Harmonizing Taxonomy and Terminology across Force-Based Manipulation (Manual Therapy) Research Disciplines

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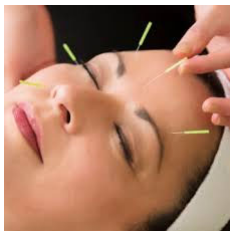
Part One: Introduction of the "state of the science" of force-based manipulation

Force-Based Manipulations

- Force-based manipulations (FBM) involve the passive application of mechanical force to the body's exterior with therapeutic intent and are recognized as a complementary and integrative health approach.

https://pubmed.ncbi.nlm.nih.gov/38078829/

Increasing Use of FBM

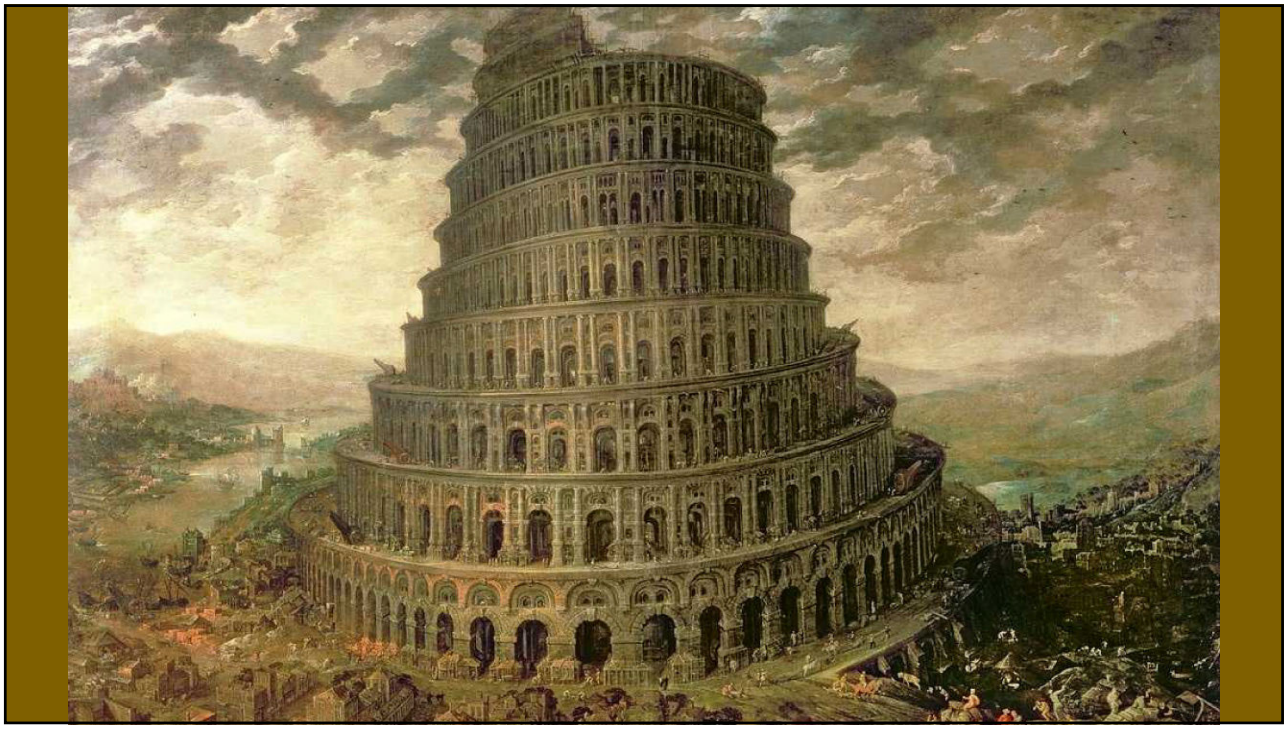
- According to the National Health Interview Survey (NHIS) conducted by the National Center for Complementary and Integrative Health (NCCIH), **36.7% of American adults** reported using at least one complementary health approach in 2022.
- In particular, use has increased among those in chronic pain, those who have experience failed traditional medical care, and those who are looking for options other than pharmaceutical choices.

Chen L, Michalsen A. Management of chronic pain using complementary and integrative medicine. *BMJ*. 2017;357:j1284

Key Stakeholders/Research Scientists

- Basic scientists
- Movement scientists
- Imaging specialists
- Biomechanical engineers
- Consumers

- Clinical scientists
- Physiotherapists
- Chiropractors
- Osteopaths
- NIH and other funding sources
- Policy Makers
- Healthcare Organizations
- Professional Associations



[GUEST EDITORIAL]

Manual Physical Therapy: We Speak Gibberish

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J Orthop Sports Phys Ther 2008;38(3):97-98. doi:10.2519/jospt.2008.0303

A Model for Standardizing Manipulation Terminology in Physical Therapy Practice

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Carl DeRosa, PT, PhD, DPT, FAPTA[2];
Tamara Little, PT, DMT, FAAOMPT[3];
Britt Smith, PT, DPT, OCS, FAAOMPT[4] *for the American Academy of Orthopaedic Manual Physical Therapists.*

Preface

document reflects the work and recommendations of this

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Profession-based manual therapy nomenclature: exploring history, limitations, and opportunities

Brian Degenhardt[a,b], Patrick L.S. van Dun[c,d], Eric Jacobson[e], Sandy Fritz[f], Paul Mettler[g], Norman Kettner[h], G. Franklin[a], Kendi Hensel[i], David Lesondak[j], Giacomo Consorti[c,k], Leah Frank[l], William R. Reed[m], Cameron MacDonald[n], Vaclav Kremen[a,o], Crystal Martin[a], Bernie Landels[r] and Paul Standley[s]

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Übersichten

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Manual medicine, manual therapy

