A VIDEO ANALYSIS MEASUREMENT TECHNIQUE FOR THE ESTIMATION OF LEG POWER DURING THE PERFORMANCE OF THE HORIZONTAL JUMP

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INTRODUCTION

The purpose of the study was to develop an accurate measurement technique for the estimation of leg power from video tape recordings of the horizontal jump. The analysis method provides a reasonably accurate video analysis method for the estimation of peak power developed during jumping motions. Standard two dimensional video analysis techniques were used to compare Horizontal Jumping Power to Force Plate recordings, including centre of mass displacement (D) and velocity (V) data. Centre of Mass (C of M) velocity changes are calculated during the take off phase of the horizontal jump performed for maximum distance. Power produced from the lower body is measured utilizing the kinematic changes in the centre of mass at take-off. The accuracy of the measurement technique is compared to Peak Power (PP) measures provided through force plate power analysis. Comparison with force plate, ground reaction forces (GRF) is selected as it is considered to be the most accurate direct measure of force (Vandewalle 1987). Correlations of (r =.62) indicated a moderate relationship between force plate power results and estimates from the video analysis. A linear prediction equation was computed to provide an estimation of Peak Power from the video velocity of C of M measures. Peak Power (Pp) = 1.3168 x Peak Video Power (Prv)- 386.63.

METHOD

Eighteen subjects performed 3 standing horizontal jumps for maximal horizontal distance. All jumps were performed from a force plate using no arm swing from a half squat position and the best of three jumps, chosen for video analysis.

The Peak 2 Dimensional Analysis Video System was used to analyse all jumps from a lateral view using a 60 Hertz film speed and a shutter speed of 1000. (Peak 1992, Plagenhoef 1983) Standardized segmental end point landmarks and Anthropometric charts were used to program for the Centre of Mass Velocity computations (Plagenhoef 1983). Centre of Mass displacement and velocities were computed for the takeoff phase of the jumps and the raw data files exported for Power Analysis.

The Power analysis calculations utilized the C of M Velocity raw data file to compute Power based on the Impulse Momentum (FT=MV2 - MV1) relationship. (Fig. 2) Peak Power is calculated at the time when Force (F) and Velocity (V) coincide to produce maximal power during the take-off phase.

The AMTI force plate and power software were used to record ground reaction forces (GRF) for all jumps with the highest Peak Power recording selected for video analysis. To compute Resultant Force (Fr), the Vertical (Fy) and Horizontal (Fx) GRF were used to calculate take off angle and the Net Resultant Force(Fr net). (Fig. 1)

RESULTS

An initial N of 18 subjects were tested and compared for both Video Power (Pv) and Force Plate Power (Pp). Using force plate data a velocity correction factor ratio of .553 was used to correct the V of C of M video data in order to compensate for the differences in sampling rates and digitizing error. Data was screened to eliminate Power results more than I-SD from the mean (N = 11). A correlation of r - .6232 indicated a moderate relationship between Video and Force Plate Power results. A linear correction equation for the prediction of Power from video was calculated. $Pp = 1.3168 (Pv) - 386.63$ where Pp = Peak Takeoff Power, Pv = Peak Video Power.

DISCUSSION

To provide a greater insight into the kinetic aspects of performance an estimation of the muscular power produced in jumping movements is provided through video analysis and inverse dynamics to calculate Force from changes in velocity Peak Power (Pp) is selected as the maximal power output during the take off phase of the jump. Calculations must consider both vertical and horizontal force relationships to calculate Resultant Force, Velocity and Power when comparing video to force plate power.

Where: GRF = Ground Reaction Force
Fx = Horizontal GRF
Fy = Vertical GRF
i = Takeoff Angle
BW = Body Weight
M = Mass
Frnet = Net Resultant Force
i = Initial Datum-Point
j = Final Datum Point
Vr = Resultant Velocity
Pr = Resultant Power

Fr = (F2)2 + (Fx)2	Fr net = Fx - BW	**Prj = Fr x Vj**
ϕ = Arcton F2/Fx	Vrj =	
BW = M **9.8/sinϕ**	Frnet t **sinϕ** I Mass	

Fig. 1 **Formulae** for Force Plate Power (Pr) Calculation.

Where: Vy = Vertical Velocity
Vx = Horizontal Velocity
Vr = Resultant Velocity
i = Take off Angle
i = Initial Datum Point
j = Final Datum Point
Fr = Resultant Force
m = **Mass**
Pr = Resultant Power

Vrj = (Vy)2 + (Vx)2	**Frj = M Δ Vr / t sin ϕ**
ϕ = **Arcan** Vy / Vx	**Prj = Frj** Vrj
Δ Vx = Vrj - Vri	

Fig. 2. Video Power (Pr) **Formulae.**

figs. 1 and 2

CONCLUSION

Estimations of Peak Power during horizontal jumps can be calculated with reasonably high accuracy using video analysis techniques. The methods and results

outlined here require further investigation using higher video sampling rates and larger subject sample to improve the accuracy of the prediction equation. The Jumping Power estimations using video analysis provide a practical, testing measure adaptable to any jumping event or competitive game situation.

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