

Protecting every talent

Biomechanical study
of lightweight athletes

Gerflor®

Athletes and impacts: science meets real-world conditions

The institute: LIBM

The Inter-University Laboratory of Human Movement Biology brings together **researchers** in **physiology**, **biomechanics** and **neuroscience applied to physical activity, sport and health**. It brings together three universities: Lyon 1, Savoie Mont-Blanc University in Chambéry and Jean Monnet University in Saint-Étienne. Its **international reach is reflected** in publications co-authored with researchers from prestigious universities such as Harvard and Stanford.

Study background

Sports floors are commonly tested in laboratories according to European standards.
These standards are based on the Berlin Athlete, a fully standardised test device representing an 80 kg male running a 100-metre sprint, and therefore do not reflect the diversity of athletes.
Through this study, Gerflor **focuses on different floor-user profiles** in order to more accurately assess **the diversity of impacts experienced according to body size, age and weight.**

Study objective

Assess **Taraflex®'s ability to reduce shocks and vibrations experienced by the musculoskeletal system of athletes with low body mass** (children, young adults and women).

In this context, the study compares the point-elastic Taraflex® sports floor with area-elastic wooden sports flooring, which a lightweight athlete cannot deform sufficiently to benefit from its biomechanical properties.



EN 14904 standard



Study scope

Protocol

Target group: male and female players aged 8 to 15, weighing 38 to 62 kg.

Floors tested:



Wooden sports floor
area-elastic floor
(in-situ shock absorption test >45%)



Taraflex®
point-elastic floor
(lab shock absorption test >25%)



Non-sports floor
(lab shock absorption test <5%, similar to a concrete slab)

Movements tested:



Straight sprints
3 × 30-metre straight sprints from a standing start



Sprints with change of direction
3 sprints with a change of direction - "505 test":
- 10 m acceleration,
- 5 m deceleration, a 180° turn
- 5 m re-acceleration

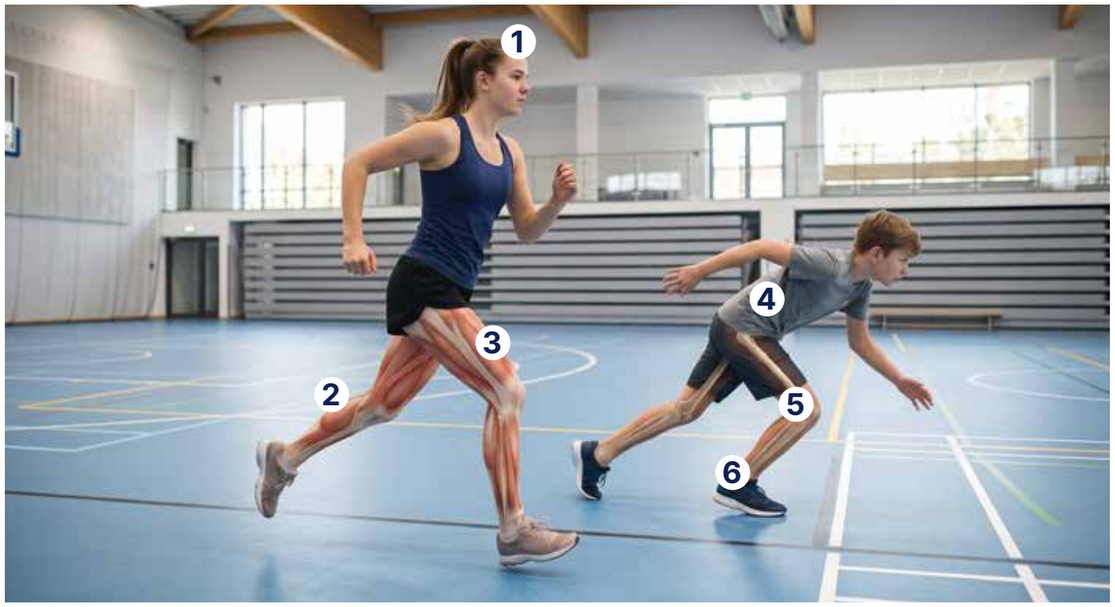


Countermovement jumps
Flight time measured and jump height calculated.
- 3 maximal jumps from a standing start.
- 3 landings from a height of 27 cm.

