

Body Engineering Rehabilitation and Related Manual Therapy Approaches in Musculoskeletal Rehabilitation: A Scoping Review of Terminology, Therapeutic Approaches, Mechanisms, and Clinical Evidence

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Abstract

Background: Body Engineering Rehabilitation is a practitioner -developed rehabilitation approach that has been described in conceptual and clinical publications associated with manual and hands-on rehabilitation. Although publications describing the approach have emerged, its terminology, conceptual foundations, therapeutic components, proposed mechanisms, clinical applications, and empirical evidence have not been comprehensively mapped. Because the broader manual therapy literature is heterogeneous and includes multiple overlapping intervention labels, distinguishing direct evidence for Body Engineering from related evidence is important for maintaining scientific neutrality.

Objective: To map and synthesize the available literature concerning the terminology, theoretical foundations, therapeutic approaches, proposed mechanisms, clinical applications, and evidence relevant to Body Engineering Rehabilitation and related manual and movement-based approaches in musculoskeletal rehabilitation.

Methods: A scoping review design was adopted in accordance with the JBI Manual for Evidence Synthesis and reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR). Search reporting was informed by PRISMA-S. The Population–Concept–Context framework was used to define eligibility. Literature directly describing Body Engineering Rehabilitation was mapped separately from related evidence concerning manual therapy, joint mobilization or manipulation, myofascial and fascial interventions, muscle energy techniques, neural mobilization, neuromuscular approaches, and combined manual therapy and exercise. Evidence was categorized according to its directness, design, intervention architecture, and methodological limitations. Because database export files and complete search histories were not available for all information sources, exact database retrieval counts were not fabricated and remain subject to verification.

Results: The direct Body Engineering evidence base was limited and heterogeneous. The mapped direct literature comprised a foundational conceptual book, two case-based clinical publications, and

a recent literature review addressing the integration of Body Engineering principles into postoperative anterior cruciate ligament rehabilitation. No randomized controlled or comparative clinical study specifically evaluating a standardized Body Engineering intervention was identified in the direct evidence set. The available case-based reports involved multimodal rehabilitation programs, limiting attribution of observed improvements specifically to Body Engineering. The broader literature demonstrated substantial heterogeneity in manual therapy terminology, intervention description, treatment dosage, and reporting. Evidence concerning muscle energy techniques, myofascial /fascial interventions, neural mobilization, neuromuscular approaches, and combined manual therapy and exercise showed variable findings and methodological limitations. Mechanistic literature suggested possible neurophysiological, proprioceptive, sensorimotor, autonomic, and biomechanical responses to related manual interventions, but causal links between these mechanisms and clinically meaningful outcomes remain incompletely established.

Conclusions: Body Engineering Rehabilitation has been explicitly described and clinically applied, but its current direct evidence base remains limited and is dominated by conceptual and case-based publications. The available evidence does not permit definitive conclusions regarding independent clinical effectiveness, comparative effectiveness, superiority, or a mechanism specific to Body Engineering. Future research should prioritize operational definition, treatment standardization, reproducibility, independent replication, feasibility studies, comparative trials, and appropriately designed mechanistic investigations.

Keywords: Body Engineering Rehabilitation, Manual Therapy, Musculoskeletal Rehabilitation, Physical Therapy, Myofascial Therapy, Neural Mobilization, Muscle Energy Technique, Neuromuscular Rehabilitation, Rehabilitation, Scoping Review.

1. Introduction

1.1 Background:

Musculoskeletal rehabilitation encompasses a broad range of interventions designed to reduce symptoms, restore movement, improve physical function, and support participation in daily activities. Within physiotherapy and rehabilitation practice, manual and hands-on interventions have traditionally been used alongside exercise, education, movement retraining, and other therapeutic strategies.

The term “manual therapy,” however, does not represent a single standardized intervention. It may encompass joint mobilization, manipulation, massage, soft-tissue techniques, myofascial approaches, muscle energy techniques, neural mobilization, and other hands-on procedures. A recent scoping review of low-back-pain trials demonstrated substantial heterogeneity in the terminology used to describe interventions labelled as manual therapy, illustrating the difficulty of treating the term as a uniform therapeutic entity (Wenger et al., 2024). Similar concerns have been identified regarding the reproducibility and reporting of manual therapy interventions, with

important components of treatment frequently incompletely described (Ruzich et al., 2024).

Within this broader field, Body Engineering Rehabilitation has been described as a practitioner-developed approach associated with manual and rehabilitation practice. A foundational publication by Al-Baqaei (2019) presents Body Engineering Rehabilitation in the context of hand therapy and rehabilitation. Subsequent publications have described its clinical application in individual rehabilitation cases and have proposed its integration into contemporary rehabilitation frameworks.

The existence of publications describing Body Engineering, however, should not be equated with the establishment of its clinical efficacy. A central purpose of the present review is therefore to distinguish between literature directly evaluating or describing Body Engineering and literature concerning related rehabilitation approaches.

1.2 Conceptual and Terminological Considerations:

The terminology surrounding manual rehabilitation presents a methodological challenge. Different interventions may share therapeutic procedures while being described using different names, whereas similar terminology may be used for interventions that differ substantially in content, dosage, practitioner decision-making, and treatment goals.

This problem is particularly relevant to an emerging approach such as Body Engineering. Similarity between a Body Engineering intervention and an intervention described elsewhere as manual therapy, myofascial therapy, neuromuscular therapy, neural mobilization, or movement rehabilitation does not establish equivalence.

Accordingly, this review uses five evidence roles:

1. Direct evidence — publications explicitly identifying Body Engineering or Body Engineering Rehabilitation as the intervention or conceptual approach.
2. Conceptual evidence — publications defining or explaining Body Engineering or its proposed principles.
3. Related clinical evidence — research evaluating other manual, movement, fascial, joint, neural, or neuromuscular interventions that may provide contextual evidence.
4. Mechanistic evidence — research addressing physiological, neurological, sensory, biomechanical, or proprioceptive responses associated with related interventions.
5. Methodological evidence — research concerning terminology, reporting, reproducibility, intervention classification, and trial design.

