MICROGATE

JUMP ANALYSIS BEYOND VERTICAL ASSESSMENT

MULTI-TECHNOLOGY APPROACH FOR COMPREHENSIVE FUNCTIONAL EVALUATION

OPTOELECTRONIC SYSTEMS + INERTIAL SENSORS

MICRO PILLS

CONTEXT

In functional assessment, jump tests provide key insights into neuromuscular performance

FORCE PLATE CONSTRAINTS

Limited surface area restricts natural movement patterns (especially for large-footed athletes), **high costs** limit accessibility, and the small target area may psychologically alter spontaneous biomechanics.

FIELD-BASED ALTERNATIVE

Optoelectronic bars + IMUs provide unrestricted assessment space, **enabling natural movement** execution in ecologically valid conditions.

This approach captures both performance and dynamic control without spatial, economic, or psychological barriers.

THREE VALIDATED PROTOCOLS FOR COMPREHENSIVE ASSESSMENT

Here are three field-based protocols that evaluate jump performance across multiple planes:

DRIFT PROTOCOL

Vertical plane → neuromuscolar control under fatigue

HOP FOR DISTANCE

Horizontal plane → propulsion + dynamic stability

SIDE HOPS

Frontal plane → lateral control + reactive endurance

Each protocol provides specific biomechanical insights when integrated with IMU data.

DRIFT PROTOCOL NEUROMUSCULAR CONTROL UNDER FATIGUE

PROTOCOL EXECUTION

5 maximal vertical jumps per leg (10 total).

KEY PARAMETERS

- Mean jump height + bilateral asymmetry
- Area occupied by 5 landings
- **Power Density = Power / Area**

This metric combines power output with landing control. High power with poor control highlights motor control deficits rather than strength limitations.
High bilateral asymmetry is associated with increased injury risk.

