# A State-Based Model for Interpretation and Treatment Sequencing in Equine Osteopathy


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**Abstract**

This paper proposes a state based model for equine osteopathic assessment and treatment sequencing that differentiates among mechanical restriction, compensatory adaptation, and protective guarding. The model is not intended to replace established osteopathic principles, but to refine clinical reasoning in presentations that do not respond as straightforward mobility deficits.

Horses presenting with primary mechanical restriction may respond predictably to direct mobilization, whereas patterns shaped by compensatory adaptation or protective organization may require an alternative initial approach. Accordingly, the model shifts emphasis from the location of visible restriction to the functional role of the observed pattern, with consideration of whether mobility, support, or regulation should be prioritized.

The discussion draws upon literature from equine biomechanics, rehabilitation science, manual therapy, rider-horse interaction, fascia research, pain science, and motor control. Collectively, these domains support the relevance of distinguishing among different forms of movement limitation, although direct empirical evaluation of a state-based osteopathic model in horses remains limited.

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## Introduction

Equine osteopathic assessment commonly begins with the identification of movement restriction. However, not all apparent restrictions arise from the same underlying mechanism. Some horses present with primary mechanical limitation, whereas others demonstrate compensatory adaptation or protective organization associated with discomfort, instability, overload, or task demand. Interpreting these presentations as a uniform mobility deficit risks misidentifying the primary driver and may limit the persistence of clinical improvement.

This paper presents a state-based model to guide assessment and intervention sequencing within equine osteopathic practice. The model distinguishes among mechanical restriction, compensatory adaptation, and protective guarding and is interpretive rather than diagnostic in its purpose. It remains grounded in established osteopathic principles, including structure–function relationships, whole-body integration, palpatory assessment, and reassessment through manual reasoning (Haussler, 2016; Haussler, 2018). Its primary distinction lies in the order of interpretation, emphasizing the role of the pattern rather than assuming that reduced movement necessarily requires increased mobility.

The literature informing this model is interdisciplinary rather than derived from a single unified framework. Biomechanical research demonstrates that equine movement arises from an interconnected system rather than isolated regions (Clayton & Hobbs, 2017). Rehabilitation literature emphasizes functional assessment, proprioception, neuromotor control, and the complexity of measuring meaningful change over time (McGowan et al., 2016; Atalaia et al., 2021; Tabor et al., 2020). In addition, pain science and motor control research indicate that altered movement may reflect adaptive or protective strategies rather than tissue-level dysfunction alone (Hodges & Tucker, 2011; Moseley & Butler, 2015; Stergiou et al., 2006).

The central premise of this paper is that intervention is more likely to be effective when aligned with the horse's dominant functional state at the time of assessment. Mechanical restriction may warrant direct mobilization, compensatory patterns require identification of the underlying driver, and protective guarding may necessitate increased support or regulation prior to the introduction of mobility-based intervention.

Accordingly, the model is structured around three primary functional states: mechanical restriction, compensatory adaptation, and protective guarding. These categories are not presented as fixed diagnoses, but as clinically useful interpretive patterns intended to guide reasoning, sequencing, and reassessment.

**State Identification Criteria**

Within this model, classification is based on observable pattern behavior across varying conditions rather than on isolated findings. Mechanical restriction is inferred where movement limitation is consistent across contexts and demonstrates proportionate improvement following targeted mobilization. Compensatory adaptation is inferred where the primary site of observable tension or restriction appears secondary to altered loading, redistribution of effort, or substitution elsewhere, particularly where localized intervention produces incomplete or transient change. Protective guarding is inferred where findings are diffuse, variable, or context-dependent, especially when movement patterns fluctuate in response to task demand, environmental conditions, handling, or rider influence, and where direct mobilization does not result in sustained integration. These distinctions are not discrete and require ongoing reassessment.

