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REVIEW ARTICLE

Tecnobody Postural Bench for Assessment of Posterior-Chain Load Symmetry and Rehabilitation: A Narrative Technical Review

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ABSTRACT

Background: The Tecnobody Postural Bench (TBed) is a sensor-based system intended for postural and musculoskeletal assessment in the supine position. The system records regional loads across adjustable body-support segments and presents side-to-side comparisons and angle-dependent changes through dedicated software. Although these outputs are commonly described as measures of muscle tension or posterior-chain symmetry, evidence supporting their reliability, validity, and clinical interpretation remains limited.

Objective: To describe the design, measurement workflow, software outputs, and proposed clinical applications of the Tecnobody Postural Bench, and to place these features in the context of published evidence on regional load asymmetry, centre-of-pressure measurement, and rehabilitation biofeedback.

Methods: This narrative technical review synthesizes manufacturer documentation and published reports that have used the Postural Bench, supplemented by peer-reviewed literature addressing centre-of-pressure measurement and biomechanical biofeedback. Manufacturer information was used to describe device configuration and software functions, whereas clinical interpretation was based preferentially on peer-reviewed evidence.

Results: The system uses adjustable support segments and load-sensing elements to record regional loading at predefined body positions. The software permits left-right comparisons, angle-dependent measurements, graphical display, and within-person pre/post comparison. Published applications include assessment of posterior-chain loading in athletes and regional loading asymmetry in people with neck pain. However, sensor output expressed in kilogram equivalents should be interpreted as an external load measure rather than a direct measurement of physiological muscle force. Likewise, software-derived pressure-centre variables should not be assumed to be interchangeable with validated force-platform centre-of-pressure metrics without device-specific validation.

Conclusion: The Postural Bench offers a structured platform for quantifying regional load distribution and visualizing side-to-side asymmetry during postural assessment and rehabilitation. Its principal value is likely as an adjunct for standardized within-patient assessment and biofeedback. Independent studies establishing measurement reliability, construct validity, responsiveness, normative values, and clinically meaningful thresholds are required before its outputs can be used as stand-alone diagnostic measures.

Keywords: Biomechanical assessment; Biofeedback; Load asymmetry; Muscle loading; Postural assessment; Rehabilitation

Introduction

Objective assessment of movement and load distribution is increasingly used in musculoskeletal and sports rehabilitation to complement clinical examination. Sensor-based systems can provide quantitative information on movement, force, pressure, and symmetry that is difficult to estimate consistently by observation alone. The Tecnobody Postural Bench (TBed) was developed as a postural assessment and rehabilitation system that records regional loading while the individual lies on an adjustable sensor-equipped bench [1].

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The device is intended to characterize left-right loading patterns across body regions and to examine how those patterns change as the bench position is altered. The software describes these measurements in terms of load, symmetry, and muscle tension. Published studies have used the system to examine posterior-chain asymmetry in junior badminton players and the relationship between regional loading asymmetry and neck disability [2,3]. These reports indicate potential clinical and sports applications, but they do not by themselves establish diagnostic accuracy or the physiological specificity of the recorded signals.

A key interpretive issue is that load sensors measure external forces transmitted to the support surface. Such values may be influenced by body mass distribution, segment position, gravity, passive tissue tension, active muscle contraction, and contact geometry. They therefore should not be equated automatically with isolated muscle force. The present review describes the Postural Bench, its assessment workflow and proposed applications, while explicitly distinguishing device-generated load indices from direct measurements of muscle physiology.

Review Approach

This article was structured as a narrative technical review rather than a systematic review. Technical descriptions were derived from the Postural Suite/TBed documentation supplied with the original manuscript [1]. Device-specific clinical evidence was represented by published studies using the Postural Bench in athletic and musculoskeletal populations [2,3]. To contextualize the interpretation of pressure-centre and feedback outputs, established literature on centre-of-pressure measurement reliability and biomechanical biofeedback was also considered [4-7]. No meta-analysis was undertaken because the available Postural Bench literature is sparse and methodologically heterogeneous.

Device Design and Measurement Configuration

The Postural Bench consists of adjustable support regions corresponding to the scapular, lumbar, pelvic, and tibial areas, together with bilateral foot supports. The system is coupled to load-sensing elements and Postural Suite software, which displays numerical and graphical outputs in real time [1]. The original technical description identifies four standard assessment positions: 180°, 120°, 105°, and 90°. In routine use, measurements at 90° may be less practical because of positioning constraints, and anterior assessments are described primarily in the 180° configuration [1].

