KINEMATICS OF FREE THROW SHOOTING BY CLASS 1.0 WHEELCHAIR BASKETBALL PLAYERS

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INTRODUCTION

Wheelchair basketball players classified as 1.0 are those players who are considered to have the greatest degree of disability. International wheelchair basketball classification specifications indicate that class 1.0 players have no favourable sitting balance when sitting in a wheelchair without the support of a backrest and the trunk cannot be moved in any plane without the help of at least one arm. Typical disabilities include T1-T7 paraplegia without abdominal muscle control and post-polio paralysis with arm involvement and loss of trunk musculature control. A review of game statistics from the 1994 Gold Cup Men's World Wheelchair Basketball Championship indicates that players classified as 1 0 had free throw (FT) percentages as good as, or better than the majority of other players (52%). Due to the physical limitations of these players, one might have expected that their free throw shooting skill would have been decreased as compared to the other players.

The purpose of this investigations, therefore, was to develop a better understanding of the FT as performed by class 1.0 wheelchair basketball players by identifying and describing the kinematic differences between successfbl and unsuccessful FT attempts. In order to identify kinematic differences between successful and missed FT, three-dimensional video data was collected during the 1994 Gold Cup held in Edmonton, Alberta.

METHODOLOGY

Two Panasonic SVHS cameras, one set parallel to the free throw line to obtain a side view of the player and one set obliquely to the front line to obtain a more frontal view of the player, were used to record the right side of the players attempting Ft at one basket. One successfbl and one missed FT for seven players were selected for analysis. Due to the limited number of Class 1.0 players who were recorded shooting a successful and an unsuccessful FT, an additional six shots (3 successful and 3 missed) from six diierent players were also analysed. Joint centers, body landmarks and pints on the wheelchair were identified and the following points were digitized: four points on the periphery of the ball, knuckle of the right middle finger (base of the third metacarpal), center of the right wrist join, right elbow (between lateral

epicondyle of humerus and head of radius), right and left shoulders (greater tubercle of humerus), the right ear (concha), the nose (apex), the neck (seventh cervical vertebra), right hip (greater trochanter of the femur), axle and right outside edge of the right tire. The dimensions of the calibrated field were 225cm x 300cm x 150cm which encompassed sixteen control points. An additional sixteen points were used to assess the reconstruction accuracy which found the RMS to be as follows; x=0.13, y=0.09cm, and z=0.12cm. The 3D coordinate data reconstruction was performed using the DLT method, followed by smoothing with a quintic spline.

RESULTS

Preliminary analysis of the Class 1.0 data found that in general, there was a large amount of variance between the players on the parameters of interest. Within player trends were seen, therefore, comparisons were made between successful and missed shots for individual players, with the remaining shots being used for supporting data. Visual inspection of the graphs from several different variables revealed some interesting trends. Looking at the action of the wrist, six of seven players showed greater angular wrist velocity prior to release during missed shots. In plotting the angular velocities of the shoulder and elbow together for each players, the data suggests two distinct patterns as shown in Figures 1 and 2. Most players appeared to use a pushing motion for the FT, whereas others used more of a sequential or throwing pattern. Analysis of all twenty Ft indicated that thirteen of the shots showed a pushing pattern. Both shoulder and elbow velocity were greater at release during successful shots in six of seven players. All but one of the subjects, demonstrated a backward lean during shooting which would be mainly due to the tilted sitting position in the wheelchair to compensate for lack of balance. Head movement ranged from 0-9 degrees prior to release with a tendency towards less movement during successful shots. Wheelchair position in relation to the FT line was quite variable between subjects, with some players directly facing the basket, while other were at an angle as great as 50 degree to the FT line.