This distinction is central to the interpretation of the findings.

1.3 Body Engineering and the Broader Manual Rehabilitation Literature:

The foundational Body Engineering publication identified in this review is Introduction to Rehabilitation Body Engineering for Hand Therapy by Al-Baqaei (2019). The publication provides

conceptual material concerning rehabilitation and hand therapy but does not constitute controlled clinical efficacy evidence.

Subsequent publications have described Body Engineering in clinical contexts. Alboqaei (2024), for example, reported the rehabilitation of a child with spastic quadriplegia following hypoxic injury using a program identified as Body Engineering/hand therapy. The program also included Bobath-based treatment, massage, balance training, hydrotherapy, play-based therapy, and strengthening. Therefore, the reported outcome represents the effect of a multimodal rehabilitation program rather than an isolated test of Body Engineering.

Similarly, a 2025 case publication described Body Engineering and hand therapy in a patient with quadriplegia following an accident. Again, the clinical intervention was embedded within a broader rehabilitation process.

A 2026 literature review further discussed the integration of Body Engineering principles into postoperative ACL rehabilitation. This publication contributes conceptual evidence regarding possible integration of Body Engineering within rehabilitation but does not establish comparative clinical effectiveness.

The distinction between description and efficacy is therefore particularly important. An intervention may be described, clinically applied, and associated with improvement in a case without establishing that the intervention caused the improvement or that it performs better than other rehabilitation approaches.

1.4 Proposed Mechanisms:

The broader manual therapy literature has proposed multiple mechanisms through which hands-on interventions may influence symptoms and function. These include mechanical effects, altered sensory input, proprioceptive changes, mechanosensation, neurophysiological modulation, changes in sensorimotor integration, autonomic responses, and contextual or cognitive effects.

A living review of the mechanisms of manual therapy identified evidence of varying quality for neurovascular, neurological, neurotransmitter /neuropeptide, neuroimmune, neuromuscular, and neuroendocrine responses. However, the quality and clinical significance of these mechanisms varied considerably, and the clinical implications of proposed mechanisms remain incompletely established (Keter et al., 2025).

A recent scoping review of neurophysiological responses to spinal mobilization and manipulation similarly identified studies reporting changes in cortical excitability, functional connectivity, and sensorimotor processing. Importantly, these studies did not consistently establish a direct relationship between neurophysiological changes and clinical improvement (Jahromi et al., 2026).

Such findings may provide a scientific context for hypothesis generation regarding Body Engineering, but they cannot be interpreted as evidence that Body Engineering itself produces the

same effects.

1.5 Rationale for the Scoping Review:

A scoping review was considered appropriate because the available evidence appears conceptually broad, methodologically heterogeneous, and insufficiently characterized. JBI describes scoping reviews as particularly useful for mapping broad bodies of evidence, clarifying concepts, identifying research strategies and outcomes, and identifying gaps requiring future investigation (Peters et al., 2024).

The present review therefore does not seek to estimate a pooled treatment effect for Body Engineering. Instead, it seeks to determine what has been described, studied, proposed, and reported, and to identify where direct evidence exists and where evidence remains indirect or absent.

1.6 Review Objective:

The objective of this scoping review was:

To map and synthesize the existing literature concerning the theoretical foundations, terminology, therapeutic approaches, proposed mechanisms, clinical applications, and evidence relevant to Body Engineering Rehabilitation and related manual and movement-based rehabilitation in musculoskeletal and rehabilitation contexts.

1.7 Review Questions:

The review addressed the following questions:

1. What terminology and conceptual descriptions are used in relation to Body Engineering Rehabilitation?
2. What therapeutic techniques and intervention architectures are reported?
3. What mechanisms are proposed or investigated in Body Engineering and related manual rehabilitation?
4. What clinical conditions and rehabilitation contexts have been studied?
5. What types of evidence are currently available?
6. What direct evidence exists specifically for Body Engineering Rehabilitation?
7. What methodological and knowledge gaps should guide future research?

2. Methods

2.1 Review Design:

A scoping review design was adopted following the methodological guidance of the JBI Manual for Evidence Synthesis (Peters et al., 2024). Reporting was informed by PRISMA-ScR (Tricco et al., 2018), while reporting of the literature search was informed by PRISMA-S (Rethlefsen et al., 2021).

The review was designed to map the breadth and characteristics of the evidence rather than to estimate a pooled intervention effect.

2.2 Review Question:

The primary review question was:

What is known from the existing literature about the principles, terminology, therapeutic approaches, proposed mechanisms, clinical applications, and evidence relevant to Body Engineering Rehabilitation and related manual therapy approaches in musculoskeletal rehabilitation?

2.3 Eligibility Framework:

The Population–Concept–Context (PCC) framework was used.

Element	Definition
Population	Humans undergoing musculoskeletal rehabilitation or conservative rehabilitation for musculoskeletal conditions
Concept	Body Engineering Rehabilitation and related manual, movement, fascial, muscular, joint, neural, neuromuscular, and biomechanical approaches
Context	Physiotherapy, rehabilitation, manual therapy, musculoskeletal clinical practice, and related healthcare settings

Direct Body Engineering publications involving neurological rehabilitation were retained when necessary to characterize the direct evidence base, but these were classified separately from the core musculoskeletal evidence.

2.4 Inclusion Criteria:

Sources were eligible when they met the following criteria:

- Involved human participants or clinically relevant human rehabilitation concepts;
- Addressed musculoskeletal rehabilitation or a relevant rehabilitation context;
- Explicitly described Body Engineering or Body Engineering Rehabilitation, or addressed a related manual/movement rehabilitation intervention;
- Were relevant to physiotherapy, rehabilitation, manual therapy, or related clinical practice;
- Provided clinical, conceptual, mechanistic, methodological, or contextual information relevant to the review question;
- Included randomized controlled trials, clinical trials, quasi-experimental studies, cohort studies, case-control studies, case reports or series, qualitative studies, systematic reviews, scoping reviews, narrative or theoretical publications, and selected grey literature where relevant.