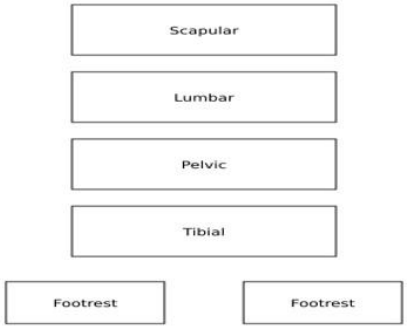


Figure 1. *Schematic representation of the Postural Bench support regions and bilateral footrests. Image retained from the submitted manuscript.*

The software interface presents segment-specific values and bilateral comparisons. The system also allows the clinician to observe changes in load as body position is modified, which may be useful for identifying reproducible side-to-side differences or position-dependent loading patterns within the same individual.

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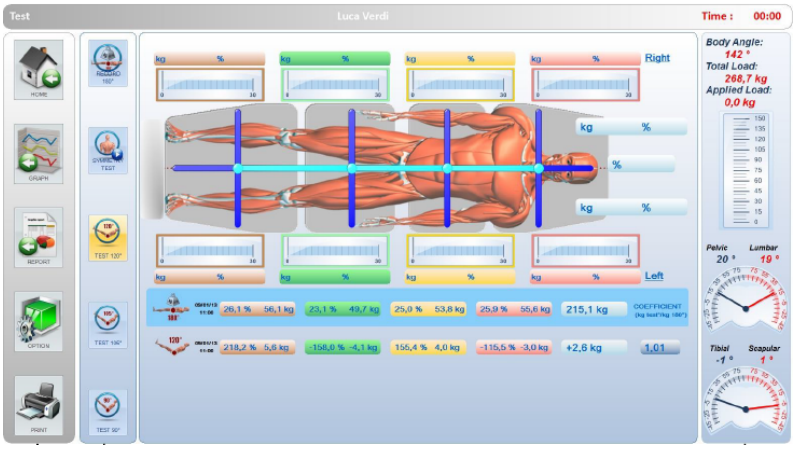


Figure 2. *Example of the Postural Suite assessment interface showing regional loading values and left-right comparisons. Image retained from the submitted manuscript.*

The original documentation distinguishes between 'total load' and 'applied load'. In practical terms, these outputs should be interpreted as sensor-recorded resultant load under the test condition. Although the software may label a component as muscle tension, the measurement is not a direct recording of contractile force from an individual muscle. For publication and clinical interpretation, the more conservative terms regional load, loading asymmetry, or device-derived load index are therefore preferable.

Assessment Workflow and Software Outputs

Before testing, patient information is entered into the Postural Suite software and the individual is positioned according to the device protocol. Measurements are then obtained at the selected bench angles. The software displays regional values for the right and left sides and can calculate ratios or coefficients comparing the 180° position with more flexed test positions [1,3]. Such coefficients provide a concise description of how sensor-recorded loading changes with position, but their physiological meaning should be interpreted cautiously until construct validity has been established.

The graphical display uses a body-oriented coordinate system to represent direction and distribution of loading. In the submitted material, a centre-of-pressure (CoP) or pressure-centre marker is displayed relative to the body axes.

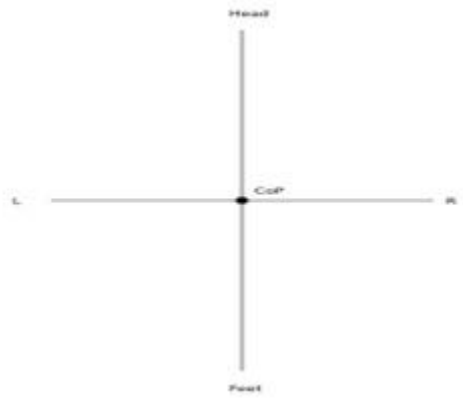


Figure 3. *Body-oriented coordinate system used to display the software-derived pressure-centre position. Image retained from the submitted manuscript.*

