Physical Activity and Weight Loss Interventions in Older Adults With Knee Osteoarthritis

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Osteoarthritis is a degenerative disease that affects articular cartilage and the underlying subchondral bone. The cartilaginous surfaces become pitted resulting in hypertrophic changes along the joint margins and reactive changes in the subchondral bone. Severe osteoarthritis is characterized by joint space narrowing, absence of articular cartilage, increased density and stiffness of the subchondral bone, and osteophyte formation along the joint margins.[1,2]

The knee is the most commonly affected weight-bearing joint. The major symptoms of knee osteoarthritis are pain and stiffness. Decreased mobility leading to muscle atrophy, an accelerated decline in physical function, and the inability to engage in activities of daily living such as walking and climbing stairs are clinical consequences that often lead to a loss of independence and a poor quality of life.[2-6]

The etiology of primary (idiopathic) osteoarthritis is unknown, although biomechanical and inflammatory mechanisms have been proposed as causative factors. Biomechanically, either structural abnormalities such as obesity or neuromuscular dysfunction may cause increased joint loads during walking. Failure to absorb these loads properly may cause microcracks in the subchondral tissue leading to increased stresses and cartilage degradation.[7]

Recent studies demonstrate that low-grade inflammation plays a pathophysiological role in osteoarthritis. The inflammatory cytokine interleukin-1 beta (IL-1ß) is present in the joint fluids of osteoarthritis patients.[8] Interleukin-1 beta is believed to play a role in mediating joint inflammation and cartilage degradation in osteoarthritis.[9] Likewise, an inflammatory component associated with osteoarthritis can be detected in the circulation since serum concentrations of inflammatory markers such as cytokines (interleukin-6, IL-6; tumor necrosis factor alpha, TNFα) and the acute-phase reactant C-reactive protein are higher in persons with knee or hip osteoarthritis compared to those without osteoarthritis.[10-13] Longitudinal studies demonstrate that high serum levels of C-reactive protein and TNFα predict increased radiographic progression of knee osteoarthritis as much as 5 years later.[11,14,15] Moreover, a few studies associate osteoarthritis severity and physical function with higher inflammatory markers in the blood.[10,16,17] Thus, severity, mobility, pain, stiffness, and radiographic progression are at least partly mediated by the level of chronic inflammation in osteoarthritis patients. Diffusion of cytokines from the synovial fluid into the cartilage could contribute to the cartilage matrix loss observed in osteoarthritis by stimulating chondrocyte catabolic activity and inhibiting anabolic activity.

Obesity is a major risk factor for knee osteoarthritis.[18] Weight change and the risk of developing knee osteoarthritis are significantly associated. Felson et al showed that a 5.1 kg loss in body mass over a 10-year period reduced the odds of developing osteoarthritis by more than 50%.[19] Obese individuals have higher concentrations of inflammatory markers than lean people, and a large percentage of people with knee osteoarthritis are overweight or obese. Hence, obese individuals with knee osteoarthritis may have an even greater contribution of inflammation to functional limitation and disease progression.[20] Besides direct effects on the joint, inflammatory mediators can also affect muscle function and lower the pain threshold.

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Unfortunately, treatments that affect the underlying biomechanical and inflammatory disease pathways are limited. The primary aim of therapies currently available is pain relief.

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Antiinflammatory medications and orthopaedic procedures are primary methods of treatment. More recently, exercise and weight loss have been used as therapeutic modalities for knee osteoarthritis patients.

The difficulty patients with knee osteoarthritis have with activities of daily living often result in activity avoidance.[21] Physical exercise, however, is an effective nonpharmacologic treatment. Several studies have shown that pain and disability improve with short-term (3 to 6 months) exercise. Short-term walking programs improve aerobic capacity, walking time, and self-reported function.[22,23] Similarly, lower extremity resistance training increases strength, decreases pain, and improves function in patients with osteoarthritis.[24,25] More recently, long-term walking and resistance training programs have been effective in slowing the decline in physical function commonly seen in this disabled population. A randomized clinical trial of 18-month walking and resistance training programs in 439 community-dwelling older adults with knee osteoarthritis reduced disability and pain and improved balance and mobility relative to a health education control group.[26] In a similar population, greater adherence to a physical activity program was associated with better physical performance and self-reported physical function.[27] Exercise also has been shown to improve late-life minor depression.[28]

Short- and long-term aerobic and resistance training programs are safe and effective treatments for knee osteoarthritis.[21] Traditional 3 days per week, 1 hour per day programs have been the most common regimens studied. Unfortunately, little is known regarding the dose response to exercise in the older, mostly female, sedentary, and predominately overweight population. Continuous weight-bearing aerobic exercise such as walking can initially be difficult for patients with knee osteoarthritis who experience significant pain. Starting with short bouts of exercise and inserting several rest periods when the patient has progressed to 30 or 40 minutes of walking improves adherence. Adding several resistance training exercises between periods of walking has proven effective and popular with patients.[8,29] The intensity of the exercise intervention may differ depending on the desired outcomes. If the goal is making exercise a part of a healthy lifestyle, then continued participation is more important than intensity. The exercise prescription should be flexible enough to accommodate periods of greater pain.

An important component of treatment for knee osteoarthritis is the reduction of body weight in patients who are overweight or obese. Results of a randomized, controlled clinical trial have shown that a program of diet and exercise results in greater improvements in self-reported function, mobility, and pain than exercise only, diet only, or healthy lifestyle interventions.[29] A dose response to weight loss indicated that participants who lost between 7.5% and 11.0% of their body weight exhibited significantly better self-reported function than participants who exhibited more modest weight loss (2.5% to 7.5%) or no weight loss (gained to 2.5%).[2] Christensen et al[30] recently found that an 11% weight loss in an intensive diet group over an 8-week period produced a 3-fold improvement in function in older, obese adults with knee osteoarthritis relative to a control diet group that lost 4% of their body weight.

Studies have shown that weight loss decreases inflammation, reducing the cytokine activity that may be related to cartilage degradation. Nicklas et al[20] showed that a 5% weight loss over 18 months significantly reduced C-reactive protein, IL-6, and TNFα receptor 1 concentrations compared with a weight stable group. However, it is not yet known whether a specific amount of weight loss maximally reduces inflammation or whether improvements in physical function, pain, and osteoarthritis progression are related to a decline in chronic inflammation with weight loss.

Weight loss also has a beneficial effect on knee joint loads. Messier et al[31] found that every 1 lb in weight loss was related to a 4 lb decrease in knee compressive forces per step. These results imply that if an average weight knee osteoarthritis patient (about 200 lb) lost 10 lb, each knee would be subjected to 48 000 lb less in knee compressive forces per mile walked. Accumulated over thousands of steps per day, a reduction of this magnitude would appear to be clinically meaningful.

Both exercise and weight loss interventions improve pain and self-reported function, reduce inflammation, and enhance balance and mobility in older, obese adults with knee osteoarthritis. While effective, neither exercise nor weight loss interventions have attenuated disease progression. We suggest that a weight loss of 10% to 15% of baseline body weight, or 2 to 3 times greater weight loss than achieved in recent long-term studies, may provide the necessary stimulus to reduce inflammation and knee joint loads to levels that result in less cartilage degradation and a slowing of disease progression. **NCMJ**

Acknowledgement: *This work was supported by NIH grants 1R01AR052528-01 and M01-RR-0021.*

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