Biomechanics Matters: Solving Clinical Problems with Biomechanics

As physical therapists and experts in the movement system, biomechanics is the basis for what we do. We may not use the terms in our daily practice, but we likely use the principles. Whether it be analyzing how an individual gets from sit to stand or shifting ones center of mass over the base of support, or by altering a running pattern to decrease the loading on a patient’s knee, PT’s routinely apply biomechanical principles—either consciously or unconsciously.

For some PTs “biomechanics” conjures nightmares of equations. Yet much of the literature that establishes a role for PTs as the “movement experts” uses biomechanical analyses. Clinicians require some level of biomechanical understanding and literacy to position themselves as movement experts. Because biomechanics is so fundamental to physical therapy, it is easy to overlook its importance in both the clinic and the classroom. This problem is compounded by the assumption the biomechanics is only done in expensive motion capture laboratories, and sometimes leaves the clinician wondering, “How do I apply this information to treat my patient?”

The purpose of the session is to highlight the importance of biomechanical principles in the evaluation and treatment of patients across the continuum. We will use case presentations to illustrate the application of biomechanics in clinical practice. We will also review fundamental biomechanical principles, and provide examples of biomechanical literature that are particularly relevant to PTs. We will briefly discuss how technology commonly available to the practitioner can assist in translating research into practice. We will also engage attendees in a discussion of the essential biomechanical competencies that every PT graduate requires and how to best integrate them into a curriculum.

Session learning objectives:
At the conclusion of the course, each attendee will:
1. describe the fundamental biomechanical principles required of the physical therapist;
2. understand how biomechanical principles apply to patient evaluation;
3. understand how biomechanical principles apply to patient treatment.

Speakers:
Irene Davis, PT, PhD, FACSM, FAPTA, FASB
Professor, Dept of Physical Medicine and Rehabilitation
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Cara Lewis, PT, PhD
Associate Professor of Physical Therapy, Rehabilitation Sciences (PhD), and Medicine
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Boston University
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Carol Oatis, PT, PhD
Professor, Department of Physical Therapy
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Christopher M. Powers, PT, PhD, FAPTA
Professor, Division of Biokinesiology & Physical Therapy
Outline of Content:
1. Introduction: why biomechanics matters to what we do as clinicians (Cara Lewis)
2. Brief review of basic biomechanical principles and terminology relevant to clinicians (20 minutes, Carol Oatis)
   a. Guiding questions for PTs
      i. What is required to perform the task?
      ii. What is the effect of the task on the body?
      iii. How can we change the patient or the task to improve function?
      iv. Example: squat
   b. Newton’s Laws as the basis for answering those questions
      i. Newton’s 1st Law: A body at rest or in uniform motion tends to stay in that state unless acted upon by an external force.
      ii. Newton’s 2nd Law
      iii. Newton’s 3rd Law: For every action there is an equal and opposite reaction
   c. Muscles exert Forces
   d. Moment (Torque) Tends to cause a rotation
      i. Force applied at some distance from the point of rotation
      ii. Joints rotate
   e. Internal Moments: produced by muscles and ligaments
      i. Muscles have moment arms (lever arms)
   f. External Moments: produced by external loads
      i. External loads have moment arms
      ii. Example: ground reaction force
   g. Dynamic Equilibrium
      i. Mechanical power
   h. Bottom line: A strong biomechanical foundation answers daily clinical questions.
3. Biomechanics in the clinic: case presentations demonstrating the use of biomechanics in clinical decision making
   a. Posture and hip pain: how altering posture changes center of mass location, joint moments, and hip joint forces (Cara Lewis)
      i. Trunk position modifies center of mass location
      ii. Center of mass location alters joint moments
   b. How we use biomechanical principles to understand causes of and treatment approaches for patellofemoral pain (Chris Powers)
      i. Patellofemoral joint reaction forces and stress
      ii. Estimation of knee extensor moments using 2D video
      iii. Biomechanical considerations for the prescription of open and closed chain exercises for persons with patellofemoral pain
   c. Running mechanics and the foot: biomechanical strategies to reduce impact forces during running (Irene Davis)
      i. Tibial accelerometry
4. Panel discussion on whether clinicians feel biomechanics matter, including:
   a. Is there adequate training in biomechanics in the classroom?
   b. How do we best train PTs to apply biomechanics in the clinic?
c. How do we best integrate biomechanics into the curriculum?
d. Is there technology that is easily available to any practitioner for biomechanics?

References


5. deAlmeida MO, Saragiotto BT, Yamato TP, Lopes AD. Is the rearfoot pattern the most frequently foot strike pattern among recreational shod distance runners? Phys Ther Sport. 2015; 16(1): 29-33.


