Data Driven Surfaces for Equine Rehabilitation

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INTRODUCTION

Testing of arena footing is an area of expanding potential. Recently, laboratory design of equestrian surfaces has been used in top competition venues (Jumper Nation, 2020). During rehabilitation from injury, surface selection is an important, yet often overlooked, consideration. Previous studies have associated optimal performance surfaces with a higher risk of injury, and shock absorbing surface properties with decreased performance (Chateau et al., 2010, Dura et al., 1999). Rehabilitation is optimized when surfaces of varying characteristics are employed.

Table 1 summarizes the classification of injuries seen at a rehabilitation center in Lexington KY, for 188 horses serviced from 2018 to 2020. This wide spectrum of case load, combined with the benefits of employing diverse surfaces for limb adaptation, provides a strong argument for providing variability in surfaces. The purpose of this abstract is to describe the surfaces available at the rehabilitation and fitness center referred to in Table 1.

Table 1 - 188 horses treated over 2 year period	
Soft Tissue (any tendon or ligament)	31.39%
Medical (any abscess, lacerations, ulcers, reproduction, or unknown)	25.55%
Boney (chips, navicular, or unknown foot issue)	22.63%
Fitness (boarded for conditioning)	14.60%
Neurological (all conditions causing neurologic disfunction)	5.84%
TOTAL	100.01%
Of boarded horses: 22.63% had RF injury, 19.71% had LF injury, 14.6% had injury elsewhere	

MATERIALS & METHODS

Measurements were acquired at an equine rehabilitation facility from 2019 through 2022. Eight different surfaces were evaluated using laboratory grade tools developed by iEquitek, LLC to

measure cushioning and compliance. An index was created to determine fingerprints of each area.

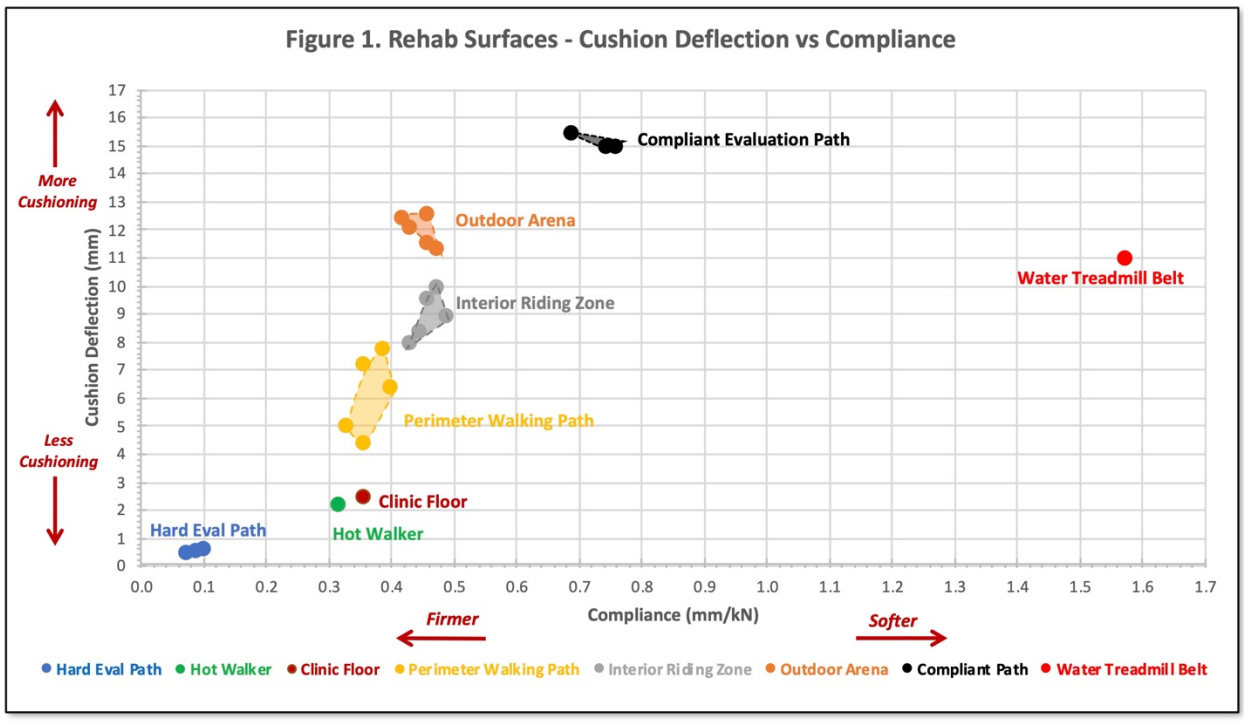
Compliance (mm/kN), being the reciprocal of stiffness, is calculated by measuring the compacted surface deflection upon subjecting the surface to 7kN impulses. Cushion deflection is defined as the surface deflection upon footfall during the initial concussion phase of the stance. A subset of the data is presented.