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DRIFT 2D PROTOCOL

Athlete

Last name: 2 **First name:** 2

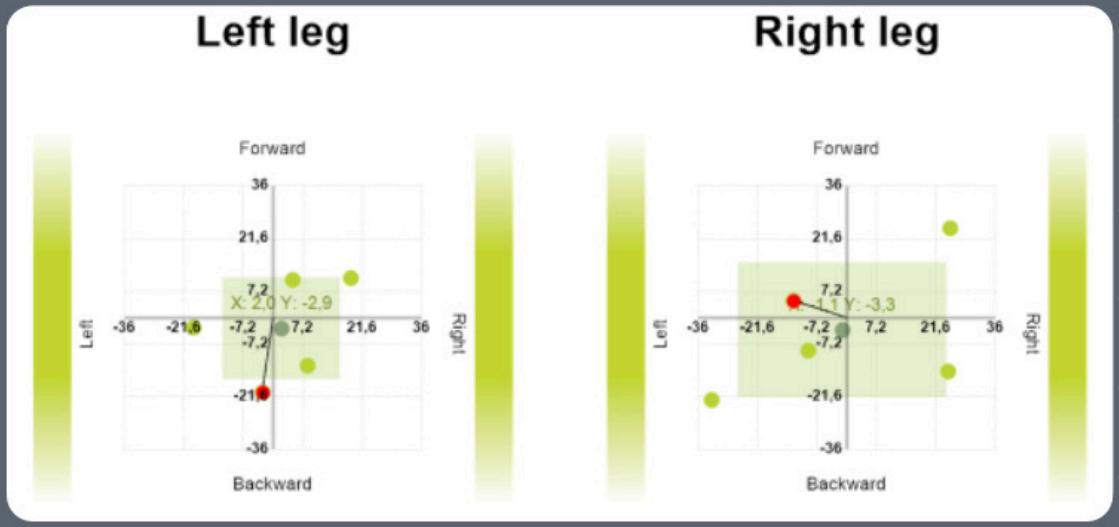
Gender: M

DRIFT 2D PROTOCOL

	L	R	Delta%
Average height[cm]	22,1	24,8	-12,1%
Average power[W/kg]	23,84	27,07	-13,6%
Average contact time[s]	0,309	0,297	3,9%
Average flight time[s]	0,424	0,449	-5,9%
Average LEFT/RIGHT drift[cm]	2,0	-1,1	157,6%
Average FRONT/BACK drift[cm]	-2,9	-3,3	-14,4%
Standard deviation LEFT/RIGHT drift[cm]	14,2	25,3	-78,2%
Standard deviation FRONT/BACK drift[cm]	13,9	18,4	-32,7%
Area[cm²]	788,0	1863,4	-136,5%
Power Density[W/kg/dm²]	3,02	1,45	52,0%
Verticality	1,386	1,006	27,4%

KEY POINT

HIGHER POWER ≠ HIGHER NEUROMUSCOLAR CONTROL



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HOP FOR DISTANCE HORIZONTAL PROPULSION

PROTOCOL EXECUTION

3 maximal single-leg broad jumps per leg. Landing must be held stable for 3 seconds to be valid.

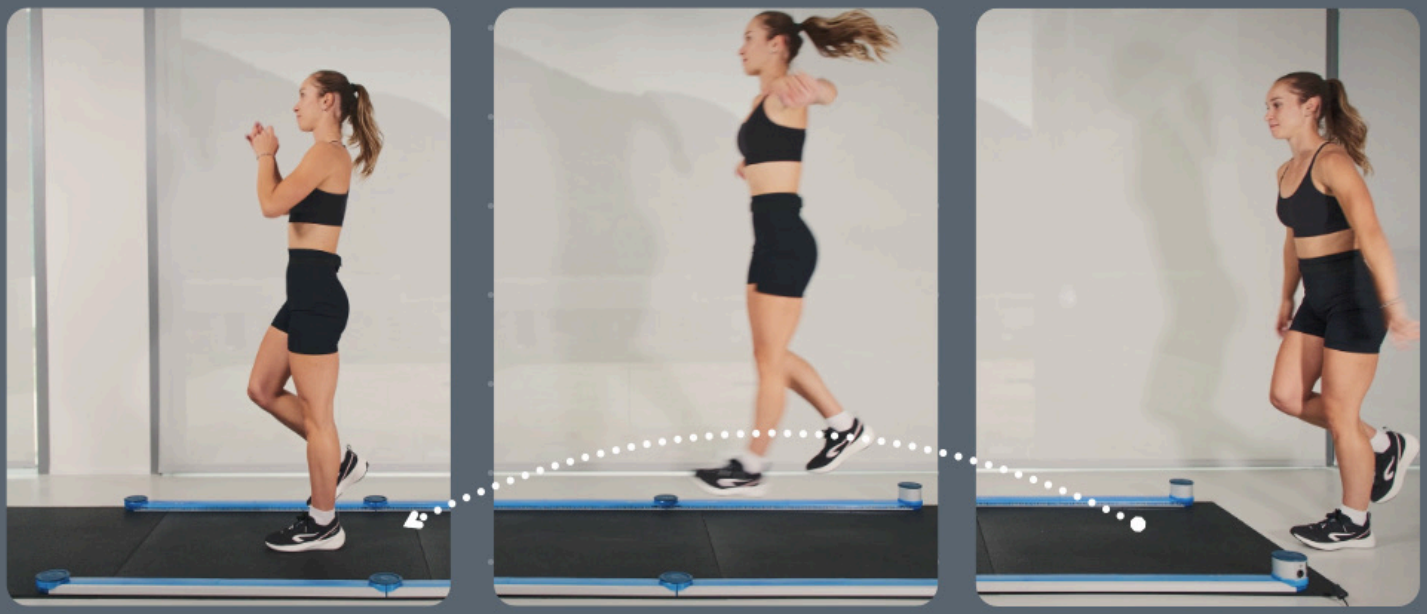
OPTOELECTRONIC SYSTEM MEASURES

Distance covered (cm)

CLINICAL RELEVANCE

Distance quantifies horizontal propulsion capacity, essential for sports requiring explosive forward movements (sprinting, jumping sports).

