

SLEEP FITTING™
A BIOMECHANICAL APPROACH TO SPORTS REST

The Oniric Sleep Fitting™ model as a scientific foundation for physiological recovery.

Pressure distribution · Body alignment · Anthropometry

An analysis of how the interaction between the body and the resting surface shapes load distribution, posture and the cyclist's support needs.

oniric

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WHITE PAPER

SLEEP FITTING™: A BIOMECHANICAL APPROACH TO SPORTS REST

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INTRODUCTION AND BIOMECHANICAL JUSTIFICATION

In modern cycling, training load and competitive intensity demand absolute efficiency in tissue and metabolic regeneration processes. While disciplines such as bike fitting have revolutionized the dynamic interaction between the cyclist and the bicycle to maximize performance and prevent injuries, the static interaction during the third of life dedicated to sleep has remained relegated to purely subjective assessments.

From the perspective of biomechanical engineering, nighttime rest constitutes a critical mechanical phenomenon. A professional or amateur long-distance cyclist subjects their spine to prolonged positions of trunk flexion, paravertebral muscle fatigue, and high pressures in the perineal and ischial areas. Consequently, the resting surface must act as an active orthopedic support capable of reversing the accumulated loads, ensuring intervertebral disc decompression, and promoting biomechanical conditions compatible with a more efficient recovery.

> **Recovery happens during sleep.**
>
> **Sleep happens on a biomechanical surface.**

Over the last few decades, scientific research has consolidated the role of sleep as one of the fundamental pillars of physiological recovery and adaptation to training [1,2].

ONIRIC EVIDENCE MODEL

Scientific foundation of the Sleep Fitting™ model.

LEVEL 4

ONIRIC SLEEP FITTING™

Personalisation model

Integration of biomechanical and anthropometric data to generate the optimal sleep configuration for each athlete.

LEVEL 3

ANTHROPOMETRIC BASIS + PRESSURE MAPPING

Objective data from the body and its interaction with the resting surface.

Identification of individual needs and load patterns.

LEVEL 2

IBV TESTS

Objective biomechanical validation

Experimental tests conducted by the Biomechanics Institute of Valencia.

- **PROY08/0006** Pressure distribution
- **PROY08/0627** Spinal alignment

IBV
INSTITUTO DE BIOMECÁNICA DE VALENCIA

LEVEL 1

SCIENTIFIC LITERATURE

Theoretical foundation and prior evidence

Published research supporting the relationship between rest, biomechanicas and recovery.

Biomechanics | Sleep | Recovery | Ergonomics

The Oniric Sleep Fitting™ model is built on a solid foundation of scientific literature, experimental evidence and objective data to offer personalised sleep solutions aimed at optimising athlete recovery.

However, there is a question that has received much less attention:

How does the interaction between the body and the resting surface influence the quality of that recovery?

From a biomechanical perspective, rest is not solely a physiological phenomenon. It is also a mechanical phenomenon. For approximately a third of our lives, the body remains in continuous contact with a surface that conditions:

- load distribution,
- body alignment,
- pressure exerted on soft tissues,
- postural stability.

These variables can be measured, analyzed, and optimized. Precisely on this premise, the ergonomic systems of Viscoform and subsequently the Oniric Sleep Fitting™ model are developed.

From subjective comfort to objective biomechanics

The choice of a mattress has traditionally been based on subjective criteria:

- feeling of firmness,
- perception of comfort,
- personal preferences.

However, current scientific literature proposes a different approach. Authors like Verhaert et al. demonstrated that the interaction between the body and a resting surface can be analyzed using objective biomechanical parameters, especially pressure distribution and spinal alignment [3].

According to these authors:

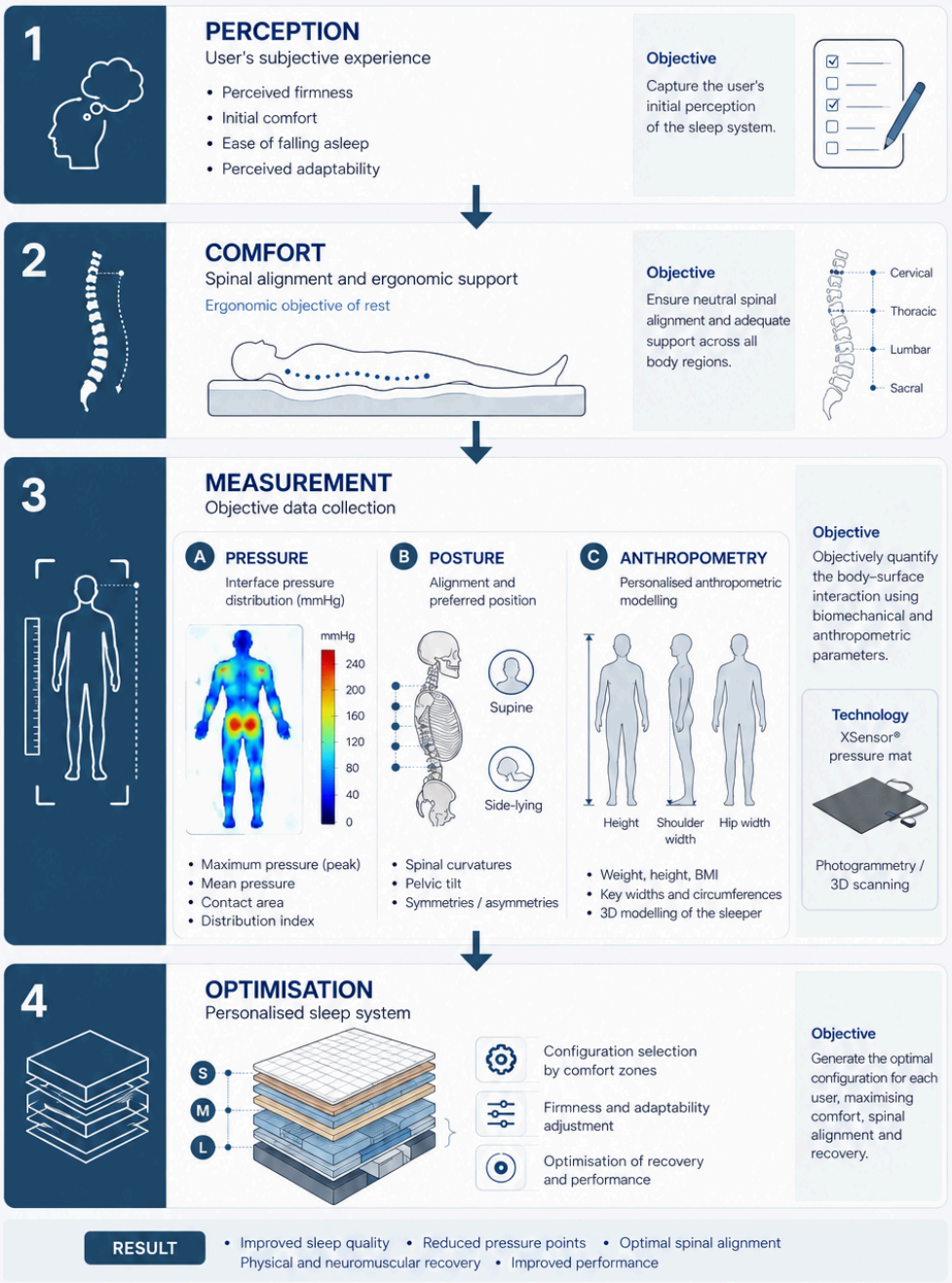
> "An optimal mattress should redistribute pressure while maintaining spinal alignment." [3]

This statement summarizes one of the fundamental principles of ergonomics applied to rest: A surface should not be limited to being comfortable. It must adequately distribute loads without compromising posture.

FIGURE 3.1

Ergonomic assessment model for sleep systems

Based on the Verhaert V. et al. (2011) framework – Applied Ergonomics



Source: Adapted from Verhaert V. et al. (2011). Applied Ergonomics, 42(4), 637–643.