Science, clinical application, evidence

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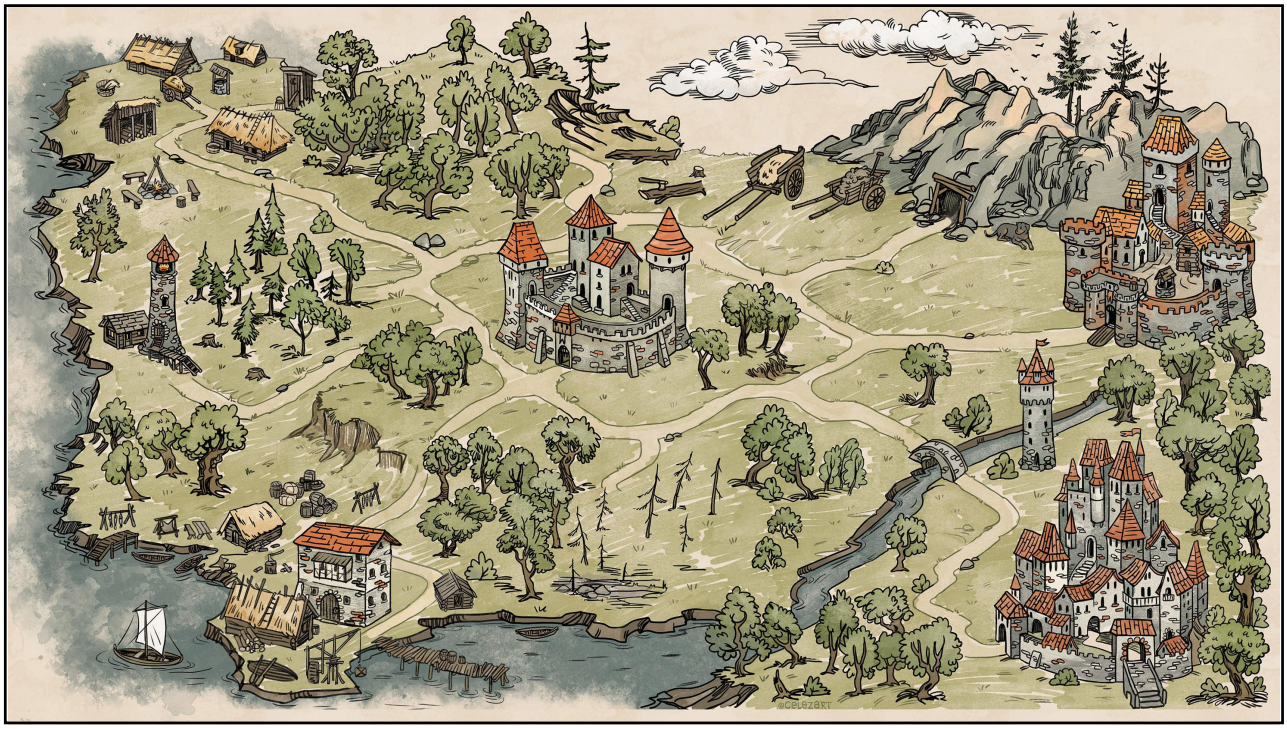

Framework and Taxonomy Working Group Members


Chad Cook


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Geoffrey Bove


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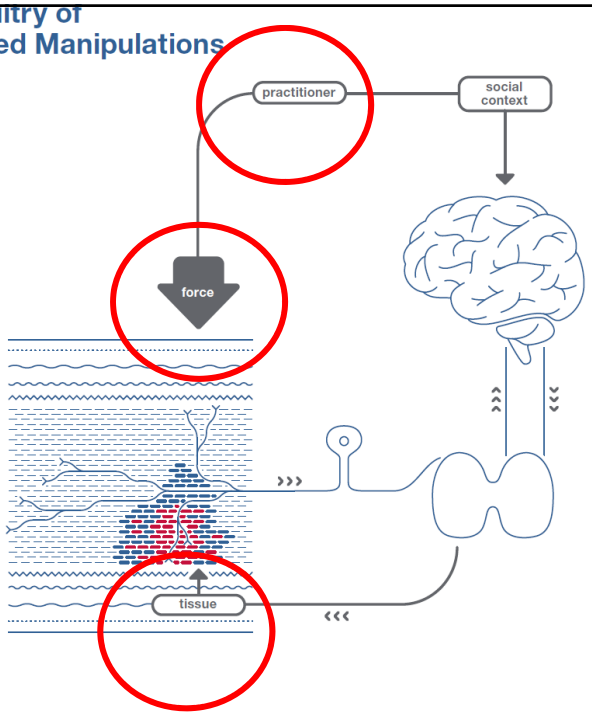
Neurocircuitry of Force-Based Manipulations



Working group is charged with refining the proposed framework, including, complete representation of physiological responses to force, standardizing languages, and building a taxonomy on potential moderators of force (i.e., application domains, force continuum, etc).

Targeted Deliverables

- Common terminology and taxonomy for force-based manipulation nomenclature and classification
- A standardized "force" document
- A model to guide force-based manipulation research
- Classifications of the term "treatment mechanism" including differentiation of causal and associational mechanisms
- Publications outlining gaps in FBM mechanism research and blue sky objectives

Presentation Purpose

1. Discuss the force document, including standardization of language, mediators and types
2. Outline the model that is used to guide FBM research
3. Describe the FBM compendium, which will provide a framework for the public and serve as an operation's manual for future FBM grant submissions

Part Four: The Force-Based Manipulation Compendium

The Compendium

- **Chapter One**: Defining and outlining mechanisms' and FBM classifications;
- **Chapter Two**: Factors to consider when performing or researching FBM (previously discussed);
- **Chapter Three**: Taxonomy of response (treatment); mechanisms;
- **Chapter Four**: Research implications;
- **Chapter Five**: Clinical implications;
- **Glossary**.

Chapter One: Defining and outlining mechanisms' classifications

frontiers | Frontiers in Psychology

TYPE Original Research
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An international consensus definition for contextual factors: findings from a nominal group technique

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Categorizing Treatment Mechanisms into Causal and Associational Groups

Contents lists available at ScienceDirect

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Categorizing treatment mechanisms for Complementary and Integrative Musculoskeletal Interventions

Chad E. Cook [a,b,c,*], Victoria E. Abraira [d], John Burns [e], Brian F. Degenhardt [f], Greg Kawchuk [g], Damian Keter [h], M. Terry Loghmani [i], William R. Reed [j], Beth A. Winkelstein [k], Amy McDevitt [l,m]

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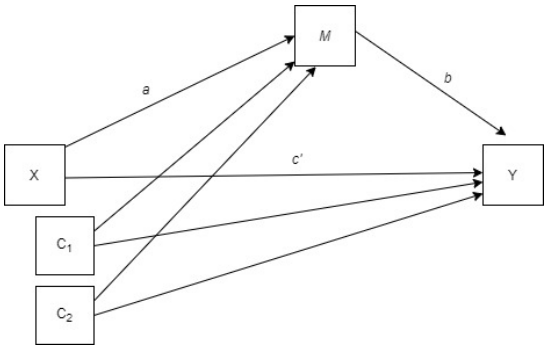
Causal Treatment Mechanisms' Designs Paper

- Paper in process
- Includes FBM researchers and biostatisticians
- Outlines the appropriate research design models to identify causal treatment mechanisms
- Expected completion in May, 2025