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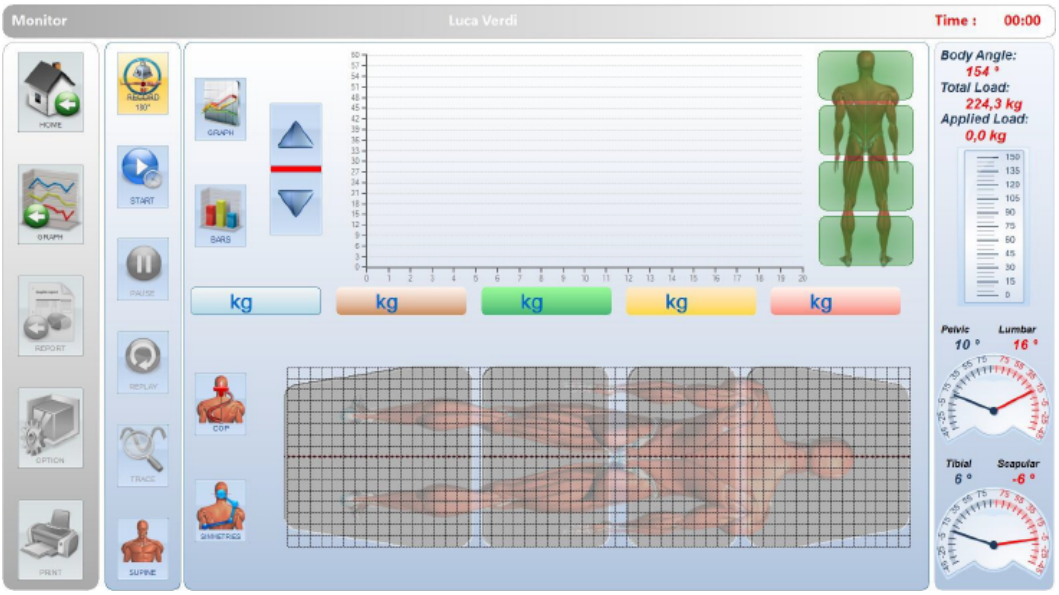


Figure 4. *Example interface for body-load and pressure-distribution analysis. Image retained from the submitted manuscript.*

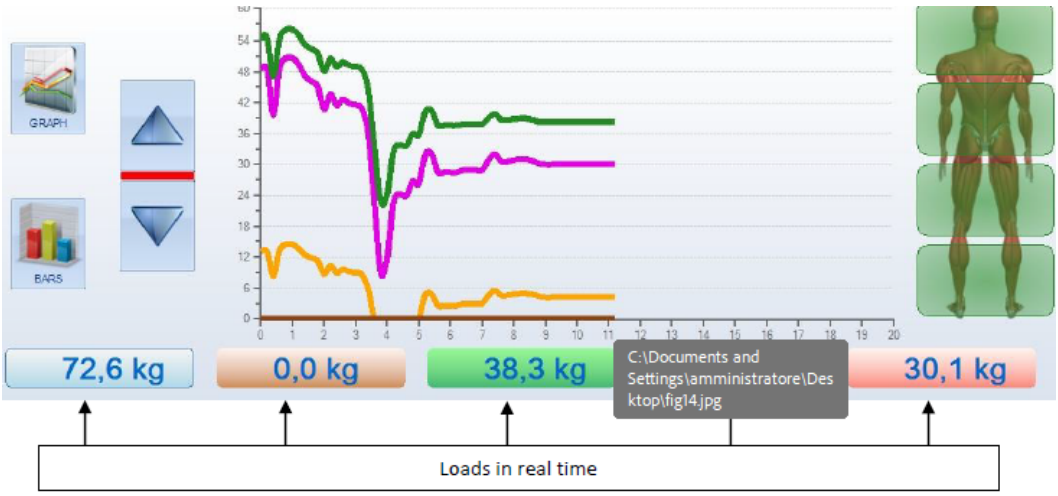


Figure 5. *Real-Time Load Distribution Analysis*

Centre-of-pressure analysis is a well-established approach in postural-control research, but its reliability depends on measurement duration, sampling procedures, stance condition, signal processing, and the variable selected [4,5]. These principles are derived largely from force-platform research in standing. Accordingly, a pressure-centre value generated by a supine segmented bench should not be assumed to be equivalent to conventional stabilometric CoP unless the device has been independently validated against a reference standard.

Interpretation of Regional Loading and Asymmetry

The principal clinical output of the system is the comparison of regional loads across sides and positions. Real-time traces can show how loading evolves during a test, while summary outputs can display segment-specific left-right differences. Repeated testing also permits pre/post comparison within the same patient, provided that positioning, angle, contact points, instructions, and measurement duration are standardized.

