Exercise Effects on Gait in a Rodent Model of Osteoarthritis
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Background: Osteoarthritis (OA) is a progressive joint disease that leads to pain and disability. Currently, there is no cure, and clinical treatment of the disease is largely palliative. One recommended treatment for OA pain is exercise. Participating in activities that could mechanically exacerbate damaged joint tissues may seem counterintuitive. Nonetheless, exercise has shown positive effects on patient-reported OA pain.

Objective: Gait analysis can be used as a quantitative behavioral measure of the rodents’ response to pain and disability. In this study, the effects of a light exercise regimen on the gait of rodents was assessed in a medial meniscus transection model of OA.

Methods: Male Lewis rats (n=30) received either medial meniscus transection with medial collateral ligament transection (MMT+MCLT, n=12), MCLT only (n=12), or a skin incision (n=6) on the right leg. MCLT and MMT+MCLT groups were split into exercise or no exercise groups (n=6/group). After 1 week of recovery, exercise groups began daily treadmill running for 30 min. (15 m/min). Exercise was carried out to 12 weeks. At 4, 6, 9, and 12 weeks, quantitative gait testing was conducted. Residualized data was calculated using a historical database of naïve rat gait.

Results & Discussion: Nonexercised animals exhibited higher than normal percent stance times on both limbs, indicating more time spent in stance than an uninjured animal. This result has been observed in previous work, where MMT+MCLT and MCLT animals developed a shuffling gait. However, exercised animals had lower percent stance time residuals (closer to 0) than nonexercised animals (p<0.05, Fig. 1), representing percent stance times closer to naïve animals. Interestingly, step width was significantly wider in nonexercised than exercised MCLT animals (p<0.05), and stride length was longer in exercised vs. nonexercised animals for both MMT+MCLT and MCLT animals (p<0.05, Fig.1). These data further support nonexercised animals tend toward a more “cautious” gait, with more time spent in stance and a wider based of support, seen in human patients with joint pain, while exercised animals do not.

Conclusion: There are many possible causes for the development of maladaptive gaits, including fear avoidance, physical disability, and pain. These gait changes can lead to aberrant loading and the development of OA in joints other than the originally effected joint. Light exercise is shown here to reduce the development of compensatory gaits in rats, and lends further support to the benefits of exercise as a long-term OA therapy.

Figure 1. Exercised animals had longer stride lengths and narrower step widths than nonexercised groups (p<0.05). Exercised animals had percent stance times closer to 0 than nonexercised