peak and Range)

It is the amount of inward movement of the foot, also called as pronation. Excessive amounts are associated with poor shock absorption.

Subject value: **R –°, L-° eversion**
Normal Values: 1°-6°

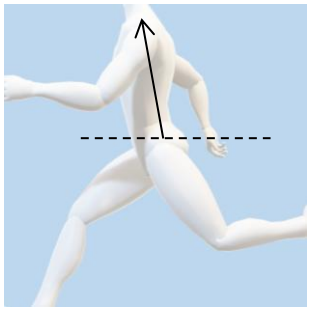
Eversion Velocity

It is the speed with which the foot everts when making contact. Very quick eversion suggests poor control of foot.

Subject value: **R –°/sec, L- °/sec**
Normal Values:

Trunk and Arm movements

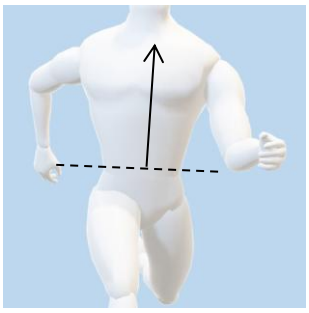
Forward Trunk Lean



This is the amount of forward bending of spine during running. This affects efficiency and foot striking. Excessive or reduced lean is detrimental to speed.

Subject value: °
Normal values: 3°-7°

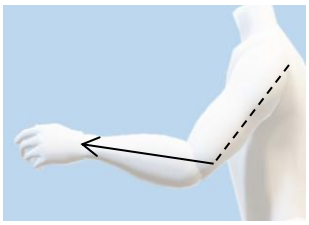
Lateral Trunk Lean



This is the amount of side to side bending of spine during running. Excessive amounts cause inefficiency.

Subject value: ± °
Normal values: ± 5° from vertical

Elbow flexion



Though highly variable across athletes, check for tension in elbows/hands if too flexed.

Subject value: **R- °, L-°**
Normal values: Variable

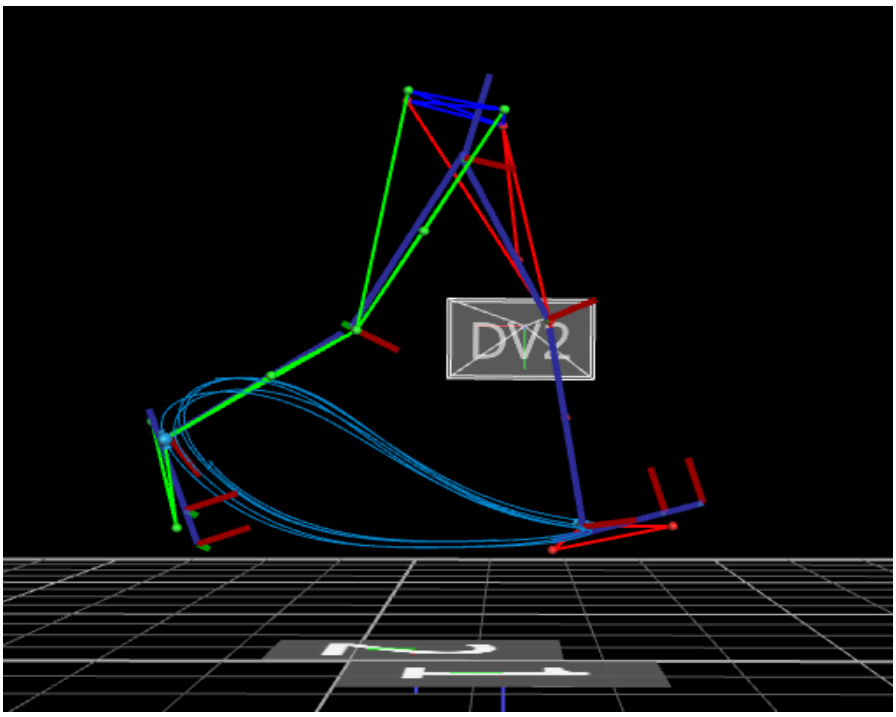
Arm forward and Back Swing

This describes how far you swing your arms forward and backward.

Subject value:
Normal values: variable; forward hands avoid crossing midline and approximately 2/3rds of forearm length is at trunk midline during backward swing.

Symmetry of Running Strikes

The trajectory of foot strikes bilaterally is compared to check for asymmetry. Difference in the shapes of the trajectory and peak heights suggest unequal power generation from lower extremities.



There is no difference between the left and right heel lifts for the subject.

Summary

The subject performed single-leg squat testing and running analysis trials on a treadmill while wearing athletic footwear. The 3-dimensional kinematic data was collected using VICON Vero 2.2 cameras synchronized with FLIR video camera at 100Hz.

Below, we discuss our main findings.

Dr Vandana Phadke
Consultant Clinical Scientist
Gait & Motion Analysis Lab

Disclaimer

The results presented in this 3D running analysis are based on comparisons with normative data published in scientific literature. It is important to note that individual anatomical and biomechanical differences exist, and as such, findings must be interpreted within the context of each person's unique characteristics. This report is intended for use by trained healthcare professionals who can appropriately analyze and apply the information to clinical or performance-related decisions. While every effort is made to ensure measurement accuracy through strict marker placement protocols and the use of trained personnel, minor errors may still occur and should be considered when interpreting results.