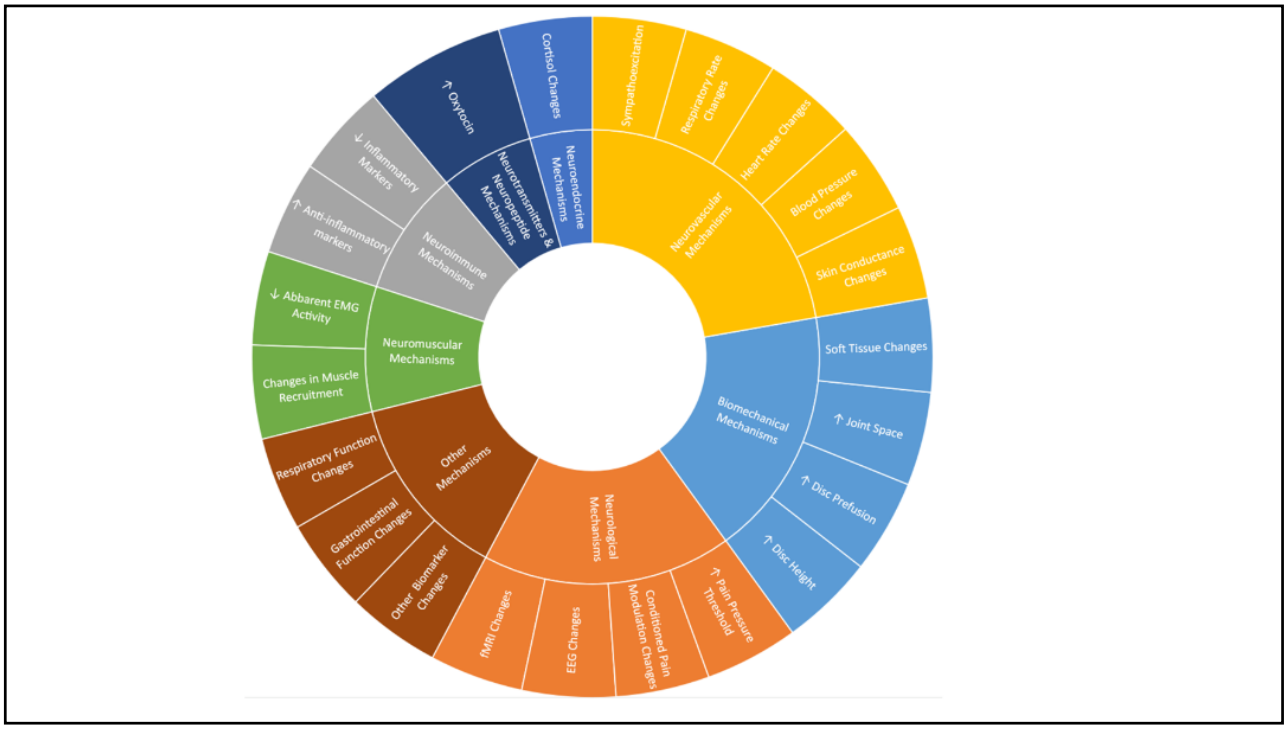
Chapter Three: Taxonomy of response (treatment); mechanisms

Appendix A: Defined mechanistic domains and examples of direct and indirect measures of these domains.

Mechanistic Domain	Definition	Examples	Direct Measure	Indirect Measure
Biomechanical	Measures of molecular, cellular or physiological processes representative of changes in the position, structure, fluid dynamics or movement characteristics of tissue.	Joint position changes, tissue movement, fluid loading	Imaging	
Neurological	Measures of molecular, cellular or physiological processes representative of changes in central nervous system and/or peripheral nervous system activity.	Changes in neural conduction	MEG, EEG, NCV	fMRI, conditioned pain modulation, temporal summation, pressure pain threshold
Neuroimmune	Measures of molecular, cellular or physiological processes representative of changes in neuroimmune system status.	Inflammatory and anti-inflammatory mediator changes	MEG, EEG (subcortical)	Inflammatory cytokine, anti-inflammatory cytokine, Leukocyte, Lymphiocyte, Neutrophil, and Immunoglobin profile. Vagus nerve activation
Neurovascular	Measures of molecular, cellular or physiological processes representative of changes in blood flow centrally or peripherally.	ANS response, blood flow changes locally and remotely	Echocardiogram, Vascular ultrasound	Skin conductance, skin temperature, heart rate, heart rate variability, blood pressure, Alpha-amylase concentration, dermal blood flow
Neurotransmitter and neuropeptide	Measures of molecular, cellular or physiological processes representative of changes in cellular messengers	Changes in neurotransmitter and neuropeptide levels (Plasma, Saliva)		Norepinephrine, Epinephrine, Serotonin, Phenethylamine, Anandamide, Neurotensin, Oxytocin, Substance P, Beta-Endorphin, Orexin A
Neuroendocrine	Measures of molecular, cellular or physiological processes representative of changes in neuroendocrine function	Changes in endocrine markers (Plasma, Saliva)	MEG, EEG (subcortical)	Cortisol level
Neuromuscular	Measures of molecular, cellular or physiological processes representative of changes in neuromuscular activation and function.	Changes in muscle tone, muscle activation	EMG	Max voluntary contraction, visualized muscle activation (US, fMRI, etc.)
Other mechanisms	Measures of molecular, cellular or physiological processes representative of changes not specified within the aforementioned domains.			

Definitions: MEG- magnetoencephalography, EEG- electroencephalogram, NCV- nerve conduction velocity, fMRI- functional magnetic resonance imaging, ANS- autonomic nervous system. US- Ultrasound

PLOS One: Paper is in Press



Chapter Four: Research Implications

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The critical need, importance, and value of mechanistic Force-Based Manipulations research

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International "Gaps" in FBM Mechanisms Research

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An international consensus on gaps in mechanisms of forced-based manipulation research: findings from a nominal group technique

Damian L. Keter[a,b], Jennifer A. Bent[c], Joel E. Bialosky[d,e], Carol A. Courtney[f], Jorge E. Esteves[g,h,i], Martha Funabashi[j,k], Samuel J. Howarth[j], H. Stephen Injeyan[j], Anna Maria Mazziari[l,m], Casper Glissmann Nim[n,o,p] and Chad E. Cook[q,r,s]

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International "Gaps" in Contextual Factors and FBM Research

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Journal of Manual & Manipulative Therapy

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/yjmt20

Identifying priority gaps in contextual factors research and force-based manipulation. An international and interdisciplinary Delphi study

David Griswold, Ken Learman, Giacomo Rossettini, Alvisa Palese, Edmund Ickert, Mark Wilhelm, Chad Cook & Jennifer Bent

International Journal of Osteopathic Medicine 55 (2025) 100750

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Context is complex: Challenges and opportunities addressing contextual factors in manual therapy mechanisms research

Damian L. Keter [a,*], Jorge E. Esteves [b,c], M. Terry Loghmani [d], Giacomo Rossettini [e], Chad E. Cook [f,g,h]

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Waste in FBM/SMT Research

Aspinall *et al. Chiropractic & Manual Therapies* (2024) 32:16
https://doi.org/10.1186/s12998-024-00539-y

Chiropractic & Manual Therapies

COMMENTARY Open Access

Waste not, want not: call to action for spinal manipulative therapy researchers

Sasha L Aspinall[1*], Casper Nim[2,3,4], Jan Hartvigsen[4,5], Chad E Cook[6], Eva Skillgate[7,8,9], Steven Vogel[10], David Hohenschurz-Schmidt[10,11], Martin Underwood[12,13] and Sidney M Rubinstein[14]