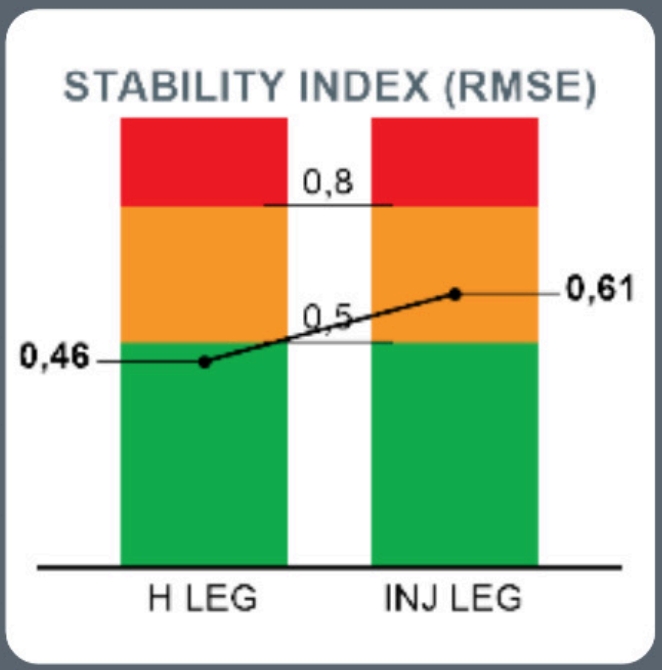
However, distance alone provides incomplete information. Landing quality is equally critical.



INERTIAL SENSORS THE MISSING DIMENSION

IMU PARAMETERS

- Post-landing stability
- Time-to-stabilization
- **Stability Index** (RMSE)



CLINICAL INTERPRETATION

Normal jump distance with high RMSE suggests reduced dynamic stability and higher injury risk. **Performance and control must always be interpreted together.**

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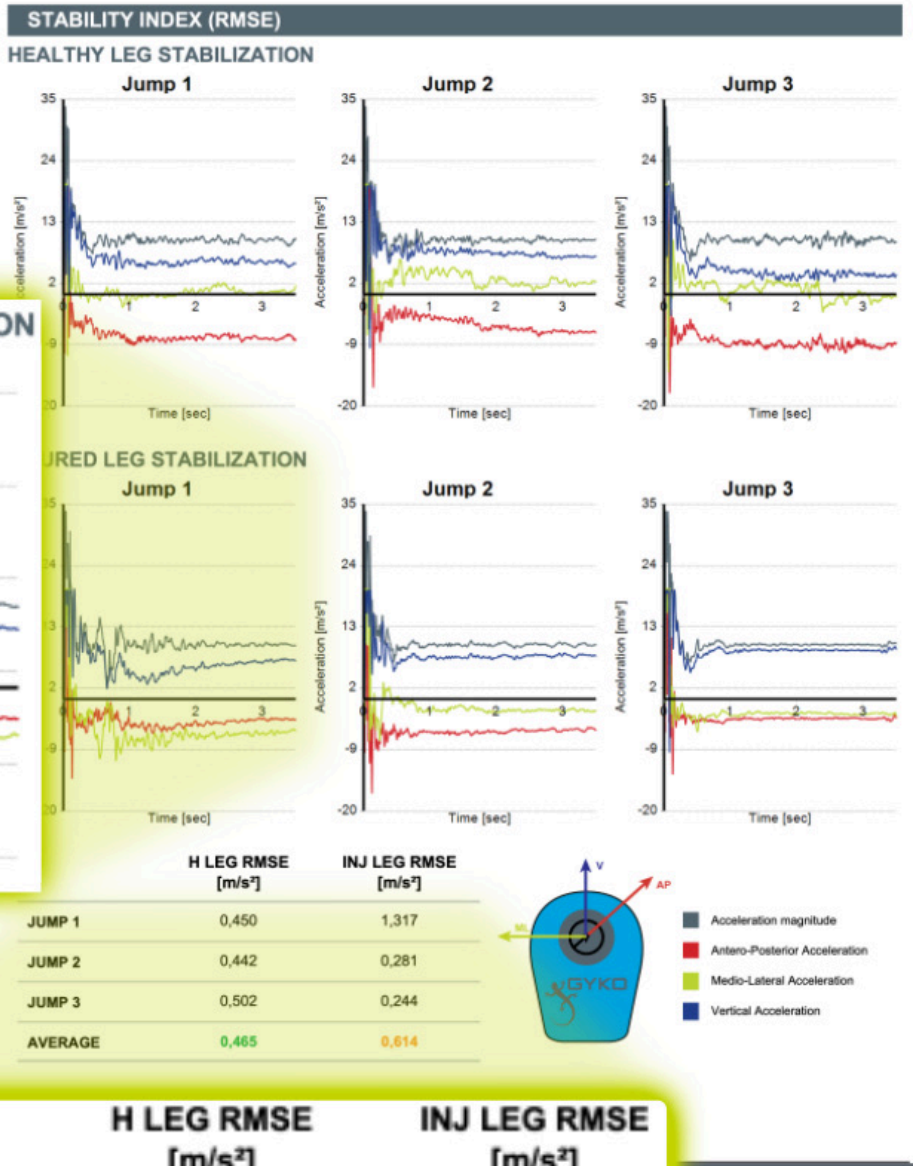