No arbitrary date restriction was applied.

2.5 Exclusion Criteria:

Sources were excluded when they:

- Involved animals or laboratory-only models without sufficient clinical relevance;
- Addressed unrelated non-rehabilitation interventions;
- Used the word “manual” in an administrative, technical, or non-therapeutic context;
- Addressed surgery or medication without a relevant rehabilitation component;
- Were conference abstracts without sufficient information for evidence mapping;
- Were duplicate publications;
- Could not reasonably be accessed for assessment; or
- Fell outside the defined Population–Concept–Context framework.

2.6 Information Sources:

The planned information sources included:

1. PubMed/MEDLINE;
2. Scopus;
3. Web of Science;
4. CINAHL;
5. PEDro;
6. Google Scholar as a supplementary source;
7. Reference-list searching;
8. Selected grey literature and author-associated publications where relevant.

The JBI methodology emphasizes transparent and appropriately structured search processes for evidence synthesis (Peters et al., 2024).

2.7 Search Strategy:

The search strategy was organized into three principal streams.

Stream A: Direct Body Engineering:

"Body Engineering" [Title/Abstract]
OR "Body Engineering Rehabilitation" [Title/Abstract]
OR "Body Engineering Therapy" [Title/Abstract]

OR "Body Engineering Approach" [Title/Abstract]
OR "Body Engineering Method" [Title/Abstract]
OR "هندسة الجسد" [Title/Abstract]
OR "هندسة الجسد التأهيلية" [Title/Abstract]
OR "هندسة الجسم" [Title/Abstract]
OR "هندسة الجسم التأهيلية" [Title/Abstract]

Stream B: Related Manual Therapy:

"Manual Therapy"[Title/Abstract]
OR "manual therap*" [Title/Abstract]
OR "manual technique*" [Title/Abstract]
OR "manual treatment*" [Title/Abstract]
OR "manual intervention*" [Title/Abstract]
OR "hands-on therap*" [Title/Abstract]
OR "manipulative therap*" [Title/Abstract]
OR "musculoskeletal manipulation*" [Title/Abstract]
OR "joint mobilization" [Title/Abstract]
OR "joint manipulation" [Title/Abstract]
OR "soft tissue therap*" [Title/Abstract]
OR "soft tissue mobilization" [Title/Abstract]
OR "myofascial therap*" [Title/Abstract]
OR "myofascial release" [Title/Abstract]
OR "fascial manipulation" [Title/Abstract]
OR "fascial mobilization" [Title/Abstract]
OR "muscle energy technique*" [Title/Abstract]
OR "neuromuscular technique*" [Title/Abstract]
OR "neural mobilization" [Title/Abstract]

Stream C: Mechanistic Evidence:

biomechanics
OR mechanosensation
OR proprioception
OR mechanoreceptor*
OR neuromuscular

OR nociception
OR "pain modulation"
OR neurophysiological
OR physiological
OR fascial

AND

Manual therap*
OR myofascial
OR fascial
OR mobilization
OR manipulation
OR "soft tissue"

The searches were intended to identify direct Body Engineering literature as well as related evidence that could assist in conceptual and mechanistic mapping.

2.8 Supplementary Searching:

Supplementary searching included backward reference-list screening, citation searching where feasible, Google Scholar searching, and targeted searches for publications associated with Body Engineering terminology and its principal developer. Because the objective was evidence mapping, supplementary searching was considered important for identifying terminology and publications that may not be indexed consistently in major biomedical databases.

2.9 Search Documentation:

A search log was established with the following fields:

Information source	Purpose	Search approach	Search date	Records retrieved	Notes
PubMed/MEDLINE	Biomedical literature	Direct + related terms	To be verified	Pending verification	Database export unavailable
Scopus	Multidisciplinary literature	Direct + related terms	To be verified	Pending verification	Database export unavailable
Web of Science	Citation and multidisciplinary literature	Direct + related terms	To be verified	Pending verification	Database export unavailable
CINAHL	Rehabilitation and allied health	Direct + related terms	To be verified	Pending verification	Database export unavailable
PEDro	Physiotherapy trials	Related intervention terms	To be verified	Pending verification	Database export unavailable

Information source	Purpose	Search approach	Search date	Records retrieved	Notes
Google Scholar	Supplementary discovery	Direct terminology + related concepts	To be verified	Not treated as definitive database count	Supplementary
Reference lists	Citation discovery	Backward searching	During review	Not separately quantified	Supplementary
Grey literature	Conceptual/contextual discovery	Targeted searching	During review	Not separately quantified	Supplementary

Exact database retrieval counts were not reported where database history or export files were unavailable. This decision was made to avoid fabricating PRISMA numbers.

2.10 Study Selection:

Sources were screened according to the PCC framework and the predefined inclusion and exclusion criteria. Screening proceeded conceptually through:

1. Identification;
2. Duplicate removal;
3. Title and abstract screening;
4. Full-text assessment;
5. Final inclusion.

Because the available evidence was heterogeneous and direct Body Engineering evidence was sparse, particular attention was given to the distinction between direct and related evidence.

2.11 Data Charting:

The following information was charted where available:

- Author and year;
- Publication type;
- Population;
- Clinical condition;
- Rehabilitation context;
- Intervention or conceptual approach;
- Treatment dosage;
- Comparator;
- Outcome measures;

- Reported findings;
- Directness of evidence;
- Methodological limitations;
- Intervention architecture;
- Relevance to Body Engineering.

2.12 Evidence Classification:

Evidence was classified according to its role:

- **Direct Evidence:**

The publication explicitly identifies Body Engineering or Body Engineering Rehabilitation.

- **Conceptual Evidence:**

The publication describes principles, definitions, theoretical concepts, or proposed applications.

- **Related Clinical Evidence:**

The publication evaluates a related intervention but does not identify it as Body Engineering.

- **Mechanistic Evidence:**

The publication investigates physiological, neurological, sensory, proprioceptive, or biomechanical mechanisms.