Outlining the Role of Specific and Shared Treatment Mechanisms

McDevitt *et al. Archives of Physiotherapy* (2023) 13:14
https://doi.org/10.1186/s40945-023-00168-3

Archives of Physiotherapy

VIEWPOINT Open Access

Cracking the code: unveiling the specific and shared mechanisms behind musculoskeletal interventions

Amy W. McDevitt[1*], Bryan O'Halloran[2] and Chad E. Cook[3,4,5]

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Specific and shared mechanisms associated with treatment for chronic neck pain: study protocol for the SS-MECH trial

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Chapter Five: Clinical Implications

Kerry et al. Chiropractic & Manual Therapies (2024) 32:17
https://doi.org/10.1186/s12998-024-00537-0

Chiropractic & Manual Therapies

REVIEW Open Access

A modern way to teach and practice manual therapy

Roger Kerry[1], Kenneth J. Young[2*], David W. Evans[3], Edward Lee[1,4], Vasileios Georgopoulos[1,5], Adam Meakins[6], Chris McCarthy[7], Chad Cook[8], Colette Ridehalgh[9,10], Steven Vogel[11], Amanda Banton[11], Cecilia Bergström[12], Anna Maria Mazzieri[13], Firas Mourad[14,15] and Nathan Hutting[16]

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Research article

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Jeehp
Journal of Educational Evaluation for Health Professions

Priorities in updating training paradigms in orthopedic manual therapy: an international Delphi study

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[LITERATURE REVIEW]

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MEGAN DONALDSON, PhD[9] • ARON S. DOWNIE, PhD[8] • STEEN HARSTED, PhD[1,3] • SIMONE HANSEN, MSc[10]
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ERIC J. ROSEEN, PhD[14] • JAMES J. YOUNG, PhD[3,15] • ANIKA YOUNG, MRes[8] • GONG-HE ZHAO, PhD[3,16]
JAN HARTVIGSEN, PhD[3,17a] • CARSTEN B. JUHL, PhD[3,18a]

The Effectiveness of Spinal Manipulative Therapy in Treating Spinal Pain Does Not Depend on the Application Procedures: A Systematic Review and Network Meta-analysis

JOSPT OPEN | RESEARCH REPORT

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Steven Z. George, PT, PhD, FAPTA[1,3] ■ Toby Hall, PT, PhD[7] ■ Greg Kawchuk, DC, PhD[8] ■ Elizabeth Lane, PT, PhD[9]
Carolina Lavazza, DO[10] ■ Enrique Lluch, PT, PhD[11,12,13] ■ Adriaan Louw, PT, PhD[14] ■ Anna Maria Mazzieri, STT, BSc[15,16]
Amy McDevitt, PT, DPT, PhD[17] ■ William R. Reed, DC, PhD[18] ■ Annina B. Schmid, PT, PhD[19] ■ Anabela G. Silva, PT, PhD[20]
Keith M. Smart, PT, PhD[21,22] ■ Emilio J. Puentedura, PT, PhD[23]

Developing Manual Therapy Frameworks for Dedicated Pain Mechanisms

■ **OBJECTIVE:** To create a consensus-based framework of manual therapy treatment approaches for the major mechanisms-based pain classifications established by the International Association for the Study of Pain (IASP) nociceptive, nociplastic, and neuropathic pain.

■ **DESIGN:** The hybridized consensus survey included experts who participated in working groups and a survey of external stakeholders.

■ **METHODS:** Eighteen working group members created theoretical treatment frameworks for nociceptive, nociplastic, and neuropathic pain mechanisms. The treatment frameworks were then sent to manual therapists and/or pain experts (stakeholders), who rank ordered the frameworks for each mechanism. The mean/median/mode of the rank ordered results was tabulated, and a single framework was identified for each pain mechanism.

■ **RESULTS:** Fifteen theoretical frameworks were created for nociceptive (3), nociplastic (6), and neuropathic (6) pain mechanisms. Ninety-six stakeholders rank ordered the framework options, and 1 framework was identified for each pain mechanism. Four of the 10 framework constructs were consistent across each mechanism, whereas notable differences in recommendations were promoted in the other six.

■ **CONCLUSION:** There were notable differences across the recommended frameworks, suggesting endorsement modification of manual therapy approaches based on the individual's dominant pain mechanism. Understanding dominant pain mechanisms may help clinicians tailor care for precision musculoskeletal medicine. *JOSPT Open 2023;1(1):48-62. Epub 10 July 2023. doi:10.2519/josptopen.2023.0002*

■ **KEY WORDS:** *manual therapy, neuropathic, nociceptive, nociplastic, pain mechanism, phenotype*

component of multimodal musculoskeletal pain management and may include procedures such as light touch, pressure, thrust joint manipulation, and nonthrust mobilization.[14,15] Across numerous forms of musculoskeletal disorders, manual therapy interventions have consistently demonstrated similar or superior clinical outcomes[2,4–6,10,14,16,18,31,37–39,44,46–47,53] and cost-effectiveness[1–5,26,28,40,51,52,54] versus a variety of comparators. The evidence is conflicting about whether subclassifying individuals into groups most likely to benefit from manual therapy may improve outcomes versus a "one size fits all" treatment approach.[8,11,20]

The International Association for the Study of Pain (IASP) describes 3 major mechanisms-based pain classifications: nociceptive, nociplastic, and neuropathic pain.[24] Different pain phenotypes have been explored within each pain mechanism, in conditions such as post-COVID,[19] cancer,[36] multiple sclerosis,[27] and osteoarthritis.[21]

Nim *et al. Chiropractic & Manual Therapies* (2023) 31:14
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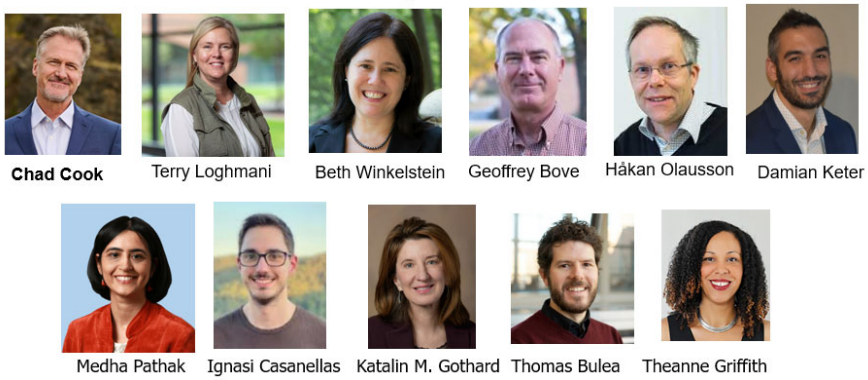
Chiropractic & Manual Therapies

