Bone Marrow Edema and Postural Misalignment: A Preliminary Report

Please Read ... A Must!

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The concept that postural stress (caused by faulty alignment of body segments) is a major factor in the development of musculoskeletal pain and premature degenerative arthritis has long been a basis of both theoretical and applied chiropractic. Recent findings supplied by magnetic resonance imaging (MRI) procedures has helped bridge the gap between clinical observations and scientific knowledge. This evidence provides support for some of the traditional, posture-based chiropractic treatment approaches (1), (2).

Structure and Stress

Humans stand and walk upright against the unrelenting force of gravity, which means our bodies are exposed to constant stress. Ideally our musculoskeletal systems are capable of providing good support against this constant stress. However, when the alignment of body parts is altered, the stresses are changed, which may lead to various types of biomechanical problems. Both the soft tissues and bones must respond to these changes or be damaged. Microtrauma (the small but repeated damage to tissues) is eventually revealed as a clinical complaint (usually pain), prior to any overt signs of physical injury. Reducing or eliminating biomechanical misalignments are rational and popular treatment approaches followed by many doctors of chiropractic, and are frequently effective.

Evidence of Bone Marrow Edema

Recent research has demonstrated the almost immediate physiologic effects of changes in alignment of weightbearing bones, and gives evidence to suggest that there are detrimental results of long-term misalignments (3). It was found that after only two weeks of enforced abnormal weightbearing, the bones of normal subjects showed MRI evidence of the development of the earliest stages of stress fractures, *"bone marrow edema"*.

Methods

First, a baseline-limited MRI examination was performed on both lower extremities of 12 asymptomatic volunteers. Then the volunteer subjects inserted a 9/16 inch longitudinal metatarsal arch pad underneath the lateral aspect of one foot to increase unilateral foot pronation. They were instructed to wear this pad in all shoes for two weeks, and not to alter their usual activities. After two weeks of altered weightbearing, follow-up MRI studies were obtained in all subjects. The pads were then removed from all volunteers, and a small group was randomly chosen for a third MRI evaluation two weeks later.

Results

The images obtained after two weeks of altered foot biomechanics showed numerous areas of increased marrow signal intensity on the T2-weighted (fat-suppressed) images, indicating bone marrow edema in eleven of the twelve subjects. These changes were seen locally (as expected) throughout the metatarso-phalangeal region. More importantly, bone marrow changes were also seen in the long bones along the kinetic chain to the hip joint, affecting the tibia and/or femur of six of the twelve volunteers.

Two weeks after removal of the pads, the lower extremities of three randomly selected subjects were again evaluated by MRI. The previously-seen marrow changes were significantly decreased in all, and had completely resolved in two of the three. Clinically, all of the volunteers complained of discomfort while wearing the foot pad, which resolved completely upon its removal.

Bone Repair

When exposed to excessive, long-term stress, bone responds by attempting to repair and strengthen its internal architecture. A stress fracture results when the repair process is overwhelmed, and the bone tis-

sue fails. If, however, additional bone can be laid down fast enough, a stress fracture is avoided. But the additional bone tissue may increase the bone's rigidity, accelerating the development of cartilage damage at the adjacent weightbearing joint. This stiffening of subchondral bone is considered to be a significant contributor to premature degenerative changes in weightbearing joints (4).

Diagnostic Imaging

Plain film radiographs are insensitive to the early changes in bone associated with biomechanical lesions (bone marrow edema, early stress fracture, etc.). It is only after extensive biomechanical stress has been imposed, either in the short term (causing a stress fracture), or in the long term (resulting in premature degenerative arthritis) that these conditions can be visualized on plain films (5). Stress fractures are usually seen as subtle areas of periosteal response without evidence of cortical or medullary abnormality. With sustained stress injury, linear areas of sclerosis and even a fracture line may eventually be observed. Degenerative joint disease (DJD) is the most commonly seen result of long-standing altered weightbearing (5). The eight essential radiographic signs of DJD include: asymmetric distribution, non-uniform loss of joint space, osteophytes, subchondral sclerosis (eburnation), subchondral cysts (geodes), intra-articular loose bodies, articular deformity, and subluxation (5).

The most sensitive imaging modality to detect early stress injury to bone is magnetic resonance imaging. MRI provides not only good anatomical localization, but it also gives useful physiological information concerning bone tissue. Bone marrow edema is identified by a diffuse, heterogeneous pattern of decreased signal intensity on T1-weighted images that becomes hyperintense (white) with T2-weighting. Specialized T2-weighted fat suppression (STIR) images are often necessary to identify small areas of marrow alteration. Regions containing free water (edema) within the fatty marrow can be identified much more readily with MRI than with a bone scan or any other imaging modality (6).

Conclusion

Although little direct scientific evidence has previously been presented to substantiate posture-based chiropractic treatment approaches, these techniques have survived because of positive clinical results and anecdotal information. Using MRI information, early physiologic changes in bones in response to altered biomechanical stress (e.g. *bone marrow edema*) can be observed.

We think this recent finding is of major significance to chiropractors for two reasons. First, the results demonstrate not only the detrimental effects of altered biomechanics on bones and joints, but also the rapid benefits of correcting functional misalignments. Secondly, this paper provides direct evidence of the specific effects of excessive pronation at the foot and ankle on the bones of the lower extremities, up to the level of the proximal femur and hip joint.

Application of the concepts and information presented in this research helps reinforce the long-held premise that inequality in weightbearing is clinically important, and that corrective, supportive devices such as Foot Levelers' flexible orthotics can help to reduce pronation (7) and protect against the damaging effects of heel-strike shock (8).

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