- **Methodological Evidence:**

The publication addresses terminology, reporting, reproducibility, or study-design issues.

This classification prevented indirect evidence from being presented as direct validation of Body Engineering.

2.13 Intervention Architecture:

Related interventions were mapped into the following architecture:

- A: single technique;
- B: single manual technique plus exercise;
- C: multimodal manual therapy;
- D: integrated rehabilitation;
- E: individualized/manual clinical reasoning.

The direct Body Engineering case reports were classified primarily as D: integrated rehabilitation, because they involved Body Engineering in combination with other rehabilitation interventions.

This taxonomy was used for evidence mapping and does not imply that Body Engineering inherently belongs to any particular intervention category.

2.14 Evidence Synthesis:

Because the direct evidence was heterogeneous and primarily conceptual or case-based, quantitative meta-analysis was not performed. The synthesis focused on:

- Evidence characteristics;
- Terminology;
- Intervention architecture;
- Clinical contexts;
- Outcomes;
- Mechanisms;
- Reporting quality;
- Methodological gaps;
- Directness of evidence.

2.15 Interpretation of Direct Clinical Evidence:

Clinical improvements reported in multimodal Body Engineering programs were interpreted as outcomes of the reported rehabilitation program rather than as isolated effects of Body Engineering. No causal attribution to Body Engineering was made where other interventions were simultaneously administered.

2.16 Conceptual Mechanism Mapping:

Mechanistic findings from related manual and movement rehabilitation literature were mapped to potential stages in a conceptual pathway:

Therapeutic input → peripheral/sensory response → central sensorimotor processing → functional response → clinical outcome.

The pathway was considered hypothesis -generating rather than a validated causal model of Body Engineering.

2.17 Methodological and Reporting Considerations:

Particular attention was given to the reproducibility of manual interventions. Previous research has demonstrated substantial variability in the terminology and reporting of manual therapy interventions (Wenger et al., 2024; Ruzich et al., 2024).

Therefore, treatment descriptions were interpreted cautiously, and the absence of standardized intervention descriptions was treated as an important evidence gap.

2.18 Reporting:

The review was structured according to PRISMA-ScR. Search reporting was informed by PRISMA-S.

3. Results

3.1 Overview of the Evidence:

The direct Body Engineering evidence identified in the review was limited and heterogeneous.

The direct evidence set consisted principally of:

1. A foundational conceptual book published in 2019;
2. A 2024 case report involving pediatric spastic quadriplegia;
3. A 2025 case study involving quadriplegia following spinal injury;
4. A 2026 literature review discussing Body Engineering principles in postoperative ACL rehabilitation.

The direct evidence did not include a randomized controlled trial or comparative clinical study evaluating a standardized Body Engineering intervention.

The broader related literature was substantially larger and included research concerning manual therapy, muscle energy techniques, fascial and myofascial interventions, neural mobilization, neuromuscular approaches, joint mobilization/manipulation, and combined manual therapy and exercise.

3.2 Direct Body Engineering Evidence:

3.2.1 Foundational 2019 Publication:

Al-Baqaei (2019) published Introduction to Rehabilitation Body Engineering for Hand Therapy. The publication represents foundational conceptual literature for the approach. Its primary value for the present review is conceptual rather than empirical. It provides a basis for identifying the terminology and intellectual development of Body Engineering Rehabilitation. It does not constitute controlled evidence of clinical effectiveness.

Evidence classification: Direct; conceptual/foundational.

Certainty regarding efficacy: Not applicable.

Primary limitation: Conceptual publication without controlled clinical comparison.

3.2.2 2024 Pediatric Case Report:

Alboqaei (2024) reported the treatment of a four-year-old child with spastic quadriplegia and global developmental delay following hypoxic injury.

The reported rehabilitation program was described as Body Engineering/hand therapy and was delivered over approximately 12 months. The intervention included approximately one session per week lasting one hour. Importantly, the reported sessions incorporated multiple components, including Bobath-based treatment, muscle massage, balance training, hydrotherapy, play-based therapy, and strengthening exercises. Reported outcomes included changes in motor abilities, activities of daily living, communication, pain, and school participation. Standardized developmental or motor assessment tools were also reported. The publication reported improvement following the rehabilitation period. However, because the intervention was multimodal and lacked a comparator, the findings cannot establish that Body Engineering independently caused the observed improvements.

Evidence classification: Direct; case report/qualitative clinical report.

Intervention architecture: D — integrated rehabilitation.

Evidence level: Very low for causal efficacy inference.

Primary limitations: Single case, no comparator, multimodal intervention, limited reproducibility, and potential attribution bias.

3.2.3 2025 Quadriplegia Case Study:

Alboqaei (2025) described the rehabilitation of a 42-year-old man with quadriplegia following an accident involving an L4 spinal fracture. The reported rehabilitation program incorporated Body Engineering and manual therapy following surgical stabilization. Functional outcomes were monitored using the Functional Independence Measure, and follow-up extended over approximately 13 months. The publication reported clinical and functional improvements during the rehabilitation period. As with the pediatric case, however, the intervention was not isolated from the broader rehabilitation program. The absence of a comparator prevents attribution of the observed improvements specifically to Body Engineering.

Evidence classification: Direct; case study.

Intervention architecture: D — integrated rehabilitation.

Evidence level: Very low for causal efficacy inference.

Primary limitations: Single case, absence of comparator, multimodal intervention, and limited independent replication.

3.2.4 2026 ACL Literature Review:

Alboqaei (2026) presented a literature review concerning the integration of Body Engineering principles into postoperative ACL rehabilitation. The publication described Body Engineering as a conceptual framework involving individualized progression, functional assessment, load calibration, biomechanical considerations, and functional symmetry. The review is relevant because it illustrates an attempt to integrate Body Engineering principles with contemporary rehabilitation concepts. However, it is a literature review rather than a controlled efficacy study. The publication itself indicates the need for further empirical research to establish clinical applicability and effectiveness.

Evidence classification: Direct; conceptual literature review.

