All Work and No Play: does this make Jack a tall boy?
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Introduction

Football is renowned for being the most popular international team sport and the attraction of a prosperous professional career is enticing for young enthusiasts. This has led to a greater number of increasingly younger individuals participating in organised training regimes that use repetitive exercises in order to develop specialist skills.

While obesity and inactivity is a mounting problem for the general population, the increased intensity of complex skills practised by competitive young athletes is just as perturbing with respect to the unknown health risks associated with prolonged intensive exercise.

The lack of scientific guidelines to prevent overtraining is partly due to the limited number of longitudinal studies which assess growing athletes over many years. The gap in the literature leads to a weakness in scientific understanding; thus the potential to uniquely combine Motion Analysis (MA) and Magnetic Resonance Imaging (MRI) to assess the development of young athletes. This research may affect the design of future health support mechanisms to protect the vulnerable area of bone growth (the epiphyseal plate) as illustrated in Figure 1.

Method and Materials

Aim

The aim of this research is to broaden scientific understanding with respect to the epiphyseal plate and subsequent development of long bones; in addition to exploring the influence exercise has on the biomechanics of gait and the future health and welfare of amateur and professional athletes.

Objectives

• Determine any potential health risks for the welfare of individuals by analysing MA over many years. The gap in the literature leads to a weakness in scientific understanding; thus the potential to uniquely combine Motion Analysis (MA) and Magnetic Resonance Imaging (MRI) to assess the development of young athletes.

The second phase of the research was carried out on the same day at the Clinical Research Centre (CRC) where MRI scans non-invasively generate images of the dimensions and volumes to be calculated and visualised in 3-D. Three different software programs were used (OsiriX®, Endpoint® and MATLAB®) to quantify the specific distribution of forces at key anatomical points of the foot.

Results

This research reveals that there is a significant difference in the kinematic and kinetic data when comparing the MA of individuals in the active and control groups. The influence that intense sports training has on the biomechanical development is particularly evident in relation to the difference in running style; pairwise comparisons confirmed that the active group tend to adopt an efficient toe-running technique and this dramatically contrasts with the heel-strike running technique selected by the control group.

Discussion

Ultimately this research provided greater insight as to the appropriate prescription of training for young athletes. If an individual’s biomechanics are found to place additional detrimental stresses and strains across the lower limb joints, this research will enable their walking, running and exercise techniques to be altered accordingly.

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References


Figure 1 – The epiphyseal plate is the cartilaginous ‘growing’ area of long bone which consists of four conceptual zones (adapted from Mitchell et al.).

Figure 2 – Pedar® box and examples of in-shoe pressure sensing insoles.

Figure 3 – 3-D reconstruction of a static trial in Vicon®.

Figure 4 – a) Coronal view of DESS MRI of the dominant right knee. b) DESS image highlighting the ‘livewire’ tool which enables outlining of the growth plate as seen in red. c) T2 image after extensive algorithmic programming to compute and process T2 pixels. d) Validation of 3-D reconstructions of growth plates of the ankle created using OsiriX® software.

Figure 5 – a) Graphs illustrating Maximum Force of the right foot recorded by Pedar® while running. b) Active group. c) Control group.

Figure 6 – a) Photograph depicting Flat foot marker placement at anatomical site.

Figure 7 – a) Photograph depicting Flat foot marker placement at anatomical site.

Figure 8 – b) Subject in Sports Laboratory.

Figure 9 – a) 3-D reconstruction of a static trial in Vicon®.

This study assessed 15 young male footballers aged between 12-14 years who attend Rangers Youth Academy. This active group were compared to an age-matched cohort of 15 non-trained school boys with a more sedentary lifestyle. Motion of the musculoskeletal system of individuals walking and running was captured using the Vicon® MX system with concealed AMTI® force plates in the Sports Laboratory, located in the Institute of Motion Analysis and Research (IMAR) and pictured in Figure 2 which also presents an example of obtaining a static trial.

Pedar® was used to simultaneously measure in-shoe pressure and reveal the specific distribution of forces at key anatomical points of the foot. Figure 3 is a photograph of the Pedar® box which was carried in a specially altered back pack.