**Rationale for a State-Based Model in Equine Osteopathy**

A recurring challenge within equine practice is the tendency to prioritize visible restriction as the primary target of intervention. Horses demonstrating reduced bending capacity, thoracic rigidity, uneven weight distribution, or persistent asymmetry often invite direct correction. While appropriate in some cases, this approach may oversimplify more complex presentations in which the visible restriction is not the primary driver.

Similar outward signs may arise from fundamentally different underlying mechanisms. A shortened stride may reflect articular or soft tissue restriction, but it may also result from altered loading, instability, pain avoidance, or the influence of handling and rider input. Likewise, increased muscular tone may represent protective recruitment rather than primary dysfunction. When muscular activity is serving a stabilizing function, reducing that tone without addressing its purpose may result in only transient improvement.

These considerations indicate a need for a more explicitly defined model of clinical reasoning to support decision-making at the point of assessment. Existing literature provides valuable contributions from biomechanics, rehabilitation science, and manual therapy, yet offers limited direct guidance for distinguishing among mechanical, compensatory, and protective presentations in practice (Haussler, 2010; McGowan et al., 2016; Atalaia et al., 2021). A structured interpretive model may therefore be of particular relevance in cases where treatment responses are inconsistent or not maintained over time.

This model also has implications for communication. Horses frequently demonstrate short-term improvement following intervention, yet the same pattern may re-emerge under conditions such as ridden work, increased demand, or environmental stress. A state-based interpretation provides a more precise explanation for these patterns and directs attention toward the functional conditions sustaining them.

**Mechanical Restriction and Compensation**

Mechanical restriction remains a foundational concept within osteopathic practice. It refers to a reduction in movement availability within a joint, tissue interface, or functional region that is sufficiently consistent to influence posture, gait, load transfer, or performance. Where the dominant limitation is mechanical, manual intervention directed toward restoring mobility is generally appropriate. Joint mobilization and manipulation have established diagnostic and therapeutic roles in equine practice, with documented effects on flexibility, muscle tone, and aspects of spinal kinematics (Haussler, 2016).

Compensatory adaptation represents a related but distinct phenomenon. It describes the manner in which the horse maintains function when optimal movement pathways are unavailable, inefficient, painful, unstable, or poorly coordinated. These adaptations are often functionally appropriate within context. The clinical challenge arises when the site of compensation is misinterpreted as the primary source of dysfunction.

For example, a horse may preferentially load one shoulder secondary to pelvic limitation, restrict thoracic mobility in response to hindlimb weakness, stabilize the cervical region due to insufficient trunk control, or exhibit ribcage bracing as a strategy to manage balance, speed, or rider influence. In such cases, the observable pattern may reflect an adaptive response rather than the originating cause.

Equine biomechanics supports this broader perspective. Movement is produced through an integrated kinetic system in which local alterations influence global motion patterns (Clayton & Hobbs, 2017). Research examining rider effects further demonstrates that functional outcomes arise from interactions across the horse–rider system rather than from isolated anatomical regions (Clayton, 2023). Rehabilitation literature similarly emphasizes that palpation alone is insufficient for comprehensive assessment, with relevant factors including pain during exercise, behavior under load, muscular symmetry, balance, proprioception, and functional performance (Tabor et al., 2020).

In clinical settings, compensatory patterns often become more evident when intervention directed at the most apparent site produces only partial or transient improvement. Local changes may be observed; however, the original pattern frequently re-emerges under functional conditions such as ridden work, increased demand, or repetition. This recurrence does not necessarily indicate treatment failure, but rather suggests that the treated region was fulfilling a necessary role within the broader system.

Fascial research further supports caution against overly localized interpretation. The fascial system is increasingly described as a continuous network involved in force transmission, proprioception, and sensory integration (Stecco & Schleip, 2016; Adstrum et al., 2017; Schleip et al., 2014). Within this context, areas of palpable density or reduced tissue glide may represent downstream expressions of broader functional organization rather than isolated dysfunction. While localized intervention may remain clinically useful, it should be guided by an understanding of system-wide integration.