Primary limitation: Absence of direct controlled efficacy testing.

3.3 Overall Character of Direct Evidence:

The direct evidence base can therefore be summarized as follows:

ID	Year	Design	Population/context	Intervention	Outcomes	Evidence role
D1	2019	Foundational book	Rehabilitation/hand therapy	Body Engineering framework	Conceptual	Direct conceptual
D2	2024	Case report	Child with spastic quadriplegia	Body Engineering + multimodal rehabilitation	Motor/function/development	Direct clinical, very low
D3	2025	Case study	Adult quadriplegia after injury	Body Engineering + manual rehabilitation	FIM/clinical outcomes	Direct clinical, very low
D4	2026	Literature review	Postoperative ACL rehabilitation	Integration of Body Engineering principles	Functional recovery concepts	Direct conceptual

The principal observation is that direct Body Engineering evidence exists, but the evidence base is not yet sufficiently developed to establish comparative effectiveness.

3.4 Related Clinical Evidence:

3.4.1 Manual Therapy Heterogeneity:

Wenger et al. (2024) conducted a scoping review examining interventions labelled as manual therapy in low-back-pain trials. The review demonstrated substantial variability in terminology and intervention description. This finding supports the present review's decision not to treat “manual therapy” as a single homogeneous intervention.

Ruzich et al. (2024) similarly evaluated reproducibility of manual therapy interventions and found substantial deficiencies in reporting. These findings are relevant to Body Engineering because an

emerging intervention cannot be reliably evaluated unless its components and delivery procedures are sufficiently described.

3.4.2 Muscle Energy Techniques:

Ahmed et al. (2021) conducted a scoping review of muscle energy techniques in chronic mechanical low-back pain. The review identified a relatively limited body of evidence and reported generally favorable findings while emphasizing the scarcity and limitations of available studies.

A subsequent systematic review and meta-analysis by Santos et al. (2022) included randomized trials evaluating muscle energy techniques in nonspecific low-back pain. The findings suggested some short-term pain effects, but effects on disability were less consistent and methodological quality was variable. These findings provide contextual evidence for one class of manual intervention but should not be interpreted as evidence for Body Engineering.

3.4.3 Myofascial and Fascial Interventions:

Isaji et al. (2024) conducted a scoping review of fascial manipulation for musculoskeletal disorders. The review demonstrated that fascial interventions have been investigated across a range of musculoskeletal conditions but that the literature remains relatively limited and heterogeneous.

Individual trials of myofascial release have reported both positive and null findings depending on the population, comparator, treatment dosage, and outcomes. Consequently, the evidence does not establish a single consistent effect across all myofascial interventions.

3.4.4 Neural Mobilization:

Studies of neural mobilization have investigated outcomes including pain, range of motion, disability, and neurodynamic measures.

For example, Cuñado González et al. (2021) investigated a neural mobilization intervention in individuals with nonspecific low-back pain using a randomized placebo-controlled design. Findings did not demonstrate consistent superiority across all outcomes.

Other studies in cervical radiculopathy and chronic musculoskeletal conditions have reported potentially favorable outcomes, but differences in protocols and comparators limit broad generalization.

3.4.5 Neuromuscular and Proprioceptive Approaches:

Neuromuscular and proprioceptive approaches have been studied in cervical and lumbar musculoskeletal conditions. Some trials have reported improvements in pain, range of motion, disability, and motor performance. However, comparative findings have varied according to the population and intervention. These interventions are therefore considered related evidence rather than direct evidence for Body Engineering.

3.4.6 Manual Therapy Combined With Exercise:

A systematic review by Narenthiran et al. (2025) examined whether adding manual therapy to exercise therapy improves outcomes in chronic low-back pain. The review identified evidence that combined approaches may produce short-term improvements in pain and disability in some studies, while other studies did not identify additional benefit. This literature is particularly relevant to the interpretation of Body Engineering because integrated rehabilitation programs frequently contain multiple simultaneous components. The findings reinforce the need to distinguish the effects of a complete rehabilitation package from the independent effect of any single component.

3.5 Mechanistic Evidence:

3.5.1 Neurophysiological Mechanisms:

Keter et al. (2025) synthesized a broad body of literature concerning mechanisms of manual therapy. Evidence was identified for possible neurovascular, neurological, neurotransmitter/neuropeptide, neuroimmune, neuromuscular, and neuroendocrine responses, but evidence quality varied substantially.

Jahromi et al. (2026) reviewed neurophysiological responses to spinal mobilization and manipulation and identified studies involving transcranial magnetic stimulation, functional magnetic resonance imaging, somatosensory evoked potentials, and other neurophysiological measures.

The findings indicate that manual interventions can be associated with measurable changes in nervous-system function. However, the available literature does not establish that these changes are specific to Body Engineering or that they necessarily mediate clinical improvement.

3.5.2 Proprioception and Sensorimotor Processing:

Proprioception is another proposed pathway relevant to manual rehabilitation. Hadjisavvas et al. (2026) reviewed the effect of joint mobilization and manipulation on proprioception and identified evidence of immediate proprioceptive changes in some comparisons, but with substantial heterogeneity. Again, these findings may inform mechanistic hypotheses but cannot establish a Body Engineering-specific mechanism.

3.6 Methodological and Reproducibility Evidence:

The methodological literature identified several challenges relevant to Body Engineering research.

- First, manual therapy terminology is highly heterogeneous.
- Second, intervention reporting may be incomplete.
- Third, treatment dosage and progression are often insufficiently standardized.
- Fourth, multimodal interventions complicate attribution of outcomes.

These issues mean that future Body Engineering studies should provide detailed descriptions of the intervention, including:

- Treatment components;
- Treatment sequence;
- Duration;
- Frequency;
- Intensity;
- Practitioner decision rules;
- Progression criteria;
- Co-interventions;
- Home programs;
- Adherence;
- Treatment fidelity.