The biomechanical conflict of flat surfaces

The human spine presents complex physiological curvatures. These curvatures allow for:

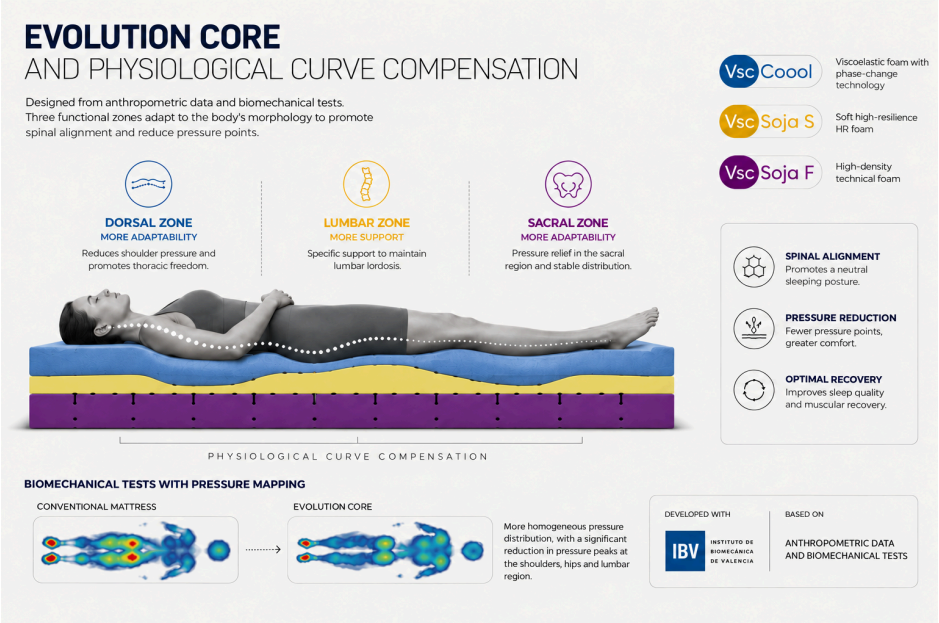
- load distribution,
- impact absorption,
- maintaining postural balance.

However, most conventional mattresses use cores with practically straight geometry. This discrepancy between the shape of the body and the shape of the surface constitutes one of the main biomechanical challenges of rest.

From this observation, Viscoform initiated a research and development program based on anthropometric and biomechanical criteria together with the Biomechanics Institute of Valencia (IBV), with the objective of translating principles of clinical ergonomics to the nighttime resting environment. The results led to the development of the Evolution system, an ergonomic architecture designed to compensate for physiological curves through differentiated functional zones:

- dorsal (adaptability),
- lumbar (support),
- sacral (adaptability).

Evolution core and physiological curve compensation



Source: Viscoform technical documentation – IBV biomechanical tests.

Pressure distribution: why it matters

When a person lies down for several hours, body weight is mainly concentrated in certain anatomical regions. The areas that typically support the greatest load are:

- shoulders,
- pelvis,
- sacral region,
- thorax.

Scientific evidence shows that excessive pressure concentrations can increase discomfort and promote frequent postural changes during the night [3,4].

From an ergonomic perspective, the goal is not to eliminate pressure, but to distribute it more homogeneously. Radwan et al. conclude that the physical characteristics of a resting surface can significantly influence sleep quality and body alignment [4].

EXPERIMENTAL BACKING: TESTS BY THE BIOMECHANICS INSTITUTE OF VALENCIA (IBV)

To objectively validate the effectiveness of the ergometric architecture that underpins the Oniric model, the Biomechanics Institute of Valencia (IBV) conducted a series of controlled experimental tests, using advanced biomedical instrumentation and rigorous statistical analysis.

A. Homogeneous Distribution of Interface Loads (IBV Project PROY08/0006)

Using XSensor® full-body pressure blankets, equipped with a matrix of 144×48 capacitive sensors (more than 6,000 reading points), the interface pressure in adult subjects in supine and lateral decubitus positions was quantitatively evaluated. The results demonstrate a systematic reduction of maximum pressures (pressure peaks) and a uniform distribution of tangential or shear forces.

Anatomical region	Measured parameter (mmHg)	Traditional innerspring mattress	Certified ergonomic core	Potential physiological impact on the cyclist
Hips (side-lying)	Maximum pressure (peak)	**95.5 mmHg**	**77.5 mmHg**	Critical relief at the hip joint; reduced peripheral tissue ischaemia.
Shoulders (side-lying)	Maximum pressure (peak)	70.8 mmHg	60.2 mmHg	Reduced scapulohumeral tension associated with the handlebar riding position.
Lumbar region (supine)	Effective contact area	311.3 cm^2	**395.1 cm^2**	Active lumbar lordosis support; helps avoid sustained tension in the paravertebral musculature.

