

Assistive and Rehabilitation Technology in Osteoarthritis of Knee

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Abstract

Osteoarthritis is a prevalent ailment that affects the aged and is one of the leading causes of disability. Knee OA is caused by a number of factors, including elderly, weight, and joint injury caused by repetitive actions like squatting and kneeling. Several factors contribute to knee OA, including cytokines, leptin, and mechanical stressors. Assistive Devices can help not only with the knee pain and stiffness, but also with mobility and individuality. Joint moment measurements provide an objective biomechanical assessment of knee joint load in osteoarthritis (KOA). Wearable sensors paired with machine learning approaches could be used to create novel assistive devices for KOA patients to help them better manage their condition and reduce the risk of non-functional overreaching. In addition to other non-pharmacological conservative treatments, gait modification advances through gait retraining therapies (e.g., altering the foot progression angle) have proved to be successful in lowering KAM during walking and relieving patient symptoms.

Keywords: Knee, Osteoarthritis, Pathogenesis.

INTRODUCTION

Osteoarthritis (OA) is amongst the most common disorders that affects people, particularly the aged. OA is the most common articular disease in the developed world, and it is a leading cause of chronic impairment, especially in the knees and hips(1). The economic costs of OA are considerable, including treatment expenditures, costs for individuals and their families who must adapt their lives and homes to the condition, and costs associated with lost work productivity(2).

Knee OA is more relevant than other types of OA not just because of its higher prevalence rate, but also because it manifests at a younger age, particularly in obese women. Pain and other OA symptoms can have a huge impact on one's quality of life, effecting both physical and psychological factors(3). Knee OA is a chronic disease that affects the total joint, including the articular cartilage, meniscus, ligaments, and peri-articular muscle, and can be caused by a variety of pathophysiological causes. It is a debilitating and painful condition that affects millions of people(4). Knee pain that develops gradually and worsens with movement, knee stiffness and swelling, pain after prolonged sitting or sleeping, and pain that worsens over time are all common clinical symptoms(5).

In knee osteoarthritis, joint moment measurements represent an objective biomechanical metric of knee joint load (KOA). Wearable sensors combined with machine learning techniques might design new assistive gadgets for KOA patients to improve disease treatment and decrease the danger of non-functional overreaching (e.g., pain). Wearable sensors combined with machine learning techniques might design new assistive gadgets for KOA patients to improve disease treatment and decrease the danger of non-functional overreaching (e.g., pain)(6). Knee osteoarthritis (KOA) of the medio-tibiofemoral joint is a common cause of impairment mostly in elderly(7).

Knee discomfort, functional impairment, and loss of mobility are all symptoms that can contribute to physical and psychological disability, as well as a lower quality of life(7). Mechanical parameters, notably the stress on the knee joint, have been proven

to have a significant impact on the severity and progression (8). The external knee adduction moment is a commonly used surrogate measure of the compressive stress of the medial compartment (KAM) (8).

ETIOLOGY

Depending on the cause, knee osteoarthritis is classed as either primary or secondary. Primary

knee osteoarthritis occurs when articular cartilage degrades for no apparent reason. This is commonly thought of as age-related deterioration as well as wear and tear. The result of articular cartilage deterioration due to an identifiable cause is secondary knee osteoarthritis(9).

Possible Causes of Secondary Knee OA

- Posttraumatic
- Postsurgical
- Congenital or malformation of the limb
- Malposition (varus/valgus)
- Scoliosis
- Rickets
- Wilson disease
- Gout
- Pseudogout
- Acromegaly
- Avascular necrosis
- Hemophilia

PATHOPHYSIOLOGY

The development of OA is based on interactions between various elements, this process can be thought of as the result of a mix of systemic and local factors(10). Obesity is now widely recognised as a complex condition characterised by inappropriate activation of neuroendocrine and pro- inflammatory pathways, which results in impaired food intake control, fat accumulation, and metabolic alterations. Activated white adipose tissue boosts the production of pro- inflammatory cytokines including IL-6, IL-1, IL-8, TNF alpha, and IL-18 while lowering the production of regulatory cytokines like IL-10(11-25). This finding backs up the association between fat and OA. Obesity genes and their products, such as leptin, may play a role in the onset and progression of OA.

METHODOLOGY

Wearable sensors combined with machine learning techniques could help design assistive gadgets for Knee Osteoarthritis patients to improve disease treatment and decrease the risks of non-functional overreaching (e.g., pain). The goal of this research

was to create an artificial neural network (ANN) that could predict external knee flexion moments (KFM) and external knee adduction moments (KAM) during diverse locomotion activities using data from two wearable sensors(27-38).

Gait modification advances by gait retraining therapies (e.g., modifying the foot progression angle) have shown to be effective in reducing KAM during walking and improving the symptoms of patients, in addition to other non-pharmacological conservative treatments (e.g., bracing or footwear interventions) said by the Author Barrios J.A. The development of assistive technologies (for example, a smart knee sleeve that monitors knee load in conjunction with a smart phone-based user feedback system) could aid in the development of effective disease-modifying strategies to decrease cartilage volume loss. As a result, alternative measurement methods have made significant progress in recent years. One of the first studies towards a wearable measurement tool was done by Van den Noort et al.(2011). In 20 Knee Osteoarthritis patients, the authors investigated the effects of an instrumented force shoe combined with an optoelectronic marker system on goal variables (e.g., KAM). In order to compute the KAM, the authors indicated that additional measuring equipment (e.g., inertial sensors) is required to collect joint locations and orientations as a supplement to ground reaction force (GRF) readings. Due to the relevance of GRF estimates as input in biomechanical analysis to estimate joint kinetics, Karatsids et al.(2016) evaluated the GRF estimation accuracies of a full- body inertial motion capture and an optical motion capture system. Their findings revealed that the two systems produced similar results.

As a result, the authors came to the conclusion that an inertial sensor-based system has a lot of potential for monitoring crucial biomechanical parameters in everyday life(38).

CONCLUSION

The goal of this study was to create an artificial neural network (ANN) that could predict external knee flexion moments (KFM) and external knee adduction moments (KAM) throughout diverse locomotion activities using data from two wearable sensors. The importance of training individuals on prevention, treatment, and self-care has been overstated, given the increased prevalence of knee pain among the population and the rising expense of treatment. Importance of these devices and rehabilitation is becoming more apparent. By using these assistive devices and rehabilitation techniques provides a significant improvement in patients with Osteoarthritis of knee.

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