

# THE PRINCIPLE OF CHANGING AXES IN DISMOUNT FROM THE HIGH BAR

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There is research available on the dismount from the high bar but no study provides an explanation on how to improve the height of the center of gravity (**C.G**) of the body. Many gymnasts lose performance points because of low height on the dismount. The purpose of this paper was to identify critical variables which can be used to improve the height of the dismount.

## **METHODOLOGY**

The dismounts from the high bar of gymnasts competing during the **1988 24th** Olympic Games (Seoul) were filmed with a 16-mm high speed, two-dimensional (2D) camera (**2D**) at frame rates of **70 f/s**. Video-tapes of the performances were made from the films by transferring images frame by frame. The seven finalists in the high **bar event** were selected as a world class group. Thirteen Penn State gymnasts were filmed 2D with a video camera during **training** and competitions and formed a university class group.

Nine body points were digitized using **PEAK Performance** Motion Measurements Systems. The raw position data were smoothed by a second-order **Butterworth** low-pass **filter** with forward and **reverse passes**, using a cutoff frequency of 12 Hz. The following linear and angular kinematic variables were calculated: center of gravity, velocity, and angles as well as angular velocity and angular **accelerations** of the arms, shoulders, and hips.

The critical variables for success were selected by applying **stepwise** regression and linear regression statistical analyses.

## **RESULTS**

The results showed that the two groups had a significant difference in height of **the C.G. with respect to the** high bar in the dismount. **The mean** values were 1.34 m above the bar for the world class group and **0.93** m above the bar for the group of Penn **State** gymnasts (**see** Figure 1). The height of dismount was significantly correlated with the angular velocity reached by the arms just after passing the bottom position (**r** = **-0.72**, **p** < **0.001**, see Figure 2).

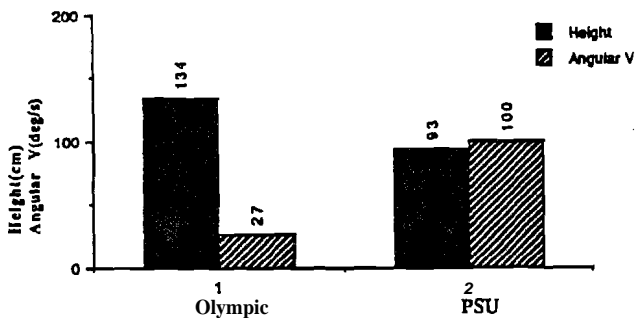


Figure 1. Comparison of two levels in high bar dismount

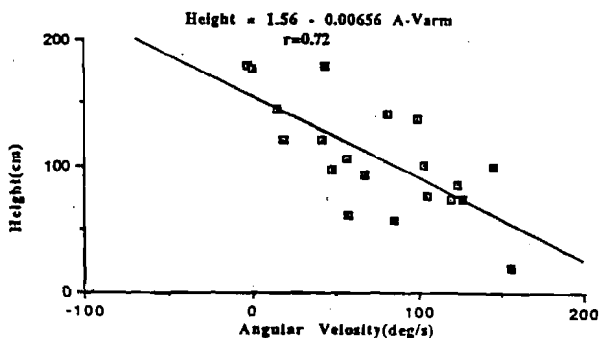


Figure 2. **Linear regression** between height and angular velocity of arms.

The mean values of angular velocity for the world class and university class were **26.8 deg/s** and **100 deg/s**, respectively. The angular velocity of the arms of the best **peinertia**. This action has been named “Changing **Axes Principle**.”

The application of this principle of changing axes has produced **significant results** for the gymnasts of Penn State University.

An **example** of the application of this principle is **that one** subject improved the up swing for his dismount from high bar during two **weeks** of training. The angular velocity of the arms **was** reduced significantly **from 156.2 deg/s to 122.9 deg/s**, while the height of C.G. of dismount increased **from 0.2 m to 0.85 m**(see Figure 4).

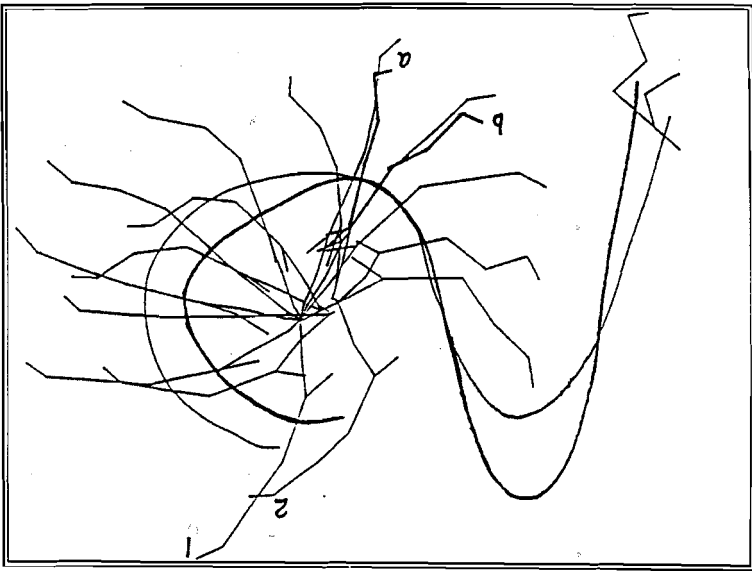


Figure 3. Compare performances of two gymnasts.  
 1-represents performance by The Penn State gymnast  
 2-represents performance by the best gymnast.  
 a-b shows the arms almost stopped and body rotated around shoulder axes.

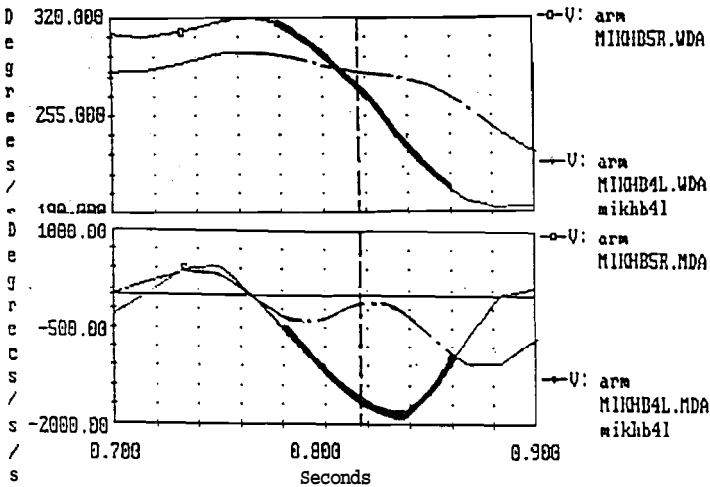


Figure 4. Compare two performances of same performer. Top represents angular velocity of arms and bottom represents angular acceleration of Arms. Heavy line represents improved performance.

## CONCLUSIONS

The principle of changing axes in dismount from the high bar is a useful principle for success in dismounts. During the up swing of the dismount, the shoulders need to be stopped for an instant, while the whole body rotates around the shoulder axis. One of the critical variables of the changing axes principle is the angular velocity of the arms just after passing the bottom position.

## REFERENCES

W.L. Bauer(1987) Physical Models in Sports Biomechanics. *Medicine and Sport Science*, 25, 107-141.