In this study, we will address the following questions:

- Do Taraflex® floors provide better absorption of impact energy and potentially harmful vibrations?
- Although they offer greater protection than wooden sports floor, do they require more muscular energy to maintain the same level of performance?
- Do they provide greater comfort and enhanced protection during falls?

Study measurements



❶ Perceived comfort measurement

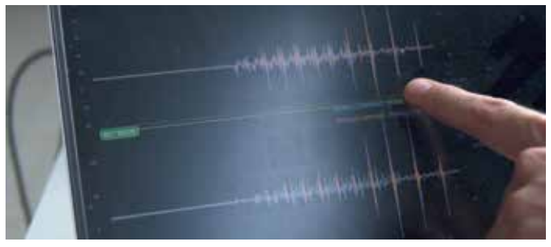
Assessment using a Visual Analogue Scale (VAS), a method validated in sport, ergonomics and medicine. This type of assessment is commonly used when evaluating sports equipment (rackets, shoes, etc.).



❷ Measurement of lower-limb muscle vibrations

The accelerometer is attached to the muscle belly of the Gastrocnemius Medialis* and Vastus Lateralis** muscles.

Equipment: triaxial accelerometers (3273A4 Series, Dytran Instrument, Marilla St, Chatsworth, CA).



❸ Measurement of muscular effort

Muscle activation levels were measured using surface electromyography electrodes attached to the Gastrocnemius Medialis* and Vastus Lateralis** muscles.

Equipment: Delsys Trigno™ quattro sensors (Delsys, Inc., Boston, USA), sampling frequency: 2,222 Hz.

*calf muscle / **thigh muscle



❹ Performance measurement

Performance is measured using photoelectric cells to measure time, speed and jump height.

Equipment for jumps: Optojump Next cells (Optogait, Microgate, Bolzano, Italy)

Equipment for sprints: gates fitted with Smart Speed dual-beam cells (Fusion Equipment, Brisbane, Australia)



❺ Effect of floor type on skin pressure while kneeling

The pressure sensors were positioned on potentially painful areas:

- the patella (kneecap)
- the infrapatellar bursa
- the tibial tuberosity

Participants remained in a kneeling position for 3 to 5 minutes.

Equipment: 0.5 mm-thick HD W-INSHOE resistive sensors (Medicapteurs, Balma, France), acquisition frequency: 100 Hz, min./max. pressure: 0.1 kgf to 8 kgf per sensor.



❻ Measurement of shock during foot-ground contact

Accelerometer attached to the shoe upper. Measuring shocks and vibrations by accelerometry remains the reference method in sport because it is portable, lightweight and offers a high acquisition frequency.

Equipment: triaxial accelerometer (Dytran Instrument Inc., Chatsworth, California), acquisition frequency: 2,000 Hz, measurement range: ±100 G.

Study results

Short- and long-term benefits

For lightweight athletes, Taraflex® delivers benefits both **in the short term**, during play and ground contact, and **in the long term** by helping reduce the mechanical stress accumulated season after season.

Better protection in every play

- Improved perceived comfort on Taraflex®
- Reduced pressure on the knee
- Better distribution of loads during repeated floor contact



Better body preservation over time

- Reduced impact energy experienced
- Better cushioning
- Less muscle vibration



Better protection in every play

Injury prevention and immediate player protection



Effect of floor type on comfort

21% improvement in perceived comfort on Taraflex® compared with a wooden sports floor.

	Taraflex®	Wooden sports floor	Non-sports floor
Perceived comfort (/10)	9.1	7.5	7.3
Taraflex® advantage		**21%**	**25%**

Effect of floor type on skin pressure while kneeling

Taraflex® significantly reduces the pressure exerted on the knee.

	Taraflex®	Wooden sports floor	Non-sports floor
Pressure exerted on the knee (gf)	4500	7.5	7.3
Taraflex® advantage		**-18%**	**-13%**

Mechanical loads are distributed over a larger area on Taraflex® than on a wooden sports floor. This is due to the flooring deformation, which increases the contact area between the knee and the surface, helping to reduce injury risk.

Better protection in every play

Injury prevention and immediate player protection

IPI, our patented index for measuring athlete protection

Developed through a collaboration between Gerflor and several internationally renowned French scientific institutions - CNRS, the University of Poitiers, ENSMA and Sensix, a specialist in biomechanical measurement technologies - the **IPI (Impact Protection Index)** is an innovative method developed to assess the comfort and protective capacity of a sports floor during falls.



