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Effect of footwork exercises on agility and balance among badminton players of Vadodara: A pilot study

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Abstract
Background: Footwork is one of the core skills in badminton which plays a primary role in maintaining balance. Therefore, involvement of footwork drills can help reduce the risk of injuries and enhance the performance level of the player in terms of their agility as well.
Aim and Objectives: The aim was to investigate the effect of footwork exercise on balance and agility among badminton players of Vadodara. To determine the effect of footwork exercise on balance and agility among badminton players using the Y Balance test and Illinois agility test respectively.
Methods: 10 badminton players were divided into the experimental Group A (N=5) and the control Group B (N=5). These badminton players were assessed at the baseline and at 4 weeks after the intervention for agility and balance where the experimental group underwent footwork exercises for 4 weeks three times a week, while the control group carried on with their routine training.
Results: Within-group analysis in Experimental Group A with paired t-test showed a significant difference in p-value (0.1223) between the pre and post-scores in the Illinois agility test as compared to the control group. However, where the Experimental group A showed a significant effect p-value (Right 0.0016), (Left 0.0394) on paired t-test on Y Balance test, the control group showed no significant difference on pre and post-scores. While between-group analysis on the unpaired t-test in Experimental Group A showed a statistically significant improvement p-value (0.0301) in Illinois agility test scores as compared to the control group but showed no significant difference on the Y Balance test between the experimental group A and control group B.
Conclusion: Footwork exercises show significant effects on agility and balance among badminton players of Vadodara.

Keywords: Footwork, badminton, agility, balance and coordination

Introduction
According to the International Federation of Sport for All and the Madison Beach Volley Tour, badminton is one of the world's most popular sports widely practiced around the world, by over 200 million, since it was registered for the 1992 Olympics [1].
In badminton, the essential elements of physical fitness are aerobic stamina, agility, strength, explosive power, speed, flexibility, balance and coordination [2]. High-racket and shuttlecock speeds are a defining characteristic of the sport; at elite-level matches, the shuttle is struck at over 250 km/h [3]. Under the rising demands, players must exhibit the highest levels of athleticism, including exceptionally quick response times, agility, and quickness [2].
Agility is defined as the ability to change direction rapidly [4]. Without losing balance it also requires changing the position of the body movement quickly and accurately [5]. It is a specific athletic stimulus of an opponent's movements that is most important for the player's performance and is linked to perceptual and decision-making skills [6]. In badminton players, agility exercises will teach to control the body in response to stimulus. By focusing on specific cues, agility drills help improve right body position, balance, coordination and explosive moves. Improved agility also includes improved body control during fast movements, improved intramuscular coordination and reduced risk of injury/reinjury [7].
Stroke play and footwork performance have been identified as two core skills in badminton where stroke play is influenced by eye-hand coordination and footwork is primarily governed by balance [2].

In badminton players, balance addresses issues of controlled COG, twisting movements particularly of the pivot foot, jump smash and offensive and defensive attacks [8]. Balance is a crucial feature of the footwork performance to move across the court quickly. The ability to maintain dynamic balance has a direct relationship with better control of jumping and running to smash and perform the lunges [9]. Overall the role of balance and its importance in injury prevention is well established in badminton and various sports [10].

Footwork is characterized by the ability to accelerate or decelerate on the field and change direction to improve accurate shots and performance. It consists of traversing six zones of the court - right and left frontcourt, midfield and backcourt - using a variety of steps, lunging strategies and arm movements [11]. Quick footwork enhances the real game over athletic performance on the court [12, 13]. Badminton footwork has been recently studied to improve performance and prevent injuries. Because quick movement to position enables quality shuttle return [14, 15]. Footwork is composed of starting, moving, braking, and returning [16].

Balance is a dynamic balance process that involves losing balance after landing, so players need body coordination and dynamic balance [17]. Agility is required for badminton players this is because it is characterized by alternating short movements and high-intensity coupled movements with short rest periods [18]. Even though balance and agility are identified as the key concepts and footwork performance is recognized as a fundamental skill for excellence in badminton. Very few studies have been done on this therefore the aim is to fill the gap of the study by investigating the effectiveness of footwork on balance and agility among badminton players of Vadodara.

Materials and Methodology

Sources of Data: Sports Complex, Vadodara.

Study population: Badminton players.

Sample size: N=10 (Pilot study).

Sampling method: Convenience sampling

Study duration: 9-10 months

Study design: Experimental pre-test and post-test study design.

Inclusion criteria: [19]

- Badminton players playing at least twice in a week.
- Playing badminton for at least more than 1 year.
- 18-30 years of age.
- Male and Female badminton players.
- Willing to complete 4-week intervention.

Exclusion criteria: [19]

- Recent injuries.
- Regularly participated in particular sports other than badminton.
- Had ACL, hamstring, meniscus, ankle or any other LE extremities that are associated with diminished dynamic balance during last 3 years.

Materials to be used

- Cones and Markers.
- Ladder.
- Stopwatch.
- Measuring tape.