**Protective Guarding and Regulation**

The concepts of protection, guarding, and regulation require careful interpretation within equine osteopathic reasoning. This discussion does not propose that all complex or nonresponsive cases are primarily neurological, nor does it diminish the relevance of structural dysfunction. Rather, certain presentations may reflect movement limitation maintained as a protective response rather than arising solely from mechanical constraint. This distinction has direct implications for clinical decision-making.

This position is consistent with literature indicating that movement is influenced not only by tissue state, but also by perceived threat, motor adaptation, prior experience, and system-level strategies aimed at maintaining control (Hodges & Tucker, 2011; Moseley & Butler, 2015). Pain-related adaptation has been described as a redistribution of activity serving a protective function, challenging the assumption that reduced movement necessarily reflects localized structural damage.

Although derived from human research, these concepts provide a relevant interpretive framework when applied with appropriate caution. Altered movement may represent a protective strategy that persists even when tissue-level factors alone do not fully explain the presentation. In this context, movement limitation may be maintained by functional necessity rather than by structural incapacity.

This interpretation represents a clinically reasoned extension rather than a validated equine-specific classification.

In equine presentations, protective guarding may be suspected where findings are diffuse, inconsistent, or highly context-dependent. Palpation may reveal distributed muscular tone rather than a distinct focal restriction, and movement patterns may vary with environmental conditions, handling approach, rider influence, task demand, or arousal level. These features suggest that the presentation may be organized around stabilization or control rather than representing a singular mechanical limitation.

Equine-specific literature provides indirect support for this interpretation. The ridden horse pain ethogram described by Dyson and Pollard (2020) demonstrates that behavioral responses under saddle can provide insight into musculoskeletal discomfort and its relationship to gait and rider interaction. Equine rehabilitation literature further emphasizes the role of neuromotor control, sensorimotor integration, balance, and proprioception in the restoration of functional movement (McGowan et al., 2016).

Within this model, regulation is defined in a clinical and functional sense. It refers to establishing conditions in which the horse can reduce unnecessary guarding, tolerate therapeutic input, and access more available movement options. This may involve adjusting pacing, reducing pressure, improving clarity of handling, enhancing postural support, or applying manual techniques aimed at reducing excessive muscular tone without imposing forced movement. Regulation is therefore considered a context-dependent strategy rather than a universal explanation.

**Treatment Sequencing: Mobility, Support, or Regulation**

If the distinctions outlined are clinically meaningful, they should inform not only description, but also the sequencing of intervention. The purpose of the model is to improve the selection and order of treatment based on the dominant characteristics of the presentation.

Where mechanical restriction predominates, mobilization is typically the most direct and appropriate initial approach. Soft tissue techniques, articular mobilization, and related manual interventions may restore movement, reduce localized hypertonicity, and improve function in a relatively predictable manner (Haussler, 2016; Haussler, 2018).

Where compensatory adaptation predominates, intervention requires a shift from isolated regions of tension to relational patterns within the system. Treatment at the site of compensation may still be appropriate; however, it should not occur in isolation or under the assumption that it represents the primary issue. The more relevant consideration is the functional role that the region is fulfilling.

Where protective guarding predominates, initiating intervention with mobility-focused input may be poorly timed. The horse may resist the input, tolerate it without sustained change, or demonstrate transient improvement followed by reorganization of the original pattern. In such cases, a support-first or regulation-first approach may be more appropriate.

Support may involve enhancing the system's capacity to stabilize, selecting interventions that can be tolerated without increasing guarding, or modifying task demands to reduce the need for defensive organization. Regulation may involve reducing speed, simplifying tasks, lowering reactivity, or applying manual techniques aimed at decreasing excessive muscular tone prior to introducing increased range of motion.

This sequencing approach is consistent with motor control literature, which indicates that adaptation to pain or perceived threat is organized according to task demands and protective requirements (Hodges & Tucker, 2011; Van Dieen et al., 2019). Rehabilitation literature similarly supports graded, functionally oriented intervention rather than prioritizing increased range of motion in isolation (McGowan et al., 2016; Atalaia et al., 2021).