STUDY PROTOCOL Open Access

The effectiveness of spinal manipulative therapy procedures for spine pain: protocol for a systematic review and network meta-analysis

Casper G. Nim[1,2,3*], Sasha L. Aspinall[4], Chad E. Cook[5,6,7], Leticia A. Corrêa[8], Megan Donaldson[9], Aron S. Downie[8], Steen Harsted[1,3], Jan Hartvigsen[3,10], Hazel J. Jenkins[8], David McNaughton[11], Luana Nyirö[12], Stephen M. Perle[4,13], Eric J. Roseen[14], James J. Young[3,15], Anika Young[8], Gong-He Zhao[3,16] and Carsten B. Juhl[3,17]

Glossary



- Over 300 critical terms defined and alphabetized

Harmonizing Nomenclature

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Profession-based manual therapy nomenclature: exploring history, limitations, and opportunities

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“What’s in a name?” Standardizing force types, modifications and moderators/mediators

Beth A. Winkelstein, PhD

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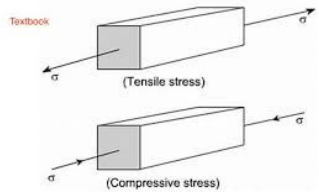
Terminology & need for shared lexicon

"STRESS"



World Health Organization	*'state of worry or mental tension caused by a difficult situation'*
Biomechanist	*'force over a cross-sectional area'*
Cellular Physiologist	*'state of dysfunction'*
Pain Practitioner	*'a state of pressure or dysregulation'*
Force-Based Practitioner	*'pressure'*
Computational Modeler	*described by an equation….*

Terminology & need for shared lexicon

"STIFFNESS"

extent to which an object resists deformation

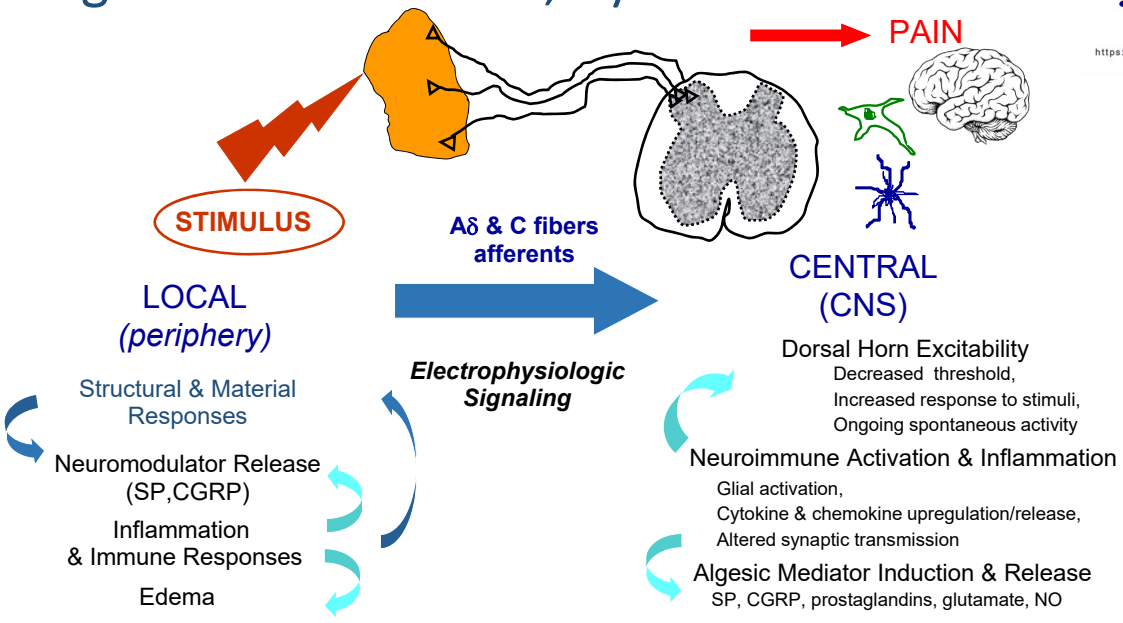
(Fung 1993, Humphrey 2002)

sensation of difficulty in movement *(Orbai et al 2014, Stanton et al 2017)*

"STRAIN"

Simple words highlight challenges working across disciplines and the need for common understanding about, and use of, terminology."

Regulation of Function, Dysfunction & Pain



Force Parameters

Complex & 'in the intersection'

FBM – complicated by provider & receiver

Overall Consideration:

- *Dosing (extent of treatment)*
- *Controlled vs Subjective*
- *Feedback (subject & tissue)*

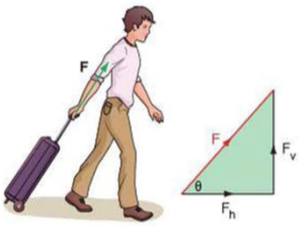
Contributing to Dosing

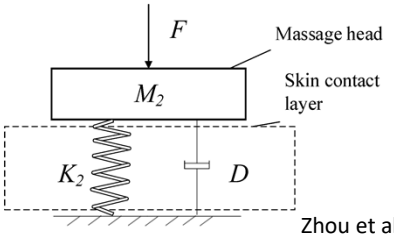
- Magnitude
- Angle
- Direction
- Area
- Rate
- Frequency
- Pattern
- Mode

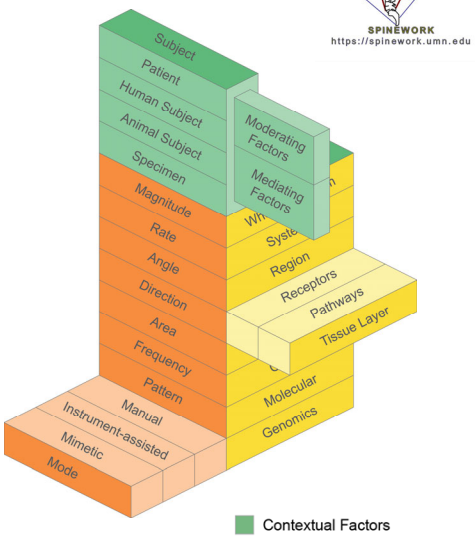
Force Parameters

Contributing to Dosing

- Magnitude
- Angle
- Direction
- Area







Zhou et al 2022, *Micromachines*

Force Parameters

Contributing to Dosing

- Magnitude
- Angle
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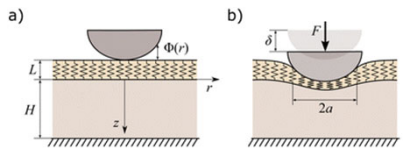
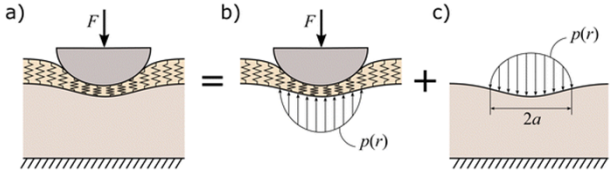
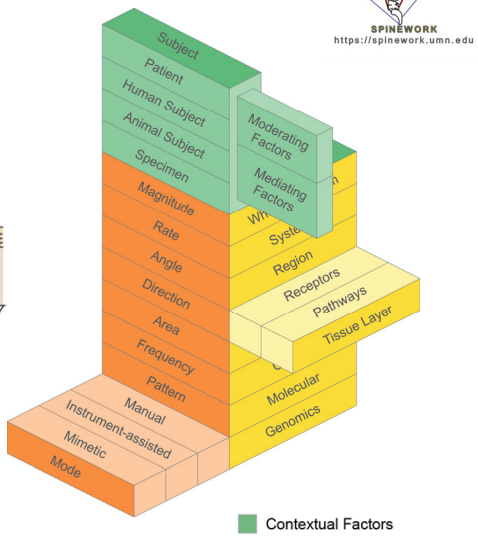
- Area