Procedure

Ethical approval had been taken for this study. 10 badminton players are recruited based on the inclusion and exclusion criteria. Pre-intervention data are collected at the baseline then, players are allotted in 1:1 ratio to either Group A [(n=5) footwork exercise + routine exercises] and Group B [(n=5, 1 drop out) control group routine exercises] for 3 days/week for 4 weeks. Informed consent is obtained from all players and verbal explanation will be given to players regarding intervention. Post-exercise data is collected at the end of the intervention.

Intervention

<table>
<tr><th colspan="4">Below Intervention for Group A + Routine training</th></tr>
<tr><td></td><td>Footwork drills</td><td>Sets*Reps</td><td></td></tr>
<tr><td colspan="4">Ladder drills:</td></tr>
<tr><td rowspan="5">Warm up for 5-10 mins</td><td>Lateral shuffle
Lateral in & outs
Ali shuffle
Skiers
Ickey shuffle</td><td>2*2</td><td rowspan="4">Cool down for 5-10 mins</td></tr>
<tr><td>Figure of 8 5m</td><td>3*10</td></tr>
<tr><td>Backpedal sprint</td><td>3*10</td></tr>
<tr><td>Squat jumps</td><td>3*10</td></tr>
<tr><td></td><td>Single leg jumps</td><td>3*10</td><td></td></tr>
<tr><td colspan="4">Group B: Only routine training like warm up-stretching, jogging, around the court, skipping rope, pushups, and on-court shuttle practice.</td></tr>
</table>

Group A: Intervention group, Group B: Control group

The exercise protocol will last for 40-45 mins as per aerobic exercise protocol.

Outcome measures: Y Balance Test [20].

Procedure

It is a functional test that requires strength, flexibility, neuromuscular control, balance, stability, and range of motion (ROM). The lower quarter version of the YBT Lower Quadrant was performed barefoot. The player was instructed to stand on the leg (which was being evaluated) in the centre of the platform with the most distal end of the longest toe just behind the red line. While maintaining a single-leg stance, the player was instructed to reach with the free limb in the anterior direction, followed by posteromedial direction and then posterolateral direction with three trials each, all named in relation to the stance foot, per YBT-Lower Quadrant protocol. Reliability of the test is 0.88-0.99.

Illinois Agility test [21]

Procedure: IAT *measures the ability to change position and direction*. The player starts by lying flat facing Cone 1 and have to run to Cone 2 which is placed 10m apart and then he runs 10 m to Cone 3. Further, he has to weave around cones 3, 4, 5, 6 and back 3.3m apart and run to cone 710 m apart and the finish point-Cone 8. Reliability of this test is 0.85-0.98.

Statistical Analysis

- Between the groups, an unpaired t-test is used.
- Within the group, a paired t-test is used.

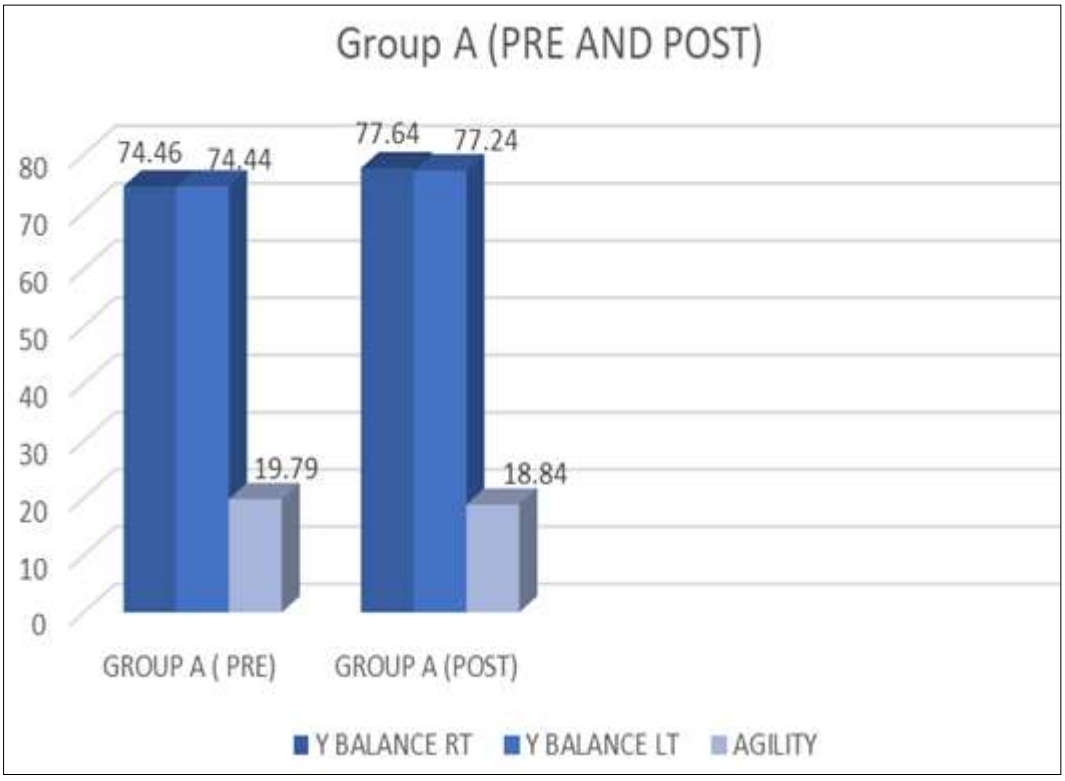
All statistical analysis will be performed by using IBM SPSS Version 29.0.0 (Armonk, NY: IBM Corp).