B. Postural Preservation and Spinal Alignment (IBV Project PROY08/0627)

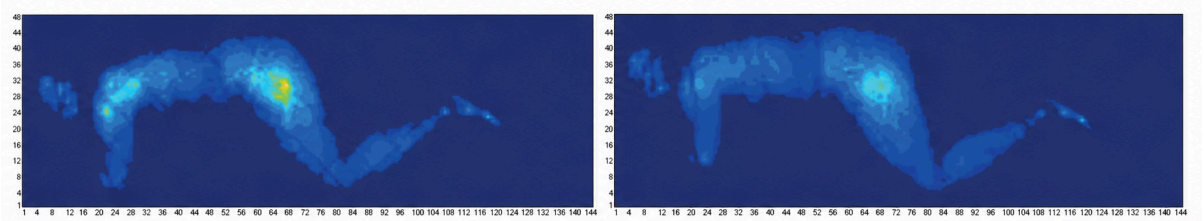
Postural adaptability was measured externally using a high-precision inclinometric rachimeter, analyzing the spinous processes of the C7, T12, and L5 segments. The intra-subject statistical study through analysis of variance (ANOVA) conclusively demonstrated that the ergonomic surface brings the spine closer to its natural neutral physiological position (standing reference).

The clinical relevance factor: The statistical models yielded a significance level of $p = 0.011$ (below the critical threshold of 0.05). This means there is a scientific certainty of

over 98.9% that the optimization of lumbar support is not random, but a direct consequence of the internal geometric modeling of the core.

Pressure distribution comparison

The pressure images obtained showed a more homogeneous distribution of mechanical loads and a visual reduction of certain pressure concentration areas



Figures 4 and 5: Direct comparison of the pressure footprint. On the left, the reference mattress shows critical high-pressure areas (red/yellow). On the right, the Viscoform Evolution system achieves a more homogeneous distribution, minimising pressure peaks.

Source: Biomechanical test PROY08/0006. Biomechanics Institute of Valencia.

Anthropometry: why not all bodies need the same support

One of the most consistent findings of research in ergonomics is that support needs vary significantly between individuals. Wong et al. concluded that anthropometric variables such as:

- body weight,
- height,
- body proportions,
- habitual resting posture,

directly influence mattress perception and support needs [5].

The authors state:

> "Anthropometric characteristics influence mattress perception and support requirements." [5]

This finding constitutes one of the scientific foundations that justify biomechanical personalization applied to rest.

From certified ergonomics to Sleep Fitting™

The natural evolution of this approach leads to a simple question: If bodies are different, why should they all rest on the same configuration? From this question arises the Sleep Fitting™ concept developed by Oniric.

