When Fat is Good: The Biomechanical Role of Fat in the Musculoskeletal System

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Fat has basically three purposes. The first purpose that most of us are most familiar in our personal life, and to some degree dissatisfied with, is as an energy store. Fat as an energy store has varying distributions and differences within women and men, but it predominates subcutaneously and intraabdominally.

The two other functions of fat are what this discussion is based upon. The first is as a cushioning mechanism. The cushioning function of the fat perhaps is best understood in the subcutaneous calcaneal fat, and to a lesser degree in the metatarsal fat pads. The fat in these areas has a distinct anatomic organization to accentuate its shock absorption when one ambulates. In fact loss of this fat is seen in diabetes mellitus as one of the predisposing factors in the development of diabetic pedal disease.

The cushioning aspect of fat is best seen in about articulations. Fat in these areas acts as a cushion to motion. This is particularly true for Hoffa's fat pad in the knee and Kager's fat pad and to the Achilles tendon. To some degree the subacromial fat pad has a similar cushioning effect against impingement.

The third function of fat is as a space holder. Closely related to this space holder function is that fat forms when skeletal structures scar. Intellectually we understand these two as related conditions, in that the fat when present is neither good nor bad, but merely a marker of a prior insult or filling in a gap. The response of most of the musculoskeletal system to injury over the long term is eventual formation of fat. The prototype for this is radiation therapy to the spine. But it is seen following most other marrow disorders including osteomyelitis and fractures The same response is seen following a muscle tears, and interestingly most other insults either neurogenic or inflammatory to muscle. Besides having fat inside the substance of muscle, the muscle may decrease in size and have increased fat around it. Combining the concepts of scar and fat filling in the gap. Lastly, although, controversial it appears that to major degree in most patients epidural fat is also a space holder and independent of body habitus.

In some situations fat act as a combination of the above. The function of fat in synovium is as a cushion but it is also a response to injury. Therefore lipoma arborescens for example is a reaction to an insult, but a positive reaction in that it lessens further insults.

So therefore, in the musculoskeletal system we see fat within muscle, around muscle, in marrow, cushioning in weight bearing in subcutaneous tissues and lastly within and around joints. All of these effects if not positive are at least not negative.

There is however one last importance of fat in the musculoskeletal system. This latter process is the result of the fat in your body as an energy store and iterates the concept of Wolff's law. Wolff's law states that bone responds to stress in such a way as to minimize the negative result of future stresses. One major stress in body weight. From this we see that bone density is more stable in large patients with less of a risk of osteoporosis. However, tendons are larger in larger patients-potentially worsening impingment. Also obese patients have greater degrees and earlier osteoarthritis. Finally, the spine enlarges as we get fatter, leading to earlier spinal stenosis. Fat both local and systemic has major mechanical effects on the musculoskeletal system, some bad, some good, and some as far as we understand today indifferent.