Equipment: 9 coaxial cylinders fitted with strain gauges
European patent EP2642275.



This index directly measures the stress experienced by joints, particularly the elbow and knee, during an impact, in order to quantify the risk of injuries such as bruising, haematomas or more severe trauma.

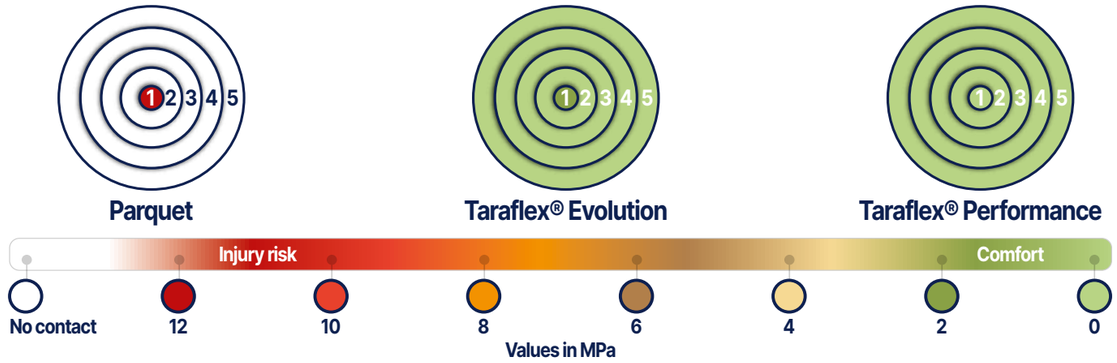
Based on scientific work published by ETH Zürich University*, the protocol uses a spherical impactor to simulate real fall conditions for different user profiles, **including the fall of a 35 kg child while running**.

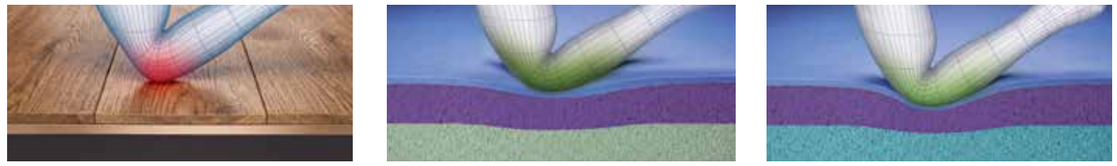
The analysis takes into account the actual area deformed at the moment of impact and the distribution of forces. The larger the contact area and the lower the stress, the more **comfortable and protective** the floor is considered.

*"Reaction behavior of floors under typical loadings incurred by children and adults", R.Müller & J.Deno

Did you know?
12 MPa is equivalent to 120 kg concentrated on the surface area of a fingernail.

IPI comparison between wooden sports flooring and the Taraflex® range
Impact area and associated pressure





How can such a difference be explained?

Thanks to the unique product construction of Taraflex® solutions:

- **Specific foam formulations** tailored to requirements, with 5 different foams for enhanced performance and safety

Low density	Standard density	Density +	Density ++	Density +++
Lightness	Cushioning	Elasticity	Energy return	Compactness

- CXP COMFORT HD **dual-density foam technology**



The IPI complements this advanced biomechanical approach and demonstrates that Taraflex® provides a higher level of protection during impacts by reducing mechanical loads and improving force distribution. Taraflex® confirms its ability to **combine sports performance and safety**, helping to **limit injury risk and sustainably improve user comfort**.

Better Body Preservation Over Time

Protection against long-term injuries

Effect of floor type on performance and muscular effort

- **The softness of Taraflex® has no negative effect on running or jumping performance**; times in the different tests are identical.
- Measurements of muscle activation levels (mV) show that **Taraflex® does not require more energy to achieve the same result.**



Effect of floor type on heel impacts



Did you know?
When the foot hits the ground (step, jump or landing), the body absorbs a shock wave that travels from the feet through the skeleton and soft tissues.

Three indicators can be used to assess its impact:

- Shock energy ($m.s^{-2}$): the amount of energy transmitted to the body
- Peak acceleration ($m.s^{-2}$): the maximum intensity of the impact
- Impact frequency (Hz): the number of soft-tissue oscillations per second.