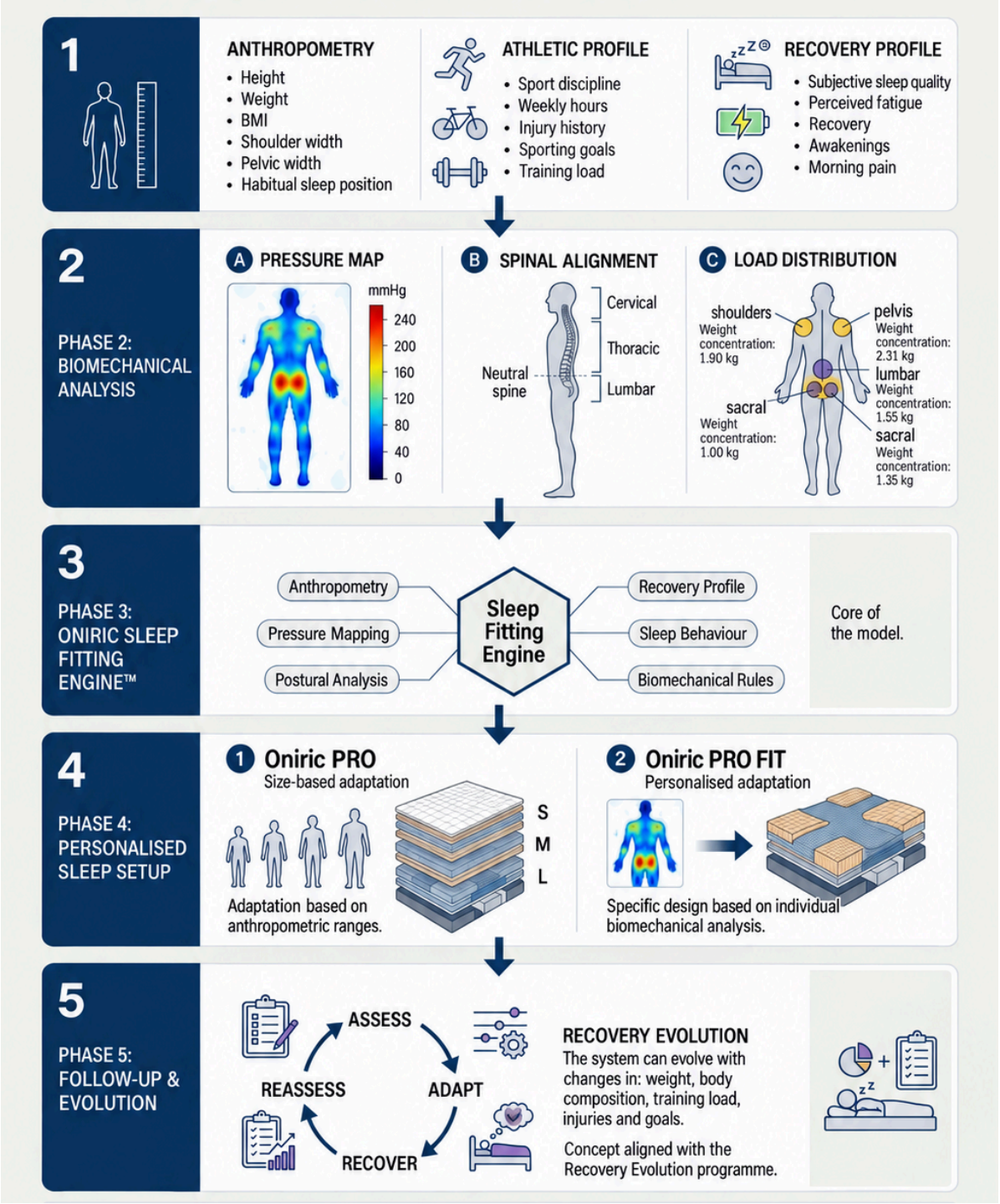
The model combines:

- anthropometry,
- postural analysis,
- pressure distribution,
- sleep habits,
- recovery needs,

with the objective of establishing a rest configuration adapted to the biomechanical characteristics of each user. The approach is conceptually similar to that used in widely accepted disciplines such as bike fitting or clinical ergonomics.

Oniric Sleep Fitting™ Model.

Methodology for biomechanical adaptation of the sleep system based on anthropometry, pressure distribution, and recovery analysis.



Source:Oniric Recovery Lab.

Influence of BMI and anthropometry on biomechanical response

One of the most interesting findings observed during the tests of the Biomechanics Institute of Valencia (IBV) was the possible influence of certain anthropometric variables on the biomechanical response to the sleep system. The analysis of the lumbar alignment data suggested that the Body Mass Index (BMI) could modulate the effect of the mattress on the user's posture. Although the authors indicate that the sample size did not allow reaching sufficient statistical power to establish a definitive conclusion, the results showed a consistent trend according to which users with a higher BMI obtained a better restoration of the lumbar curvature on the ergonomic viscoelastic system than on the reference innerspring mattress.

According to the report itself:

> *"The body mass index (BMI) variable can influence the mattress's effect on users (...). Following this hypothesis, users with a higher BMI would improve their lumbar curvature with the viscoelastic mattress compared to the reference innerspring mattress."*

Although this observation requires additional studies with larger samples, it constitutes preliminary evidence consistent with one of the fundamental principles of ergonomics applied to rest: different body profiles may require different mechanical responses to achieve optimal postural alignment.

Limitations of current knowledge

Although there is solid evidence on the influence of pressure distribution, body alignment, and anthropometry on comfort and sleep quality, specific studies that directly evaluate the impact of personalized rest systems on sports performance variables and physiological recovery in cyclists are still necessary.

Conclusion

The available scientific evidence indicates that variables such as pressure distribution, body alignment, and anthropometry play a relevant role in the interaction between the body and the resting surface. The tests developed alongside the Biomechanics Institute of Valencia also provide their own experimental evidence that supports the practical application of these biomechanical principles to the design of ergonomic rest systems.

On this basis, **Oniric Sleep Fitting™** is built: A model that transfers to rest the same philosophy that is already successfully applied in other areas of biomechanical optimization of human performance.

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