A CROSS-SECTIONAL BIOMECHANICAL EVALUATION OF DIABETIC LOWER LIMBS PRIOR TO FOOT ULCERATION

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INTRODUCTION

Over 5% of the Irish population has been diagnosed with diabetes; realistically this number is thought to be about 15% when undiagnosed and pre-diabetes cases are included [1]. Due to undiagnosed and poorly controlled diabetes, patients are needlessly developing foot complications, leading to prolonged hospital stays, increased immobility and more seriously amputation. Diabetic foot complications arise due to peripheral neuropathy, which deprives the patients of the early warning signs of pain and/or pressure. The epidemiology of lower limb ulceration begins with the onset of peripheral neuropathy which is linked to muscle wastage, gait misalignment and limited joint mobility [2]. These symptoms along with increased body weight contribute to elevated plantar pressures, in turn leading to ulceration and finally the feared result of amputation. To put this in perspective 80% of diabetic amputations are preceded by a plantar ulcer [3]. Therefore, the objective of this study is to perform an in depth assessment of the lower limb inclusive of (i) lifestyle questionnaire, (ii) biomechanical exam, (iii) 3D gait analysis, (iv) electromyography (EMG) and (v) plantar pressure. It is anticipated comparing the results of low-moderate risk diabetic feet to case matched controls, will highlight biomechanical discrepancies, which will allow for early intervention and a proactive approach to ulcer prevention.

METHODS

Subjects:

Twenty DM patients and their healthy counterparts that match the profiles of the DM patients in relation to age and weight will take part in this study.

Instrumentation:

Lower body gait analysis will be carried out using 3D motion analysis system (VICON Ltd, UK). Retro-reflective markers will be attached to the lower body according to the Vicon Plug in Gait recommendations. A multisegmental biomechanical foot model based on the Oxford foot model will be used to calculate foot motion (dorsi/planar flexion, adduction/abduction, internal/external rotation). The lower limb muscle activity will be recorded simultaneously using wireless EMG sensors (Aurion Ltd, Italy). The Ground Reaction Force (GRF) will be measured using force plates. Static and dynamic plantar pressure distributions (Figure 1) will be thoroughly studied using HR pressure mat (Tekscan Ltd, USA).

RESULTS

The results obtained are to provide understanding of the early biomechanical effects of diabetes on the lower limbs. Preliminary results indicate to common regions susceptible to diabetic foot complications, within this pilot group results are patient specific and of yet no clear correlation has emerged. It is evident, on comparison of assessment groups, that with the onset of diabetes the lower limbs begin to suffer. Analyses of the diabetic participants indicate to diminishing biomechanics of the lower limb such as (i) delayed firing for the Tibialis Anterior (ii) Increased Plantar Pressure (iii) Reduced intersegmental motion.

DISCUSSION/CONCLUSION

The feet are the most vulnerable part of the human body with regard to injury and infection and diabetes makes them more susceptible. To-date, the effect of DM on the ankle-foot joint biomechanics has not been well defined. This study offers detailed biomechanical analysis of the complicated diabetic foot. It is hoped that the results of this study can be used to guide future strategies for preventing pressure ulcers associated with DM and as such this project will have tremendous impact on the field of podiatric research and orthotic design/development.

REFERENCES