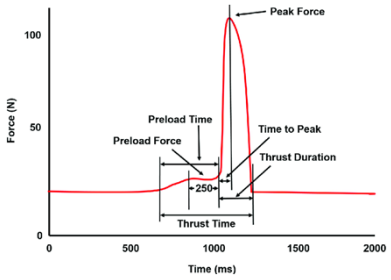


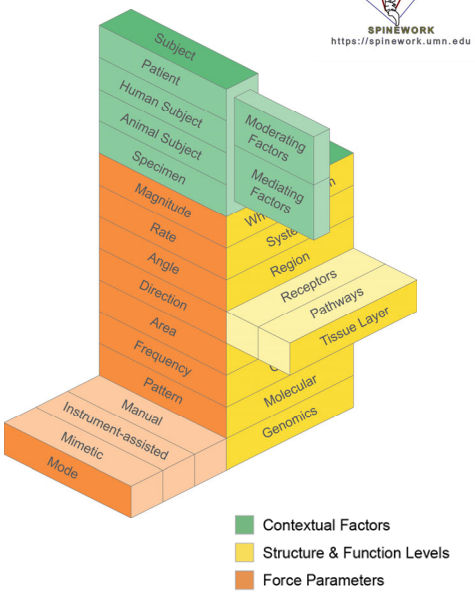
Argatov et al 2023, *Royal Soc Chem*

Force Parameters

Contributing to Dosing

- Magnitude
- Angle
- Direction
- Area
- Rate
- Frequency





Colloca et al 2020, *JMPT*

Force Parameters

Contributing to Dosing

- Magnitude
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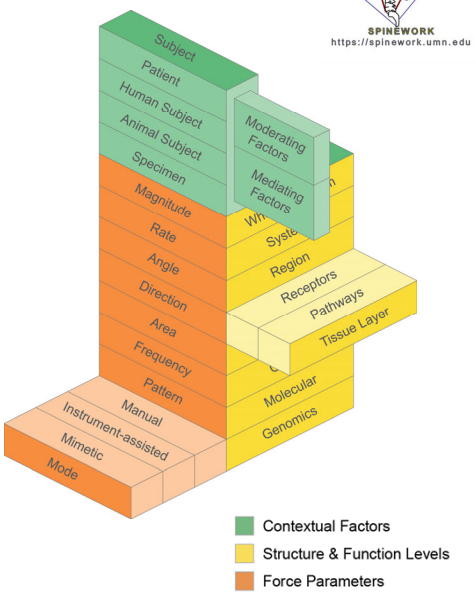
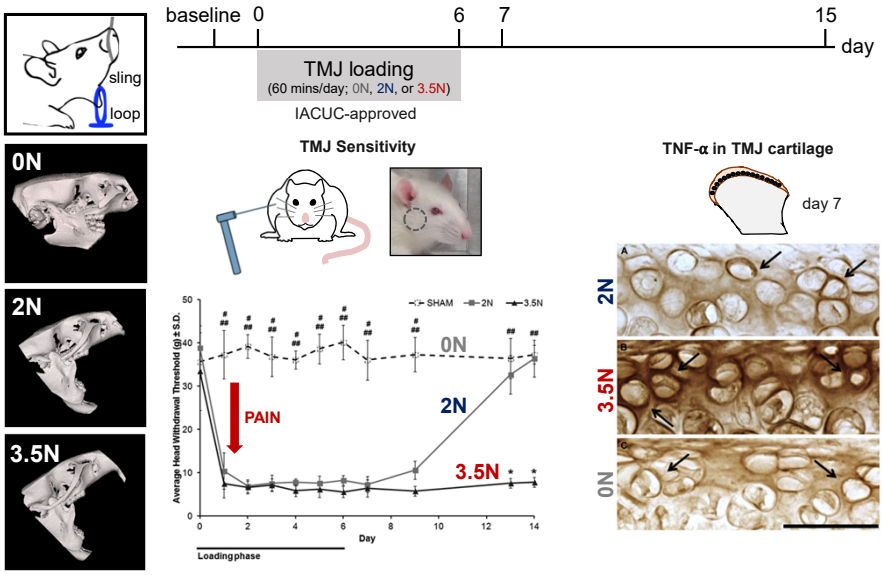
- Mode

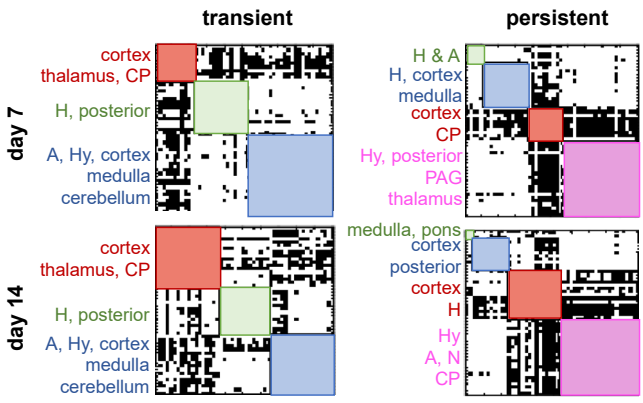


Example of Regulation Effects - Force



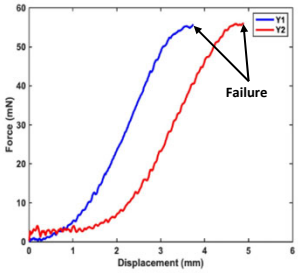
(Nicoll et al. 2010; Kartha et al. 2016; Sperry et al. 2018)