From a clinical perspective, intervention is more effective when aligned with what the system functionally requires. Where mobility is the primary limitation, mobilization is indicated. Where additional support is required, stability should be prioritized. Where protective guarding predominates, modification of conditions sustaining that response may be necessary before further progression.

An additional advantage of a sequencing-based model lies in its contribution to reassessment. When initial intervention is appropriately selected, change should be evident not only through palpation, but also within the functional context that previously revealed the issue. Where change is incomplete or not sustained, sequencing may require adjustment.

**Horse–Human Interaction and Context**

The interaction between horse and rider represents a critical contextual factor influencing movement presentation. Patterns observed in isolation may not fully reflect the demands placed on the system under ridden conditions, where timing, pressure, balance, and coordination are continuously negotiated.

Research examining rider influence demonstrates that movement outcomes are not solely determined by the horse's physical capacity, but by the interaction between horse and rider within a dynamic system (Clayton, 2023). Variability in rider input may alter load distribution, stability requirements, and the degree of muscular recruitment necessary to maintain coordination.

Within this context, patterns that appear restrictive may function as adaptive responses to rider influence rather than intrinsic dysfunction. For example, increased thoracic rigidity or cervical stabilization may emerge as strategies to manage inconsistency in rein contact, imbalance, or conflicting cues.

This has direct implications for assessment and intervention. Evaluation of movement should consider not only the horse in isolation, but also the conditions under which the pattern emerges. Where patterns are maintained or amplified under rider influence, intervention may require modification of rider input alongside physical treatment.

**Clinical Implications**

In clinical practice, recurring patterns may indicate that a purely mobility-focused approach is insufficient. Horses may demonstrate localized improvement following intervention yet return to the same pattern under functional conditions such as speed, load, or rider influence. Similarly, some horses exhibit generalized tension on palpation but respond more effectively to changes in handling, pacing, or postural support than to increasingly direct attempts at mobilization.

These observations suggest that presentation is often organized around functional demand rather than isolated restriction. Although such patterns do not define rigid categories, they support the relevance of distinguishing among mechanical, compensatory, and protective states.

These distinctions carry implications for post-intervention planning. Where mechanical restriction predominates, follow-up may focus on maintaining the newly available range of motion. Where compensatory adaptation predominates, follow-up should support development of capacity that reduces reliance on compensatory strategies. Where protective guarding predominates, progression must remain aligned with the horse's tolerance for change.

If increased range of motion is introduced before the system can stabilize or integrate that change, improvement may not persist. In this context, exercises and handling strategies function not only as interventions, but also as ongoing assessment tools, indicating whether changes achieved through manual input can be maintained under functional conditions.

This perspective also influences how complex cases are described. Common descriptors capture observable features but do not identify underlying drivers. A more clinically relevant approach is to consider whether the presentation reflects mechanical limitation, compensatory adaptation, or protective organization, thereby supporting more precise intervention selection and communication.

The primary contribution of the model lies in providing a structured approach to interpretation. It supports determination of whether mobility, support, or regulation should be prioritized and offers a rationale for variability in treatment response and progression.

In this way, clinical reasoning extends beyond identification of restriction to include interpretation of how the horse is organizing in response to both internal and external demands. This perspective supports more precise intervention and reduces the likelihood of repeatedly addressing secondary expressions of a pattern.

In practice, this model alters the threshold at which intervention is selected and adjusted. Rather than progressing linearly from identification to treatment, the practitioner continuously evaluates whether the system is able to utilize the change being introduced. Where movement improves without integration, or where patterns re-emerge under demand, this indicates that intervention has not aligned with the system's primary requirement. This shifts clinical focus away from achieving immediate change toward establishing conditions in which change can be sustained. Over time, this approach reduces repeated intervention at the same site and supports more efficient progression in complex cases.