3.7 Evidence Classification and Mapping:

The overall evidence can be summarized as follows:

Evidence domain	Evidence status	Interpretation
Body Engineering conceptual literature	Present	Establishes description and conceptual development
Body Engineering case-based evidence	Present but limited	Demonstrates clinical application; cannot establish efficacy
Body Engineering randomized evidence	Not identified	Major evidence gap
Body Engineering comparative evidence	Not identified	Major evidence gap
Manual therapy clinical evidence	Substantial but heterogeneous	Provides contextual evidence
Myofascial/fascial evidence	Available but heterogeneous	Contextual and mechanistic relevance
Muscle energy technique evidence	Available	Variable and methodologically limited
Neural mobilization evidence	Available	Variable by condition and protocol
Neuromuscular/proprioceptive evidence	Available	Contextual mechanistic relevance
Mechanistic evidence	Increasing	Does not establish Body Engineering-specific mechanisms
Reproducibility evidence	Limited/heterogeneous	Important methodological gap

3.8 Evidence Gap:

The central evidence gap is the absence of controlled research evaluating Body Engineering as a standardized intervention. This does not indicate that Body Engineering is ineffective. Rather, it

indicates that the current literature is insufficient to determine its independent clinical effect. This distinction is fundamental to the interpretation of a scoping review.

3.9 Summary of Results:

The evidence map demonstrates that Body Engineering is an identifiable rehabilitation concept with published conceptual and clinical material. At the same time, the direct evidence remains limited and largely case-based. The broader manual rehabilitation literature provides relevant contextual information regarding possible therapeutic approaches and mechanisms, but similarity between related interventions and Body Engineering cannot be assumed to constitute equivalence.

4. Discussion

4.1 Principal Findings:

This scoping review identified a small but identifiable direct literature concerning Body Engineering Rehabilitation alongside a substantially broader literature concerning manual, movement-based, fascial, neural, neuromuscular, and integrated rehabilitation approaches. The most important finding is that Body Engineering has been explicitly described and clinically applied, but the direct empirical evidence remains limited. The current evidence does not establish independent clinical effectiveness, comparative effectiveness, superiority, or a mechanism specific to Body Engineering. This conclusion is based on the nature of the available evidence rather than on an assumption that absence of controlled trials indicates lack of benefit.

4.2 Interpretation of Direct Body Engineering Evidence:

The foundational publication demonstrates that Body Engineering has a defined conceptual history and terminology. The two clinical reports demonstrate that the approach has been applied in real rehabilitation settings. However, both clinical reports are case-based and involve multimodal interventions. Therefore, they provide evidence that Body Engineering has been used clinically, but not evidence that Body Engineering alone produced the observed outcomes.

The 2026 ACL review extends the conceptual application of the approach into postoperative musculoskeletal rehabilitation, but it remains a literature review rather than primary comparative evidence.

Taken together, these publications support characterization of Body Engineering as an emerging rehabilitation approach rather than as an established evidence-based intervention with demonstrated superiority.

4.3 Relationship to the Broader Manual Therapy Literature:

The broader literature provides an important context for understanding why direct comparison is difficult. Manual therapy is not a single intervention. It includes multiple procedures and treatment philosophies, and different researchers may use the same term to describe substantially different

interventions. The findings of Wenger et al. (2024) and Ruzich et al. (2024) demonstrate the importance of terminology and intervention reporting. This is directly relevant to Body Engineering research. Before effectiveness can be evaluated rigorously, researchers must be able to describe what the intervention consists of and reproduce it across settings.

4.4 Interpretation of Related Clinical Evidence:

Evidence concerning muscle energy techniques, fascial manipulation, neural mobilization, neuromuscular techniques, and manual therapy combined with exercise suggests that manual and movement-based interventions can produce clinically relevant changes in selected circumstances. However, the evidence is heterogeneous. Some studies demonstrate improvements compared with controls, whereas others demonstrate similar improvement between active intervention groups.

This variability may reflect differences in diagnosis, treatment dose, intervention content, comparator selection, patient characteristics, adherence, and contextual effects. Therefore, related evidence should be used to formulate hypotheses for Body Engineering research rather than to validate Body Engineering retrospectively.

4.5 Multimodal Rehabilitation and the Attribution Problem:

One of the most important interpretive issues identified in this review is attribution. Rehabilitation is frequently delivered as a package rather than as an isolated technique. The direct Body Engineering clinical reports illustrate this issue clearly. When Body Engineering is combined with massage, Bobath-based treatment, hydrotherapy, balance training, strengthening, or other interventions, the observed outcome represents the combined effect of the rehabilitation program.

It would therefore be scientifically inappropriate to state that the reported improvements demonstrate the efficacy of Body Engineering alone.

Future trials should explicitly distinguish:

- Standard rehabilitation;
- Standard rehabilitation plus Body Engineering;
- Body Engineering alone where ethically and clinically appropriate; and
- Other active comparators.

4.6 Interpretation of Mechanistic Evidence:

The broader mechanistic literature suggests that manual interventions may influence sensory and neurophysiological processes. Possible mechanisms include:

- Altered afferent input;
- Mechanosensation;
- Proprioceptive processing;

- Sensorimotor integration;
- Cortical excitability;
- Functional connectivity;
- Autonomic responses;
- Pain modulation.

Nevertheless, mechanistic plausibility does not establish clinical efficacy. A mechanism should be considered demonstrated only when a study directly measures the mechanism, establishes a temporal relationship with the intervention, and preferably demonstrates an association or mediation pathway between the mechanistic change and the clinical outcome. Such evidence is currently insufficient for Body Engineering.

4.7 A Multidimensional Interpretation of Body Engineering:

Based on the available evidence, Body Engineering may potentially be understood through several complementary dimensions:

1. Therapeutic intervention — when specific hands-on procedures are delivered to a patient.
2. Integrated rehabilitation framework — when manual and movement-based interventions are combined with broader rehabilitation.
3. Clinical reasoning framework — when individualized assessment and treatment progression are emphasized.
4. Conceptual model — when principles are described without direct intervention testing.

The current evidence does not establish which of these interpretations should be regarded as the definitive characterization.