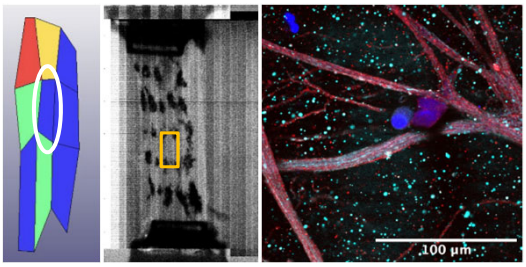
Example of Regulation Effects - Force

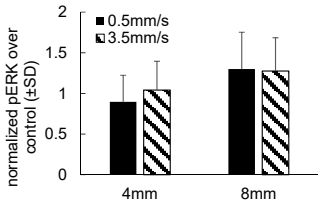


(Sperry et al. *Pain*, 2021)

Regulation Effects – Rate on Neuronal pERK





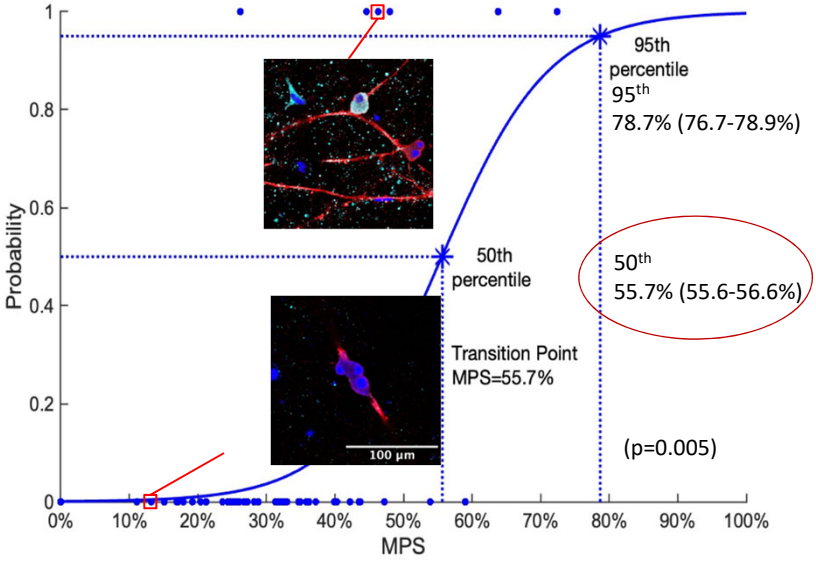


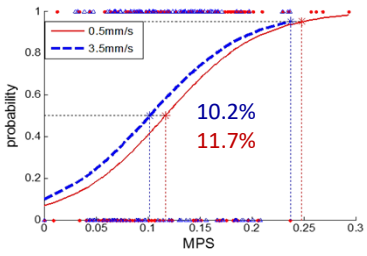
(Zhang et al, *J Biomech Eng*, 2016)

Loading mechanics
7.9±0.3 mm/s
122±16.5 %/s

(Nuethong et al., 2022; Singh & Winkelstein, 2019)

Regulation Effects – Rate on Neuronal pERK

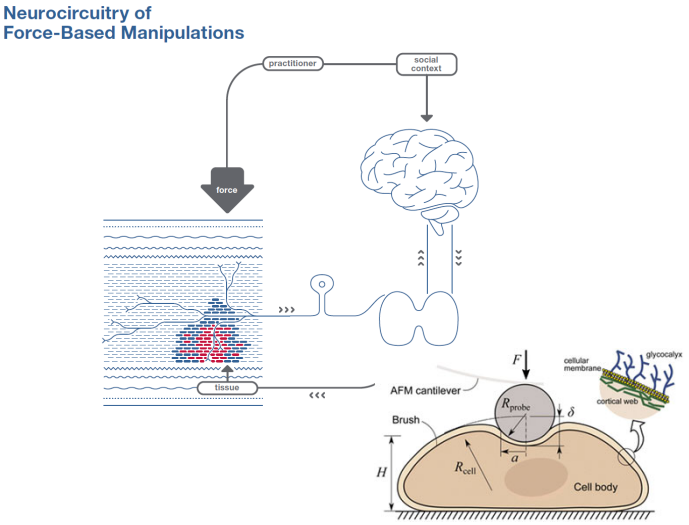




(Zhang et al, *J Biomech Eng*, 2016)

Mediators & Considerations

- Scales
  - Independent
  - Integrative
- Systems & Function
  - Individually
  - Cross-talk
  - History (cells & systems)



A Model to Guide Force-Based Manipulation (FBM) Research & Practice

Manual Therapy is a Powerful Force in Healing, Repair, Regeneration Well-Being and Health

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Associate Professor
Indiana University Indianapolis
NeuronS_MATTR

Model to Guide FBM Research & Practice

PROBLEM: The lack of conclusive evidence regarding FBM mechanisms and clinical effectiveness of FBM threatens the validity, reliability, and equitable availability of these non-invasive approaches.

PRIORITY: NIH RFA (AT-21-006) established priority objectives to meet the need for collaboration and dissemination of:

1. Terminology and characteristics of measurement of FBM
2. Contextual effects of FBM to support mechanisms research and incorporation of relevant technology and methods

Model to Guide FBM Research & Practice

PURPOSE: A model to support FBM research study design and grant proposal development, with the goal of improving safety, optimizing practice, and advancing understanding in the field.

PREMISE: The model should :

1. Be relevant across multiple disciplines
2. Support inter-disciplinary FBM research and healthcare

Model to Guide FBM Research & Practice

PROCEDURE:

FBM Taxonomy & Terminology Committee
- 3 NIH U24 Networks
- Multi-disciplinary
- Met regularly

→

3 Models Proposed
- Presented virtually
- Discussed
- Voted On (2 rounds)

→

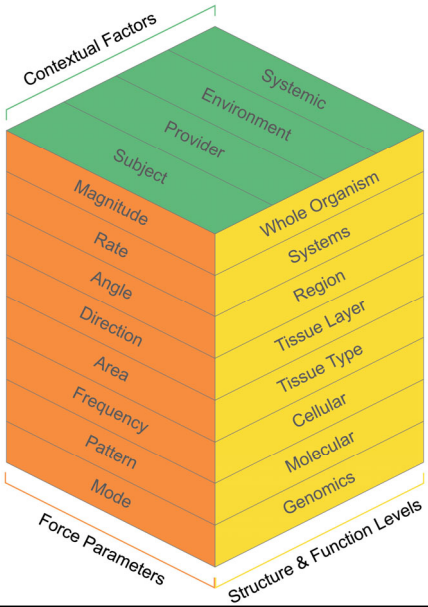
3D Matrix Model Selected
- Sub-group refined
- Virtual/Email
- Dissemination

A 3D Model to Guide FBM Research & Practice

3D MATRIX MODEL

1. ELEMENTS

- Contextual Factors
- Structure & Function Levels
- Force Parameters

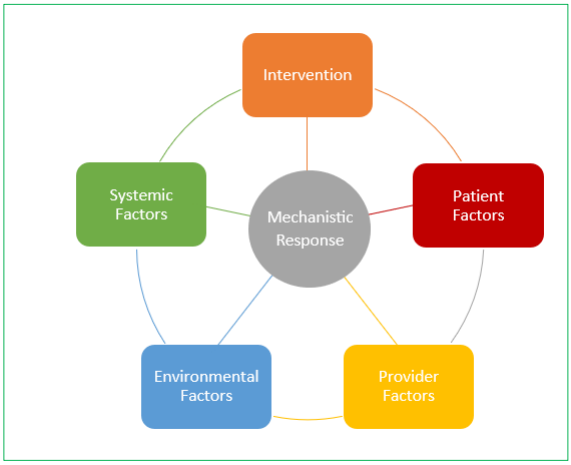


A 3D Model to Guide FBM Research & Practice

CONTEXTUAL FACTORS

The intrinsic and extrinsic components that moderate treatment mechanisms of interventions, including manual therapy.