Changes in measured load across bench angles should not be interpreted as a simple muscle force-length relationship. Altered joint and segment position changes the distribution of gravitational and contact forces, while active and passive soft-tissue contributions may also vary. Angle-dependent changes are therefore best interpreted as differences in the device-recorded loading condition rather than as a direct measure of muscle force.

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In junior badminton players, Ranawat et al. used the Postural Bench to quantify differences in scapular, lumbar, and pelvic posterior-chain loading [2]. Pattnaik and Pradhan subsequently reported associations between neck disability and selected regional loading asymmetries in participants with neck pain [3]. These studies demonstrate feasibility of the measurement approach but remain insufficient to define normal ranges, pathological cut-offs, or causal relationships.

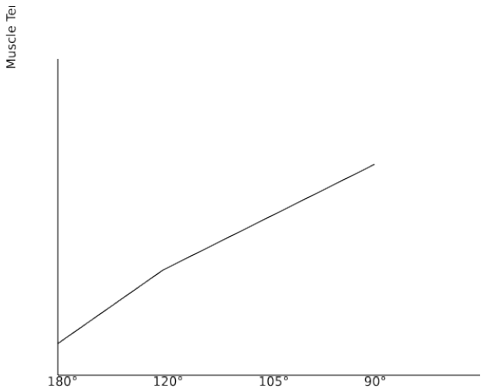


Figure 6. *Relationship Between Joint Angle and Muscle Tension*

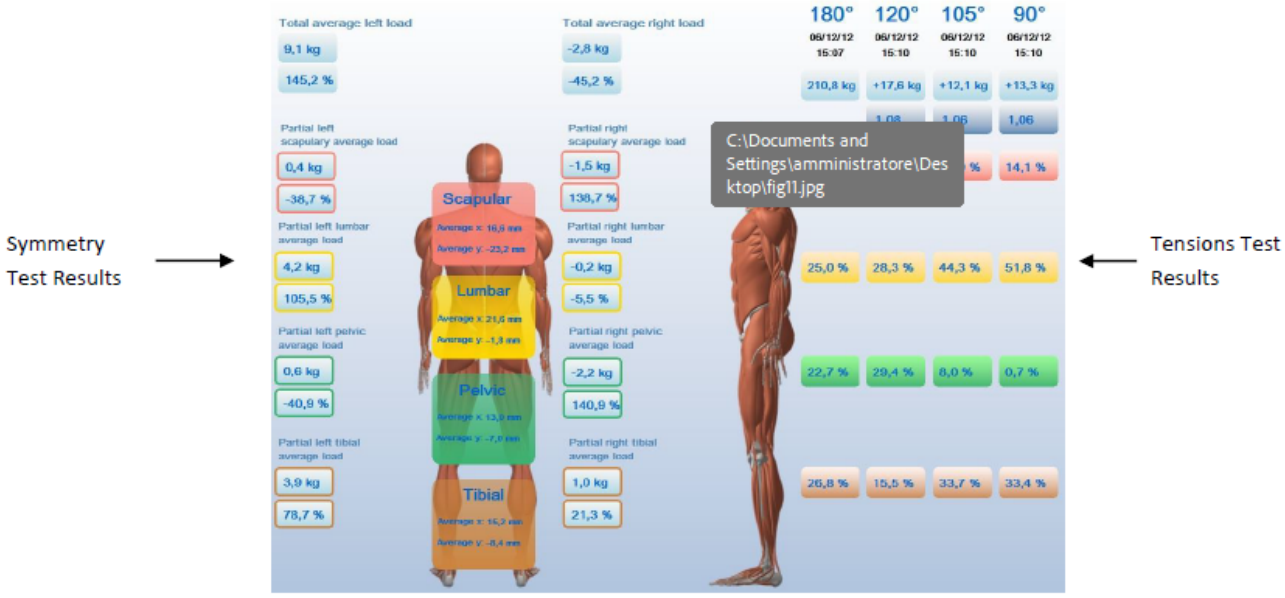


Figure 7. *Symmetry and Muscle Tension Test Results*

Clinical and Sports Applications

Potential uses of the Postural Bench include documenting regional loading patterns, identifying reproducible side-to-side differences, tracking change over time, and providing an objective visual aid during rehabilitation. In sports settings, such measurements may be used descriptively to characterize posterior-chain loading in athletes [2]. In musculoskeletal practice, the system may complement examination of pain, range of motion, strength, movement control, and patient-reported function [3].