Future research should therefore operationalize the construct before testing its effectiveness.

4.8 Clinical Implications:

The present findings do not justify claims that Body Engineering is superior to established rehabilitation approaches. They also do not justify concluding that it is ineffective. Clinicians considering the approach should recognize that its direct evidence base remains limited and that current support is primarily conceptual and case-based. Where Body Engineering is used clinically, careful documentation of treatment components, co-interventions, patient characteristics, treatment dose, and outcomes would contribute to future evidence development.

4.9 Methodological Implications for Future Research:

Future research should adopt standardized intervention reporting.

A Body Engineering intervention protocol should specify:

- Treatment rationale;
- Essential components;
- Optional components;
- Inclusion and exclusion criteria;
- Treatment dosage;
- Session structure;
- Progression criteria;
- Treatment fidelity;
- Practitioner qualifications;
- Co-interventions;
- Outcome measures.

Independent investigators should then replicate the intervention before large efficacy trials are undertaken.

4.10 Strengths:

The principal strengths of this review include:

1. Explicit separation of direct and indirect evidence;
2. Use of a scoping review methodology appropriate for a heterogeneous emerging field;
3. Incorporation of conceptual, clinical, mechanistic, and methodological evidence;
4. Avoidance of unsupported claims of efficacy;
5. Explicit consideration of multimodal intervention attribution;
6. Identification of terminology and reproducibility as research issues;
7. Development of a hypothesis-generating conceptual framework.

4.11 Limitations:

Several limitations should be considered:

- First, the direct Body Engineering evidence base is small.
- Second, much of the direct clinical evidence consists of case-based publications.
- Third, some publications were associated with the developer or author of Body Engineering, making independent replication an important unresolved issue.
- Fourth, the lack of complete database export files and search histories prevented verification of exact retrieval counts for all databases. Accordingly, numerical PRISMA counts were not

fabricated.

- Fifth, the broad related evidence base contains considerable clinical and methodological heterogeneity.
- Sixth, evidence concerning related manual therapies cannot be assumed to apply directly to Body Engineering.

4.12 Implications for Research and Knowledge Development:

The evidence gaps suggest a staged research pathway:

Definition → Reproducibility → Feasibility → Comparative Effectiveness → Mechanistic Evaluation → Independent Replication

This sequence may be preferable to immediately conducting large efficacy trials. A clearly defined intervention is necessary before reproducibility can be assessed. Reproducibility should precede large-scale effectiveness research. Mechanistic research should then investigate hypotheses that arise from the clinical evidence rather than assuming mechanisms in advance.

4.13 Overall Interpretation:

Body Engineering Rehabilitation should currently be regarded as an emerging rehabilitation approach requiring further empirical characterization and evaluation. The appropriate scientific position is therefore one of measured openness. The current literature supports continued investigation but does not justify claims of superiority, definitive efficacy, or a unique validated mechanism.

5. Evidence Gaps and Future Research

5.1 Lack of Controlled Direct Evidence:

The most prominent gap identified by this review is the limited availability of controlled empirical research specifically evaluating Body Engineering Rehabilitation. The direct literature includes conceptual publications and case-based clinical reports, but no randomized controlled or comparative clinical study specifically evaluating Body Engineering as a standardized intervention was identified. Future research should therefore progress toward prospective comparative studies after the intervention has been adequately defined and standardized.

5.2 Lack of a Standardized Operational Definition:

A second major gap concerns the operational definition of Body Engineering Rehabilitation. A standardized description should specify:

- Theoretical and clinical principles;
- Essential therapeutic components;
- Optional components;

- Treatment targets;
- Patient selection criteria;
- Contraindications and precautions;
- Treatment dosage;
- Session structure;
- Progression criteria;
- Practitioner decision-making;
- Expected outcomes;
- Treatment -fidelity procedures.

5.3 Attribution of Treatment Effects:

Future studies should distinguish between:

1. The effect of the overall rehabilitation package;
2. The incremental effect of adding Body Engineering to standard rehabilitation; and
3. The effects of specific Body Engineering components.

This distinction is essential when interventions contain multiple simultaneous therapeutic components.

5.4 Lack of Independent Replication:

Independent replication is an important priority.

Studies conducted by investigators who are not involved in developing the intervention would provide evidence regarding reproducibility, generalizability, treatment fidelity, and potential researcher or practitioner effects.

5.5 Uncertainty Regarding Mechanisms:

Future research should investigate whether proposed mechanisms associated with related manual interventions actually occur during standardized Body Engineering treatment. Studies should distinguish:

- Physiological responses;
- Intermediate sensory or motor changes
- Clinically meaningful outcomes.

5.6 Treatment Dose and Progression:

Future studies should systematically report:

- Number of sessions;
- Session duration;
- Treatment frequency;
- Intensity;
- Progression criteria;
- Practitioner contact time;
- Home rehabilitation;
- Adherence.

5.7 Outcome Selection:

Future research should prioritize validated outcomes including:

- Pain intensity;
- Pain interference;
- Disability;
- Functional performance;
- Activities of daily living;
- Quality of life;
- Range of motion;
- Strength;
- Movement-related outcomes;
- Patient -reported acceptability.

Mechanistic outcomes should complement rather than replace patient-centered clinical outcomes.

5.8 Recommended Research Pathway:

The recommended pathway is:

Definition → Reproducibility → Feasibility → Comparative Effectiveness → Mechanistic Evaluation → Independent Replication

6. Conceptual Evidence-Informed Framework

6.1 Rationale:

The literature mapped in this review suggests that manual and movement-based rehabilitation may involve interactions among mechanical, sensory, motor, contextual, and neurophysiological processes. An evidence-informed conceptual framework was therefore developed to illustrate possible pathways through which a multidimensional rehabilitation intervention could influence

clinical outcomes. The framework is not presented as a validated causal model of Body Engineering. It is a hypothesis-generating model derived from broader literature concerning manual therapy, movement rehabilitation, proprioception, sensorimotor processing, and related mechanisms.