-Cook, et al., Front Psychol, 2023



-Keter, et al., IJOM, 2025

A 3D Model to Guide FBM Research & Practice

STRUCTURE & FUNCTION LEVELS

Can consider the levels of organization of the body from different perspectives:

- Structural
- Functional
  - Performance
  - Process
- Interaction

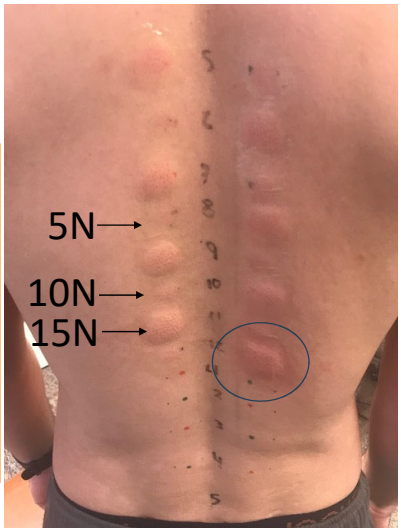
A 3D Model to Guide FBM Research & Practice

Force Parameters

Applied force should be described & quantified.

Replication & reliability.

Needed to establish FBM dose-response.



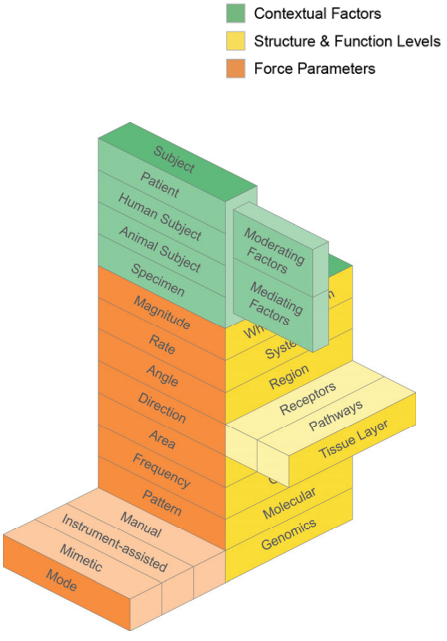
FORCE PROFILE

- Different magnitudes
- Rate (2.5cm/s); Maintained contact
- 45° angle of application
- Uni-directional; away from spine
- 2.5 cm X 2cm area treated
- 1 Hz; X 10sec; 1 session
- Linear stroke pattern; random order
- Quantitative IASTM; Clinician

A 3D Model to Guide FBM Research & Practice

2. INTERACTIVE

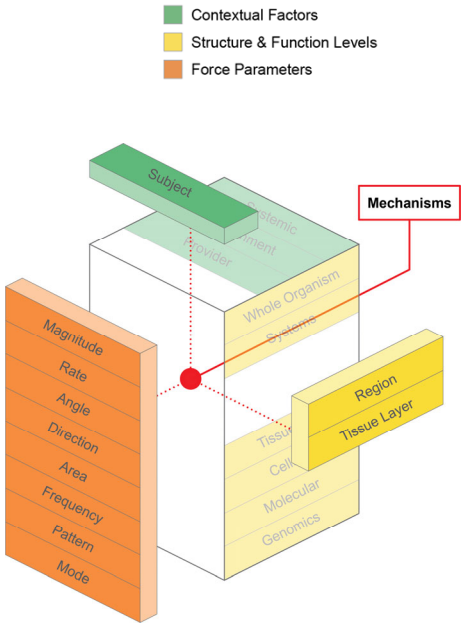
Levels can be “opened up ” to more specific and deepening sub-levels.



A 3D Model to Guide FBM Research & Practice

3. INTEGRATIVE

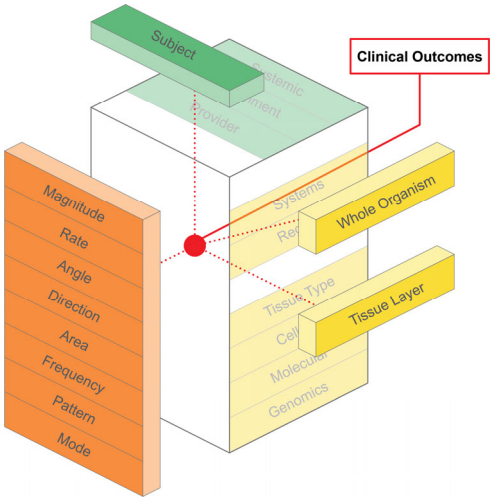
Considers the intersection of the elements, levels, and sub-levels for FBM mechanisms research.



A 3D Model to Guide FBM Research & Practice

4. TRANSLATIONAL

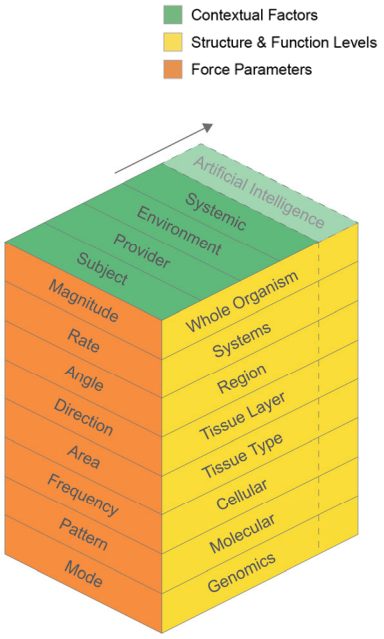
Considers the intersection of the elements, levels, and sub-levels for translational research on FBM approaches, including clinical outcomes.



A 3D Model to Guide FBM Research & Practice

4. DYNAMIC

Can expand to include additional levels & sub-levels as needed and new approaches or knowledge is acquired.



IMPLICATIONS

CONSIDERATIONS

- Does not replace the judgement of basic scientists or clinicians.
- Need to curate elements to the purpose & goals of the specific research project or patient.
- Not all inclusive.

Outcomes/ Mechanisms

The nature & integrity of this relationship must be considered & maintained.

FUTURE DIRECTIONS

- Build an animated & interactive web-based platform
- Link relevant references to each sub-level
- Expand to integrate new insights and approaches
- Repository for sustainable access