RESULTS

The surfaces included:

(1) Hard Evaluation Path – extremely firm
(2) Hot Walker (padded surface) – fairly firm
(3) Compliant Evaluation Path (footing) – very compliant
(4) Water Treadmill Belt, no water used in tests (compliant sprung surface) – very compliant
(5) Indoor Arena, Perimeter Walking Path (footing) – medium compliance
(6) Indoor Arena, Interior Riding Zone (footing) – medium compliance
(7) Outdoor Arena (footing) – moderately firm
(8) Clinic Floor (padded, rigid poured floor) – moderately firm

Figure 1 depicts Cushion Deflection vs Compliance for all 8 surfaces. As shown in Figure 1, there is a natural and designed progression of increasing compliance and increasing cushioning starting with the Hard Evaluation Path, then the Hot Walker, the Clinic Floor (Padenpor™), the Perimeter Walking Path, the Interior Riding Zone, the Outdoor Arena, and finally the Compliant



Evaluation Path. The Water Treadmill Belt (without water) is the most compliant surface with moderate cushion, as compared to the other surfaces available at the rehabilitation center.

DISCUSSION/CONCLUSION

In rehab, surfaces can be employed as a diagnostic and/or therapeutic tool when the characteristics are defined and measurable. An intuitive way to define footing surfaces is to show cushioning deflection and compliance characteristics simultaneously, as depicted in Figure 1. The progression of increasing compliance and cushioning can be used to guide surface selection for rehabilitation, throughout the rehabilitation process. Understanding the characteristics also aids in the use of a surface as a predictable diagnostic tool. The Hard Evaluation Path is a traditional, hard compacted stone dust surface for jogging. It is extremely firm with almost no cushioning. It is adjacent to the Compliant Evaluation Path, which is very compliant with extreme cushioning (Image 1). The location of the two paths is strategic, and offers a great deal of diagnostic information to the clinician when a horse's locomotion is evaluated on markedly different surfaces, located side by side.

Image 1. Evaluation Paths

Early in a rehabilitation protocol, surfaces that provide the greatest relief from pain and lameness in a particular case are employed. As rehabilitation progresses, the introduction of varying types of surfaces encourages limb adaptation. For example, horses with navicular pain generally appreciate the moderately firm feel of the Clinic Floor, a Padenpor™ surface which is less cushioned and compliant than the other surfaces and offers little to no direct frog pressure. Hand walking protocols typically start on the Padenpor™ floor before employing other surfaces available at the rehabilitation center as the patient progresses.

Ultimately, utilizing diverse surfaces during rehabilitation increases limb strength and reduces the likelihood of re-injury by providing variable loading and use. This variability stimulates musculoskeletal tissue to repair and respond in a diverse manner. Neurologic rehabilitation

benefits from the variation in proprioceptive input that is generated from navigating variable surfaces. Additional surface characteristics that can be measured and engineered for rehabilitative use include grip and response time. Footing-based surfaces present different grip to the horse. It can be noted that the footing for the rehabilitation center in this abstract was specifically designed not to exhibit excessive torque shear strength. It has been reported that "high friction between the hoof and ground may cause increased mechanical stress to the structures of the distal limb" (Gustås et al., 2007).

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