The lower these values, the less stress is placed on muscles, tendons and joints.



- **Taraflex® clearly reduces the shock energy experienced.**

	Taraflex®	Wooden sports floor	Non-sports floor
Shock energy experienced ($m.s^{-2}$) during changes of direction	774	832	873
Taraflex® advantage		**-7%**	**-11%**

- **Taraflex® reduces impact acceleration peaks transmitted to the skeleton,** providing better cushioning.

	Taraflex®	Wooden sports floor	Non-sports floor
Peak acceleration ($m.s^{-2}$) during changes of direction	554	601	675
Taraflex® advantage		**-8%**	**-18%**

- Taraflex® shifts impact away from the resonance frequency of muscle tissue, helping to **limit the propagation of the potentially traumatic shock wave.**

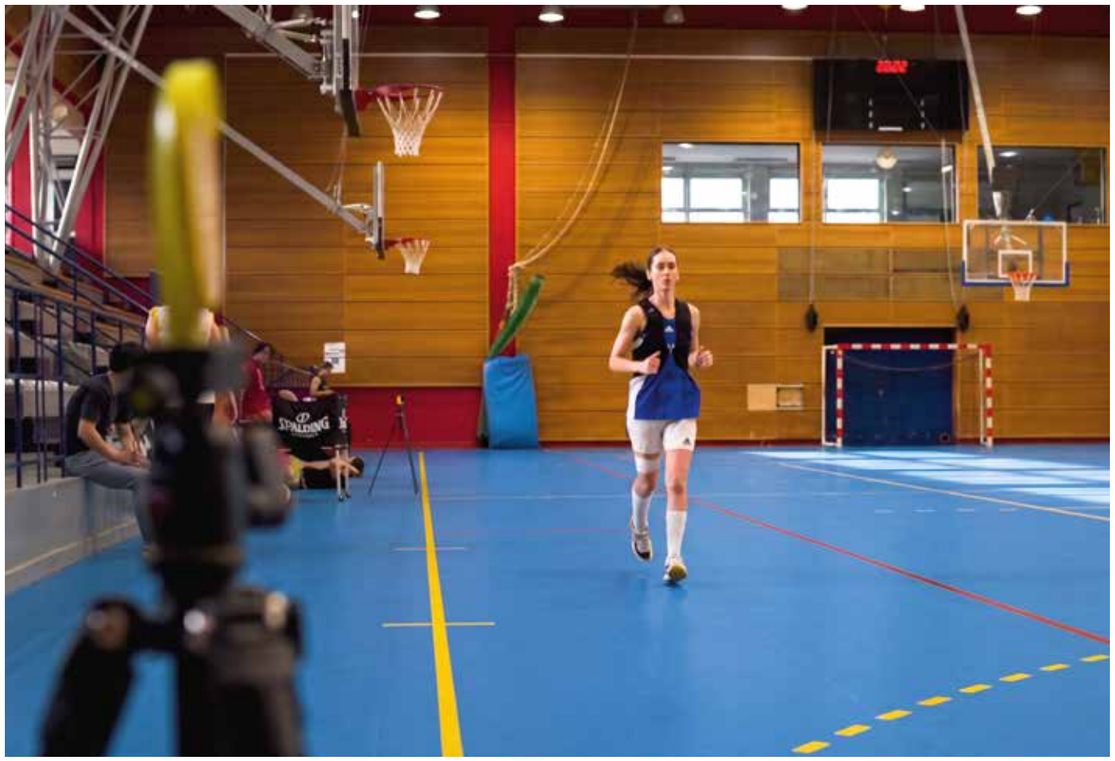
	Taraflex®	Wooden sports floor	Non-sports floor
Impact frequency during landings (Hz)	67	70	70
Taraflex® advantage		**-5%**	**-5%**

By reducing all three parameters, Taraflex® absorbs more energy, so less is transmitted to players' muscles and soft tissues, **helping to reduce the risk of musculoskeletal injuries (tendinitis, bursitis, heel pain, stress fractures, etc.).**

Better Body Preservation Over Time

Protection against long-term injuries

Effect of floor type on muscle vibrations



Did you know?
A vibration is characterised by two parameters: amplitude and frequency.

