

A Method to Analyse Forces and Moments in the Extremities of the Horse during the Stance Phase at the Trot

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Summary

A method to calculate forces and moments in horse limbs based on ground reaction force measurements and kinematic data is presented. Measurements of the ground-hoof reaction force components and determinations of the moments caused by them at the carpal, tarsal and fetlock joints were determined for 6 consecutive stances of the fore and hind limbs of a horse, trotting at a speed of 6 m/sec. The results showed small variations in the forces and in the external moments between stances. The mean maximum vertical force was 9.0 kN in the forelimb and 8.2 kN in the hind limb, while the corresponding retarding and propulsive forces were 1.7 kN and 0.7 kN in the forelimb and 2.2 kN and 1.5 kN in the hind limb. The external moments were 1.2 kNm in the carpal joint and 1.3 kNm in the fetlock joint of the forelimb and 2.0 and 1.5 kNm in the tarsal and the rear fetlock joints, respectively.

Index terms: Kinetics; locomotion; ground reaction forces.

Introduction

An understanding of the distribution and magnitude of forces and moments acting in the horse's limbs is of importance when trying to explain the origin of injuries and diseases of the extremity. Information about the external forces and moments acting at different levels of the limbs can be calculated from recordings of the vertical and horizontal ground reaction force components and the geometrical properties of the limbs. Measurements of both vertical and horizontal ground reaction forces were carried out in draught horses by Björck (1958), who used force measuring shoes mounted on the horse's hoofs. Since then, measurements have been made by a number of investigators using force plates (Koch, 1973; Geary, 1975; Pratt and O'Connor, 1976; Quddus *et al.*, 1978, Bartel *et al.*, 1978; Schryver *et al.*, 1978; Ueda *et al.*, 1981; Niki *et al.*, 1982; Goodship *et al.*, 1983; Merkens, 1983; Niki *et al.*, 1984; Merkens *et al.*, 1986).

Parker (1973) and Geary (1975) have presented mathematical models for the forelimb of the horse. These models were based on ground reaction forces, kinematic data from high-speed films and on assumptions about the force distribution between skeleton,