	H LEG RMSE [m/s²]	INJ LEG RMSE [m/s²]
JUMP 1	0,450	1,317
JUMP 2	0,442	0,281
JUMP 3	0,502	0,244
AVERAGE	0,465	0,614

	H LEG RMSE [m/s²]	INJ LEG RMSE [m/s²]
JUMP 1	0,450	1,317

KEY POINT

HIGHER RMSE INDICATES REDUCED LANDING STABILITY AND MOTOR CONTROL

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SIDE HOPS
FRONTAL PLANE CONTROL

PROTOCOL EXECUTION

Single-leg lateral hops (30 s).
Maximum speed, controlled execution.

KEY PARAMETERS

- Total number of hops
- Mean contact time (ms)
- Supination/pronation ratio
- Spatial drift

WHAT IT REVEALS

Frontal plane dynamic control, fatigue response, and compensatory strategies.
Relevant for sports with rapid directional changes (football, basketball, tennis).

RETURN TO PLAY MULTI-PLANAR FUNCTIONAL EVALUATION

THREE TESTS, THREE MOVEMENT PLANES

DRIFT PROTOCOL

Vertical plane → power, control, power density

HOP FOR DISTANCE

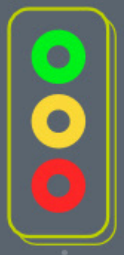
Horizontal plane → propulsion + IMU stability

SIDE HOPS

Frontal plane → lateral control, agility

LIMB SYMMETRY INDEX (LSI)

LSI = (injured limb / healthy limb) × 100



LSI 90-110%
LSI 85-90% and 110-115%
LSI < 85% or > 115%

RTP CRITERIA

✅ LSI ≥ 90% across all tests
✅ IMU stability within normal range
✅ Low performance variability

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SUMMARY

MULTI-TECHNOLOGY INTEGRATION PROVIDES:

- + COMPREHENSIVE BIOMECHANICAL DATA IN FIELD SETTINGS
- + MULTI-PLANAR ASSESSMENT (VERTICAL, HORIZONTAL, FRONTAL)
- + PERFORMANCE AND CONTROL EVALUATION
- + RAPID SETUP (<5 MINUTES) HIGH PORTABILITY

Field-based assessment enables ecologically valid functional evaluation for performance monitoring and return-to-play decision making.