- **Amplitude** ($m.s^{-2}/Hz/s$) corresponds to vibration intensity: the higher it is, the greater the muscle displacement.
- **Frequency** (Hz) corresponds to the number of soft-tissue oscillations per second: the higher it is, the faster the muscle vibrates.

Reducing both vibration amplitude and frequency helps limit the loads on muscles and can reduce neuromuscular fatigue.

- During changes of direction, **Vastus Lateralis (thigh muscle) vibration amplitude is lower** on Taraflex®: **-5%** compared with wooden sports flooring.



	Taraflex®	Wooden sports floor	Non-sports floor
Total Vastus Lateralis vibration amplitude during changes of direction ($m.s^{-2}$)	306	320	257
Taraflex® advantage		**-5%**	**+19%***

- In addition, the Vastus Lateralis vibrates at **a 4% lower frequency** (2 Hz) on Taraflex® than on wooden sports flooring. It is worth noting that an increase in muscle vibration frequency is generally associated with accelerated fatigue development.

	Taraflex®	Wooden sports floor	Non-sports floor
V. lateralis vibration frequency (Hz) during changes of direction	46	48	46
Taraflex® advantage		**-4%**	**0%***

During prolonged sports activity, Taraflex® flooring **can help reduce neuromuscular fatigue by decreasing vibrations transmitted to soft tissues.**

* Comparisons with non-sports flooring should be interpreted with caution, as participants may adapt their neuromuscular strategy to anticipate higher impacts and protect their musculoskeletal system.

Study summary

For athletes with lower body mass, whose weight is insufficient to fully activate the deformation of a wooden sports floor, **choosing Taraflex® means maintaining performance without additional energy cost while protecting the safety and health of every talent.**

Maintaining performance without additional energy cost

+21% perceived comfort



- 5%
soft-tissue vibration amplitude
- 4% / 2 Hz
soft-tissue vibration frequency

- 7% shock energy experienced
- 8% acceleration peaks (force transmitted to the skeleton)
- 5% / 3 Hz impact frequency

- 18% pressure on the knee

In conclusion...

...with Taraflex®:

- **Enhanced protection for children, adolescents and women:**

a solution particularly well suited to athletes with lower body mass

- **Performance maintained:**

same movement efficiency and same level of performance as on wooden sports flooring

- **Fewer shocks, lower loads:**

reduced shock energy, accelerations and vibrations

- **Greater everyday comfort:**

better distribution of stress on the knees and lower limbs

- **Protect today, preserve tomorrow:**

helps prevent musculoskeletal injuries in the short and long term

What we measured in this study is experienced by the body thousands of times over a sports season.



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Z0046609

Non contractual imagery - AI-generated setting – Real Gerflor products - RC Lyon B 726 580 152 - jpe - 10/2026 - Z0046609 - Indicative documentation cost: 4 €

we **care** / we **act** our commitments for **2030**

climate

-30% CO_2
scopes 1, 2, 3
in tons eq. CO_2, vs 2019
Science Based Targets[1]

resources

75%
biobased, mineral
and recycled content[2]

30%
recycled content[3]

circularity

65 000 tons
annual volume recycled[4]

45%
looselay[5]

health & well-being

100%
products better than
Indoor Air Quality
standards[6]

95%
sales covered by EPD[7]

people

30%
women[8]

40%
internal mobility[9]

Towards 0
accident[10]

Gerflor®

More details: 1. Scopes 1, 2 & 3, in absolute value, market-based. Trajectory approved by SBTi (Science Based Targets Initiative). 2. Proportion of raw materials used in floors and walls that do not contribute to resource depletion: bio-based, mineral and recycled materials. Includes salt used in the synthesis of PVC. 3. Average proportion of recycled material in Gerflor's flooring and wall coverings. 4. Volume of scraps processed at our recycling plant. 5. Proportion of turnover generated by looselay floor coverings that are easy to remove and/or reuse. 6. Proportion of floor and wall products with a TVOC concentration of less than 100 µg/m³ over a 28 days period. 7. Proportion of flooring and wall covering sales in Europe covered by FDES or EPDs. 8. Proportion of women in the workforce and among managers. 9. Proportion of positions filled through internal mobility. 10. Number of work-related accident, including temporary workers. Target on accident frequency rate (number of work-related accident per millions hour worked) <3.