The bench can also be used during or around interventions such as stretching, myofascial techniques, muscle-energy techniques, joint mobilization, and other manual or exercise-based strategies described in the device workflow [1]. However, a change in the device reading immediately after treatment should be interpreted as a change in the measured loading condition, not automatically as evidence of tissue correction or clinical efficacy. Meaningful treatment evaluation requires concordant changes in validated clinical outcomes and, ideally, controlled study designs.

Biofeedback and Interactive Rehabilitation

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Real-time biomechanical feedback can be useful in rehabilitation because it makes otherwise hidden performance variables visible to patients and clinicians. Biofeedback systems may display movement, postural-control, or force-related information and can use that information to guide exercise performance [6]. Digital rehabilitation literature suggests that the content, timing, and mode of feedback are important determinants of how effectively patients understand and use the information [7].

Within the broader Tecnobody software ecosystem, sensor-derived signals can be linked to interactive or game-like tasks. The submitted manuscript illustrates a skiing simulation as an example of this approach. Such interfaces may increase engagement and provide an external target for load-shifting or motor-control exercises. Nevertheless, evidence supporting biofeedback in rehabilitation generally cannot be taken as proof of efficacy for a specific Postural Bench protocol; device- and population-specific clinical trials are still required.



Figure 8. *VR-Based Functional Training Simulation*

Clinical Interpretation and Current Evidence Base

The Postural Bench has several practical strengths: it standardizes body positioning, produces numerical rather than purely visual descriptions of asymmetry, offers immediate graphical feedback, and allows repeated within-patient comparisons. These features can support documentation and hypothesis generation during rehabilitation.

At the same time, the clinical meaning of a measured asymmetry depends on the psychometric properties of the system. Reliability should be established separately for each region, angle, and outcome; measurement error and minimal detectable change should be reported; and validity should be tested against appropriate reference measures. Research on conventional CoP and load measurements demonstrates that apparently objective biomechanical variables can still be sensitive to test protocol and may show good relative reliability but less satisfactory absolute reliability [4,5]. This is particularly important when small pre/post differences are used to infer treatment response.

Consequently, the Postural Bench should currently be regarded as an adjunctive assessment and feedback tool rather than a stand-alone diagnostic instrument. Device-derived regional load asymmetry may identify patterns that warrant further clinical examination, but it cannot by itself determine the anatomical source of pain, establish muscle weakness, or diagnose a specific postural disorder.

Limitations and Research Priorities

The evidence base for the Postural Bench remains limited. The available device-specific literature consists mainly of descriptive or observational applications, and independent validation studies are scarce. The manufacturer terminology of 'muscle tension' may also encourage overinterpretation because the sensors record external load rather than direct muscle

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force. Normative values across age groups, sexes, body sizes, sports, and clinical populations have not been adequately established.

Future research should prioritize test-retest and inter-rater reliability; standardization of positioning and test duration; comparison with reference biomechanical measurements; calculation of standard error of measurement and minimal detectable change; prospective evaluation of responsiveness to rehabilitation; and determination of whether regional asymmetry adds clinically useful information beyond conventional examination. Multicentre studies with blinded assessors and prespecified protocols would improve generalizability. Studies should also report raw load units and clearly separate sensor output from interpretive labels generated by the software.

Because this article is a narrative review, it is also limited by the absence of a systematic search strategy, formal risk-of-bias assessment, and quantitative synthesis. Its conclusions should therefore be considered descriptive and hypothesis-generating.

Conclusion

The Tecnobody Postural Bench provides a structured, sensor-based method for visualizing regional load distribution, side-to-side asymmetry, and position-dependent changes during postural assessment. Its software interface and real-time feedback may be useful for standardized within-patient monitoring and as an adjunct to exercise or manual rehabilitation. The available literature supports the feasibility of using the device in sports and musculoskeletal settings but does not yet establish diagnostic accuracy or clinically meaningful thresholds. Until independent psychometric validation is available, Postural Bench outputs are best interpreted as device-derived load indices that complement, rather than replace, a comprehensive clinical assessment.

Declarations

Conflict of interest: The authors declare that they have no conflicts of interest related to this manuscript.

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Ethics approval: Not applicable to this narrative technical review.

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