Mechanotherapy: How Physical Therapists’ Prescription of Exercise Promotes Tissue Repair.


MECHANOTHERAPY

Mechanotherapy is described as the clinical application of mechanotranstduction, a physiological process by which mechanical loading is converted into cellular responses. These responses lead to structural change. This paper describes how exercise promotes healing at the tissue level.

Mechanotransduction in connective tissue is an ongoing physiological process like respiration and circulation. The process is well understood for bone, and the results of increased and decreased load or mechanical stimuli on the tissue is commonly known. Clinical studies have demonstrated the process in the healing of bone, as well as tendon, muscle, and cartilage. In tendons, mechanotransduction is associated with cellular proliferation and matrix remodeling. Mechanotherapy in the form of eccentric exercise has been shown to stimulate this process and result in a more normal structure. There is ongoing research to determine the appropriate load, or mechanical stimuli, for different types of tendon injury. In muscle, we know overload leads to hypertrophy. In injured tissue, after a period of rest, loading stimulates regeneration and alignment of tissue/myotubes and minimizes hypertrophy of surrounding tissue. In articular cartilage, mechanotherapy of continuous passive motion has been shown to improve outcomes in injury. Further research is needed regarding the optimum load for tissue repair in articular cartilage. In bone, mechanotherapy via intermittent compression loading in fracture healing has been shown to improve outcomes.

The three steps are mechano-coupling, cell-to-cell communication, and effector cell response. Mechano-coupling is the catalyst or the mechanical stimulus. The mechanical stimulus loads the tissue and may be in the form of shear, compression, tension, etc. The force causes a deformation of cells, and depending on the type, magnitude, and duration, chemical signals are released to other surrounding cells. This is cell-to-cell communication, step two. The cell that is mechanically stimulated spreads the loading message to more distant cells via signaling proteins. Then effector cell response occurs and a tissue “factory” produces, assembles, and aligns the correct materials. This is essentially protein synthesis that results in tissue repair and remodeling.

Mechanotherapy, although it is not being taught as an important principle in physical therapy or medical schools, is essentially musculoskeletal rehabilitation. This process is crucial for promoting the repair and remodeling of injured tissue. It is exercise prescription on the cellular level.

Clinician Perspective:
As physical therapists, we are charged to be “load masters,” a term coined by Colin Davies. We must prescribe the correct load for the specific tissue. This includes the right frequency, amount, and type of mechanical stimulus. This requires an understanding of the three stages of tissue healing: inflammation, repair, and remodeling.

We must determine when the tissue needs rest or no mechanical stimuli and bear in mind that injured tissue and healthy tissues respond differently. We must not only apply this knowledge but also impart this essential information in a meaningful way to our patients so that they will be more equipped to participate in their healing.

Reference: