International Journal of Yoga, Physiotherapy and Physical Education
Online ISSN: 2456-5067; Impact Factor: RJIF 5.24
www.sportsjournal.in
Volume 2; Issue 4; July 2017; Page No. 07-10

# Kinematic analysis of close leg press handstand performing on different apparatuses in artistic gymnastics

**[1] Joshi Hem Chandra, [2] Ghai Guru Datt, [3] Rajpoot YS**

[1] Research scholar, Department of Physical Education and Pedagogy, L.N.I.P.E., Gwalior, Madhya Pradesh, India
[2] Professor & Director, Department of Physical Education and Pedagogy, L.N.I.P.E., Gwalior, Madhya Pradesh, India
[3] Assistant Professor, Department of Physical Education and Pedagogy, L.N.I.P.E., Gwalior, Madhya Pradesh, India

**Abstract**

A press handstand is a gymnastic term referring to the slow and controlled elevation of a gymnast's body from an initial stationary position to a handstand position. The purpose the study was to kinematically analyze and compare the same skill (close leg press handstand) performing on three different apparatuses used in artistic gymnastics. A total of seven (n = 7) best male gymnasts from L.N.I.P.E., Gwalior (M.P.); who had the good mastery over the skill on all selected apparatuses were purposely selected for the present study as subjects. To acquire kinematical data, a digital Sony HDR cx-200 video recording camera with a frame rate of 60 frames per second, were used during the execution by placing it right side of the subjects(gymnasts) and perpendicular to the sagittal plane. The digitization of the skill by converting raw data into numeric values was done with the help of kinovea software to obtain selected kinematic variables. The repeated measure ANOVA was used for the kinematic comparison of all three repeated group at each apparatus. The level of significance was set at 0.05. The results showed the significant difference was found among the repeated groups in case of both the selected variables ($p < .05$) On the basic discussion it is concluded that performing close leg press handstand on parallel bars as well as the still rings was equally difficult in nature as compare to performing press handstand on floor exercise.

**Keywords:** technique, close leg press handstand, gymnastics, sagittal plane, hip joint velocity

## 1. Introduction

The recent rapid growth of the sport of gymnastics may be based, among other factors, on its versatility. Gymnasts attempt to win points in each of the various events by combining certain skills into spectacular eye pleasing routines. However, while the sport's governing body gives the athlete considerable freedom to choose or develop the appropriate skills for a particular routine, it also imposes certain restrictions. One of those restrictions is that routines on the floor, rings, and parallel bars should include a press handstand, i.e. a gymnastic skill requiring the slow elevation of an individual's body from an initial (usually an "L") stationary position to a handstand' position. Several variations of press handstands exist depending on body configuration between initial and final positions. One of them, the straight arms/flexed hips press (SAFHP), is the variation most commonly used by gymnasts.

A press handstand is a gymnastic term referring to the slow and controlled elevation of a gymnast's body from an initial stationary position to a handstand position. The body configuration between initial and final positions can vary, making certain variations of the skill more difficult than others. However, accomplishment of any variation requires a continuous change in body configuration brought about by muscular torques acting at the wrist, shoulder, and hip joints.

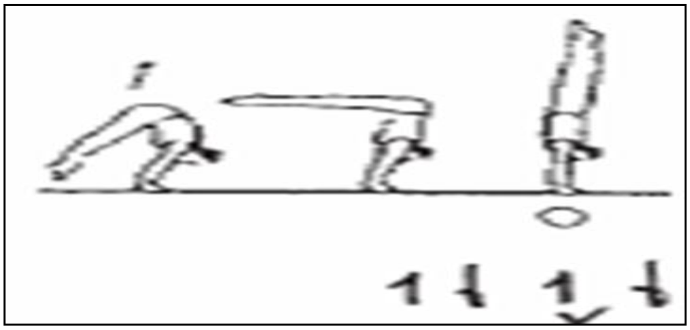

**Fig 1:** Closs Leg Press Handstand

Among those torques, the one acting at the shoulder joint is of paramount practical importance. The hip joint extensors are quite powerful and capable of generating the necessary moment during the press, regardless of limb positioning, whereas the wrist joint torques are small, especially when the body's center of mass (CM) is above the gymnast's hands (Prassas, 1985; Prassas, Kelley, & Pike, 1986).

Although handstands in general and press handstands in particular are frequently discussed qualitatively in gymnastics books (Brown, 1980; Faria, 1972; Fukushima & Russel, 1980;

Puchet, 1979), related quantitative research consists of a single study. Prassas *et al*. (1986) investigated the relationship between shoulder joint strength, hip joint flexibility, and timing to the straight arm/flexed hips press handstand on the parallel bars. They concluded that increased levels of shoulder joint strength at the later stages of shoulder joint flexion might be one of the Prerequisites for proper execution of the skill, and that utilization of an increase in existing hip joint flexibility could reduce the demands placed upon the shoulder joint musculature.

The purpose the study was to kinematically analyzed and compare one of the mounting skill (close leg press handstand) used on different apparatuses in artistic gymnastic. So, therefore, the researchers tested the hypothesis that there might be the significant difference in all selected kinematics variables while performing the same skill on different apparatuses (Two tail hypothesis).

**2. Methodology**

The methodology of the study consist of selection of subjects, selection of variables, criterion measures, filming protocol, testing procedure and the technique employed for analysis of data.

For the purpose of the study, the total 7 national level right handed male gymnasts of 18 to 23 years with minimum deviation from their demographic characteristics (Age, Height, Weight, Fat %, Arm Dominance and Experience) and those performed the particular skill (press to handstand) in their practice routine in all selected apparatuses were purposely selected. The gymnasts performed the close leg press handstand on three different apparatuses used in men's competitive gymnastics [Floor Exercise (FX), Parallel Bars (PB) and Still Rings (SR)]. The Temporal Variable (time execution of the skill) and Hip Joint Velocity (angular velocity) was used as kinematic variables for the present study with complete biomechanical approach. The temporal data was recorded in seconds and hip joint velocity was recorded in degree/second.

For collecting the data, first the vediography technique was employed in order to register the performance of close leg press handstand on all three different apparatuses for determining the average hip joint velocity and temporal variable. The camera that was used for this study was a standard Sony HDR cx-200. The frequency of the camera was 60 frames/second with HD quality of video. The video camera was mounted on the tripod stand at the vertical height of 1.06 meters in case of capturing action on floor exercise from the ground, 2.25 meters in case of capturing action on parallel bars from the ground and 2.93 meters in case of capturing action on rings from the ground. The video camera was placed perpendicularly at center in the line of the subjects to the sagittal plane at a distance of 5.90 meters in case of capturing action on floor exercise, 6.12 meters in case of capturing action on parallel bars and 5.97 meters in case of capturing action on rings and then kinovea software was used for digitizing the data and converting the raw data into numeric values The subjects performed the skill with full of control and with proper technique. One best trail was taken into consideration.

**Fig 2:** Illustration of Experimental Filming Protocol

Statistical analysis was done with SPSS (Statistical Package for the Social Sciences, 20.0, USA). The descriptive analysis was done by computing mean and standard deviation in order to have an idea about the characteristics and variations in all selected variables while performing the same skill on three different apparatuses and as the same group was tested in all the three different conditions so, repeated measure ANOVA was used to find out the mean difference among the groups (within group) whether significant or not after fulfilling all the assumptions of selected parametric test. Then obtained "f" value was tested at 0.05 level of significance. Partial eta squared of each variable was calculated to find out the total magnitude of the mean differences along with its significance level (Effect Size).

## 3. Results

The results of one way repeated measure ANOVA which were obtained in order to ascertain the mean difference in selected kinematics variables i.e. temporal variable as well as the hip joint velocity while performing press handstand on three selected apparatuses gymnastics [Floor Exercise (FX), Parallel Bars (PB) and Still Rings (SR)] have presented in table 1 mentioned below:

**Table 1:** Comparative Statistics of Selected Kinematic Variables of Press Handstand on Different Apparatuses**.**

| Variables | | M ± S.D | Mauchly's Test | F-value | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Temporal Variable (Second) | FX | 4.57 ± .37 | .728 | 20.261* | .000 | .772 |
| | PB | 4.02 ± .17 | | | | |
| | SR | 3.55 ± .22 | | | | |
| Hip Joint Velocity (d/s) | FX | 26.00 ± 2.58 | .668 | 22.354* | .000 | .788 |
| | PB | 33.86 ± 3.02 | | | | |
| | SR | 32.71 ± 3.04 | | | | |

***Significant at 0.05/2 level (two tail hypothesis)**

The presentation of results of all selected kinematic variables (Temporal and Hip Joint Velocity) mentioned in tables table 1 includes outcome of mean (M) and standard deviation (SD) as descriptive statistics, Mauchly's test to check the violation of sphericiry assumption which was found insignificant (p = .728 & .668) for both the variables, F- value to find out the mean difference which was found significant ($F_{(2, 12)}$ = 20.261 & 22.354, p = .000) for both the variable respectively at 0.05 level of significance, and the partial eta squared to find out the total effect size of the mean difference which was reported as very large (.772 & .788) in magnitude.

After pair wise comparison in case of both the variables, the bonferroni post hoc test showed significant difference while comparing apparatus 1 (FX) and apparatus 2 (PB) [d = .551 & 7.857, p = .021 & .001] and apparatus 1 (FX) and apparatus 3 (SR) [d = .821 & 6.714, p = .004 & .012] while comparing separately at 0.05 level of significance.

## 4. Discussion of Finding

Research scholar had conceptualized the study to biomechanically analyze one the mounting skill most frequenting used by the gymnasts to start his or her routine on different apparatuses in artistic gymnastics. The concept of the present study was to find out the variation in term of kinematic variables while performing same skill on three different apparatuses so that while giving training and/or teaching that particular skill, the biomechanical aspects of the skill is to be isolated by keep all the selected variables in mind those factors assist the body to perform correctly with best minimum effort.

While discussing about the kinematical variables (temporal variable and hip joint velocity) as compared apparatuses wise, the findings revealed that the performing the same skill on parallel bars as well as the still rings was equally difficult to perform as compare to performing the same skill on floor exercise (FX). The gymnast requires more concentration and attention to perform on parallel bars and still rings which leads taking less time to perform which helps the gymnast to produce optimum angular momentum in the hip joint for lifting his lower body against the gravity. The complexity of the apparatus also defines the experience in execution difficulty while performing the same skill (Sprigings *et al.*, 1997).

The height of the apparatuses (Visual difference Effect) may be another reason as the skill is performed on ground level in case of floor exercise, at the height of 2.00 meter from the ground in case of parallel bars and at the height of 2.80 meters in case of still rings this height difference might be created different in execution difficulty which influences the muscles and force them to work more while performing at certain height for avoiding losing balance or falling from handstand (Wuehr *et al*., 2014 and Asseman & Gahery, 2005).

## 5. Conclusion

While comparing the same skill on three different apparatuses all together the finding concluded that in case of both kinematical variables, performing close leg press handstand on parallel bars as well as the still rings was equally difficult in nature as compare to performing press handstand on floor exercise may be because the variation in their height from the ground which creates some difficulties to stabilize the center of mass of the body while moving against the gravity.

## 6. References


1. Singh AK, Ghai GD, Joshi HC. The Relationship of the Selected Kinematic Variables with the Performance of Cast to Upper Arm Hang on Parallel Bars in Men's Artistic Gymnastics. Scholarly Research Journal for Interdisciplinary Studies. 2014; III(XVII):2860-2868.
2. Brown JR. Teaching and coaching gymnastics for men and women. New York: John Wiley & Sons Inc, 1980.
3. Bawa GS. Fundamentals of Men's Gymnastics. New Dehli: Friends Publications, 1994.
4. Faria I. Men's gymnastics: Parallel bars. Chicago: Athletic Institute, 1972.
5. Fukushima S, Russel W. Men's gymnastics. London: Faber & Faber, 1980.

6. Hall SJ. Basic Biomechanics. McGraw-Hill-New Yark (2nd edition). 1995, 442-450.
7. Hay JG. The Biomechanics of Sports Techniques. Englewood Cliffs N.J: Prentice Hall Inc, 1993.
8. Hatze H. The Meaning of the Term Biomechanics. Journal of Biomechanics. 1974; 7:189-190.
9. Joshi HC, Kumar A, Ghai GD. "The Relationship of the Selected Kinematic Variables with the Performance of Cast to Upper Arm Hang on Parallel Bars in Men's Artistic Gymnastics. International Journal of Sports Sciences and Fitness. 2014; 4(2):166-176.
10. Prassas, S.G. (1985). A biomechanical analysis of the press handstand on the parallel bars utilizing inverse dynamics techniques. Doctoral dissertation, University of Maryland.
11. Prassas SG, Kelley DL, Pike NL. Shoulder joint torques and the straight armlflexed hips press handstand on the parallel bars. In J. Terauds, B. Gowitzke, & L. Holt (Eds.), Biomechanics in sports III and ZV (83-95). Del Mar, CA: Academic, 1986.
12. Prassas Spiros G. Biomechanical Model of the Press Handstand in Gymnastics. International Journal of Sport Biomechanics. 1988; 4:326-341.
13. Sprigings EJ, Lanovaz JL, Watson LG, Russell KW. Removing swing from a handstand on rings using a properly timed backward giant circle. Journal of biomechanics. 1997; 31(1):27-35.