6.2 Proposed Pathway:

The framework proposes:

Therapeutic input → Peripheral and sensory response → Central sensorimotor processing → Functional response → Clinical outcome

Therapeutic input may include mechanical, sensory, movement-based, and contextual/cognitive elements. These inputs may influence peripheral tissues and joints, afferent signaling, proprioceptive information, and mechanosensory processes. Such signals may interact with central sensorimotor processing, including cortical excitability, functional connectivity, sensorimotor integration, and pain-related processing. These processes may contribute to changes in movement, range of motion, strength, activity, and ultimately pain, disability, function, and quality of life.

6.3 Potential Moderators:

The proposed pathway may be modified by:

- Baseline clinical characteristics;
- Diagnosis;
- Expectations;
- Therapeutic alliance;
- Practitioner expertise;
- Treatment dose;
- Adherence;
- Co-interventions;
- Physical activity;
- Psychosocial context;
- Individual treatment response.

6.4 Figure 1:

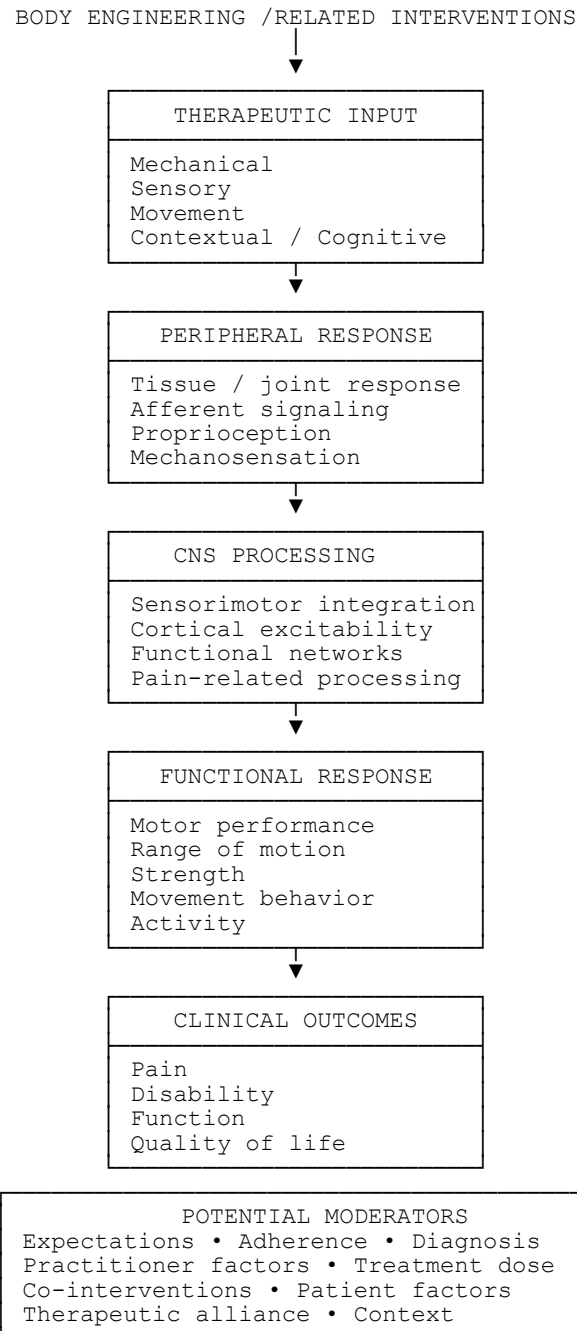


Figure (1): Conceptual evidence-informed framework for Body Engineering Rehabilitation and related manual and movement-based interventions.

6.5 Interpretation:

The framework does not imply that every Body Engineering intervention contains all of the therapeutic inputs shown. It also does not imply that every proposed pathway necessarily occurs in every patient. Instead, the framework provides a structure for future empirical research.

For example, future studies could investigate whether standardized Body Engineering treatment produces measurable changes in proprioception or movement and whether such changes are associated with subsequent functional improvement. Neurophysiological studies could examine whether cortical or sensorimotor changes occur consistently and whether those changes correlate with clinical outcomes. Such research would allow mechanistic hypotheses to be tested rather than assumed.

7. Conclusion

This scoping review mapped the available literature concerning Body Engineering Rehabilitation and related manual and movement-based rehabilitation approaches.

The review identified a limited but identifiable direct literature concerning Body Engineering. This literature includes foundational conceptual work, case-based clinical reports, and recent conceptual integration into rehabilitation contexts.

The available clinical reports demonstrate clinical application but do not provide sufficient evidence to determine the independent effectiveness of Body Engineering because of their case-based designs, absence of appropriate comparators, and use of multiple concurrent rehabilitation interventions.

The broader literature concerning manual therapy, muscle energy techniques, myofascial and fascial interventions, neural mobilization, neuromuscular approaches, joint mobilization or manipulation, and combined manual therapy and exercise provides a substantial contextual evidence base. However, these findings should not be interpreted as direct evidence validating Body Engineering as a complete rehabilitation approach.

Mechanistic research suggests that manual and movement-based interventions may be associated with changes in sensory processing, proprioception, sensorimotor integration, cortical excitability, functional connectivity, autonomic responses, and other physiological processes. Nevertheless, the causal relationship between these mechanisms and clinically meaningful outcomes remains incompletely established, and no validated mechanism specific to Body Engineering was identified.

The principal conclusion is therefore that Body Engineering Rehabilitation has been described and clinically applied, but its independent clinical effectiveness and comparative value remain insufficiently established.

The next stage of research should focus on operational definition, reproducibility, feasibility, comparative effectiveness, mechanistic evaluation, and independent replication.

Such a research pathway would provide the methodological foundation necessary to determine whether Body Engineering represents a distinct therapeutic intervention, an integrated rehabilitation framework, a clinical reasoning model, or a combination of these elements.

Until such evidence is available, conclusions regarding Body Engineering should remain proportional to the available evidence. The current literature supports continued scientific investigation but does not justify claims of superiority or definitive clinical effectiveness.

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