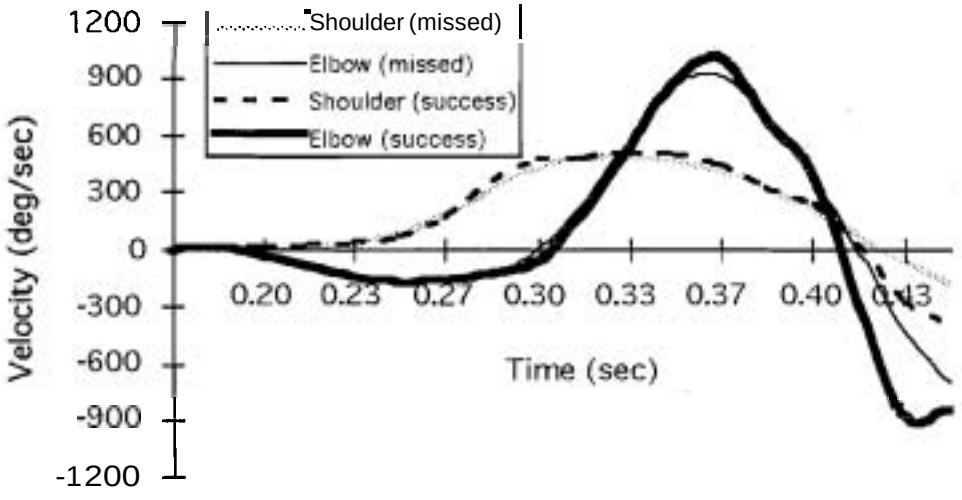

Figure 1 - Example of Throwing Pattern

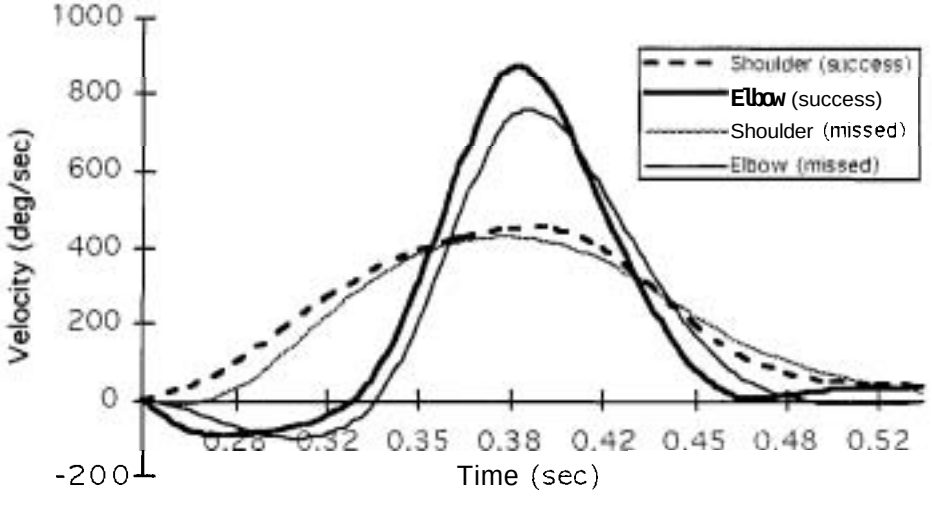

Figure 2 - Example of Pushing Pattern

Height of ball release ranged from 1.56m to 1.88m between players. Only two of six players showed a difference in release height between successful and missed shots. Projection angles ranged between 54 and 61 degrees, with four of six players having greater projection angles during missed shots. These values fall above the minimum release angle of 45 degrees suggested for wheelchair basketball players by Owen (1982). No distinct trends in ball velocity at release were identified.

DISCUSSION

The results suggest that shooting style appears to be individualistic in nature. Due to the large amount of variance between subjects, group averaging may not be appropriate. The trends identified from this preliminary investigation, however, indicate that further investigation is warranted. Analysis will be continued on the Class 1.0 data, while similar analyses will be conducted on the Class 2.0, 3.0 and 4.0 players. With an increased number of subjects, inferential statistics will be computed and comparisons will be made between the four classification groups.

REFERENCES

Owen, E. (1982). Playing and Coaching Wheelchair Basketball. Urbana, IL: University of Illinois Press.

ACKNOWLEDGEMENTS

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