TISSUE HOMEOSTASIS

Tissue Homeostasis

The following description of tissue homeostasis and subsequent graphs (adapted) was published by Dye (2005). Our joints must accept, transfer, and dissipate a range of biomechanical energy, in response to different forces. These include:

- Compression
- Distraction
- Shear (sagittal and frontal plane)
- Torque (transverse plane)

Some joints, such as the hip and shoulder, are better designed to produce and dissipate torque. Others, such as the knee, are not.

The capacity of our joints to safely accept and transfer a range of loads can be described by the envelope of function—or that range of loading applied across the joint that is compatible with and probably inductive of maintenance of tissue homeostasis. Most uninjured joints can accept a broad range of loading (from less than 1 to nearly 8 times body weight) and still maintain tissue homeostasis.

If one places an increased load across the knee through, for example, the repetitive loading involved in distance running—loss of osseous and periosseous soft tissue homeostasis can result, characterized by the early stages of a stress fracture or stress reaction. This region of increased loading, insufficient to cause immediate overt structural damage, is termed the zone of supraphysiologic overload. Conditioning exercises can improve the tissue load tolerance and capacity, and increase the zone of homeostasis, helping people avoid the region of supraphysiologic overload.

A dashboard injury to a flexed knee insufficient to cause an overt fracture also would be considered as representing a load within the zone of supraphysiologic overload. If even greater energy is placed across a knee, overt macrostructural damage, such as acute fracture of bone or rupture of a ligament can occur, and is termed the zone of macrostructural failure

If our joints are not subjected to enough load for a lengthy period of time (such as prolonged bed rest, immobilization in a cast, or extended space travel in a microgravity environment), loss of tissue homeostasis manifested by muscle atrophy and bone demineralization (calcium loss from bone) secondary to disuse can ensue. This region of diminished loading is termed the zone of sub-physiologic underload.

Deconditioning and/or injury will reduce the tissue load tolerance and capacity, and decrease the zone of homeostasis, making you more vulnerable to entering the zones of supraphysiological overload and structural failure.

Reference:

Dye, S. 2005. The Pathophysiology of Patellofemoral Pain: A Tissue Homeostasis Perspective. Clin Orth Rel Res. Number 436, pp. 100–110