**Discussion**

This model differs from conventional osteopathic reasoning not by altering structural principles, but by refining the sequence of interpretation. Rather than proceeding directly from identification of restriction to intervention, it introduces an initial distinction among mechanical limitation, compensatory adaptation, and protective organization. This distinction is clinically significant, as interventions appropriate in one context may be less effective or insufficiently sustained in another.

This shift may reduce the likelihood of directing intervention toward secondary regions functioning in a compensatory capacity. It may also improve case management by clarifying when direct mobilization is likely to be effective and when broader strategies involving support, graded progression, or modification of task demands are required. In addition, it provides a structured basis for interpreting variable or short-lived treatment responses.

The model supports integration of manual intervention with exercise and handling strategies. Where compensatory patterns predominate, intervention should reduce reliance on substitute strategies. Where protective guarding is present, intervention should aim to improve tolerance and organization without reinforcing bracing. Changes achieved through manual input must be integrated into functional movement in order to persist.

Common descriptive terms within the field capture observable features but do not guide sequencing. A state-based model encourages interpretation based on functional role and demand, supporting more consistent clinical reasoning without constituting a formal diagnostic system.

By introducing a structured method for distinguishing among these presentations, the model provides a practical means of integrating established principles with contemporary perspectives on movement variability and adaptation. Its value lies in supporting more consistent reasoning in cases where presentation alone does not clearly indicate the most appropriate intervention.

## Limitations

The model is interpretive and dependent on clinical reasoning rather than a validated diagnostic instrument. Its application is therefore influenced by practitioner experience, observational skill, and the ability to accurately assess pattern behavior across conditions.

The supporting literature is indirect. Although multiple domains provide conceptual support, including biomechanics, rehabilitation science, and motor control, there remains limited research explicitly evaluating a state-based osteopathic model in horses. Accordingly, the model should be understood as a clinically reasoned framework rather than an empirically validated classification system.

The functional states described are not mutually exclusive. Presentations may demonstrate overlapping features, and classification should reflect the dominant pattern rather than a discrete category. This requires ongoing reassessment and flexibility in interpretation, particularly in complex or evolving cases.

Manual therapy also represents only one component of equine care. Presentations involving lameness, neurological findings, saddle-related factors, hoof imbalance, or unresolved medical conditions require broader consideration and may fall outside the scope of osteopathic intervention alone.

Finally, this model is intended to inform clinical reasoning within appropriate professional scope and does not replace veterinary diagnosis. Differential considerations, including systemic, biomechanical, and rider-related factors, remain essential to comprehensive assessment and case management.

**Conclusion**

This paper presents a state-based model that positions interpretation as the primary determinant of intervention sequencing within equine osteopathic practice. By distinguishing among mechanical restriction, compensatory adaptation, and protective guarding, the model provides a structured method for selecting intervention based on the functional role of the observed pattern.

The significance of this model lies not in the introduction of new techniques, but in the reorganization of clinical reasoning. When intervention is aligned with the system's dominant requirement, change becomes more consistent and more likely to be sustained under functional conditions, with direct implications for movement quality and performance.

The central shift proposed is not where movement is limited, but how that limitation is understood. In doing so, the model reframes a common clinical assumption: that reduced movement necessarily requires increased mobility. Instead, it emphasizes that effective intervention depends on identifying whether the system is constrained, compensating, or protecting, and responding accordingly.

This model is grounded in the principle that movement patterns in the horse are organized responses to the demands placed on the system, rather than isolated mechanical deficits. By considering whether a presentation reflects constraint, compensation, or protection, intervention can be sequenced in a manner that supports more effective reorganization rather than simply increasing range of motion.

In this way, the clinical question shifts from how to change the movement that is observed to understanding what that movement is attempting to achieve within the system. Effective intervention, therefore, is not determined by the presence of restriction alone, but by the accuracy with which its functional role is identified and addressed.

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