Results

Table 1: Within-group analysis for Group A on Y balance test and Illinois agility test

Outcomes	Pre Mean ± SD	Post Mean ± SD	T Value	P Value
Y Balance Right	74.4680±12.0574	77.6400±12.5787	7.5495	0.0016
Y Balance Left	74.4440±12.4527	77.2400±12.6247	0.0394	0.0394
IAT	19.790±1.6283	18.840±1.6683	1.9548	0.1223

Table 1: As shown in Table 1, Mean ± SD were 74.4680±12.0574 and 77.6400±12.5787 respectively for Y Balance test (Right) whereas, Mean ± SD for the Y balance test (left) were 74.4440±12.4527 and 77.2400±12.6247 respectively. The t-value for the Y Balance test (Right) is 7.5495 and the t-value for the Y balance test (left) is 0.0394. Mean ± SD for the Illinois agility test were 19.790±1.6283 and 18.840±1.6683 respectively. The t value is 1.9548.



Graph 1: Within-group analysis for Group A on Y balance test and Illinois agility test

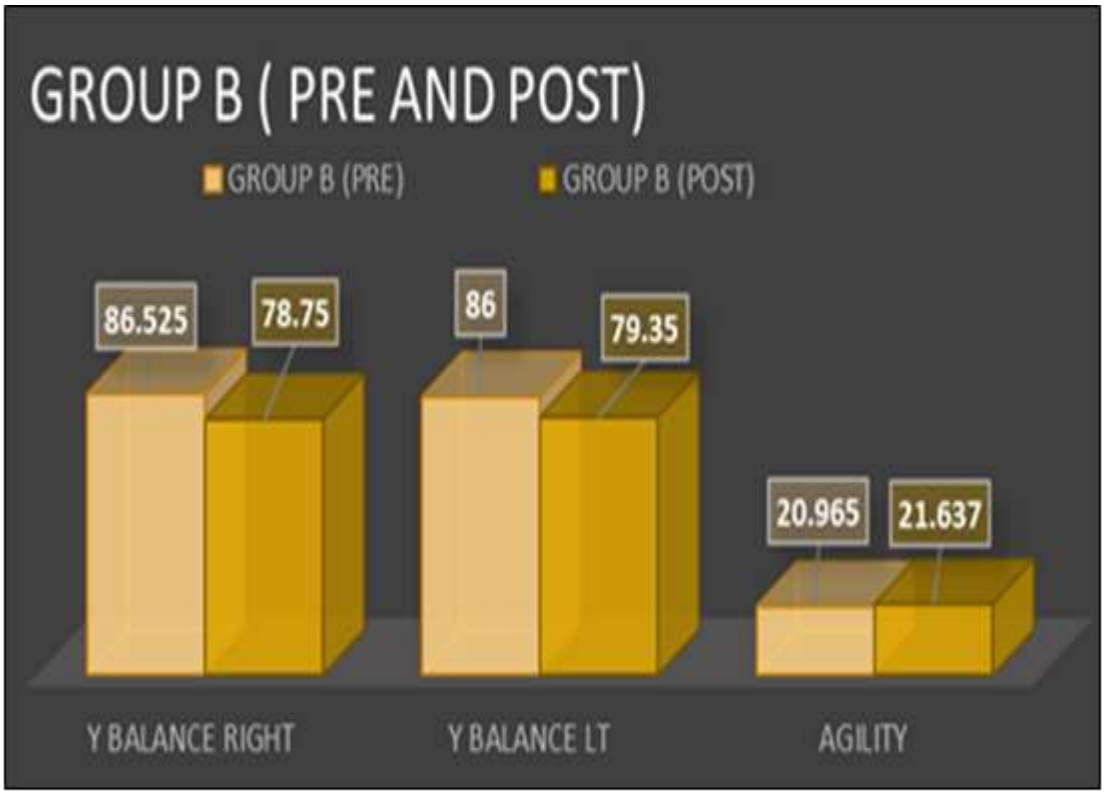
Table 2: Within-group analysis for Group B on Y balance test and Illinois agility test

Outcomes	Pre Mean ± SD	Post Mean ± SD	T Value	P Value
Y Balance Right	86.5250±18.0450	78.7500±19.3036	5.7147	0.0106
Y Balance Left	85.6000±14.8654	79.3500±15.3300	1.9934	0.1402
IAT	20.9650±1.3231	21.6375±1.3422	2.7351	0.0716

As shown in the table 2, Mean ± SD for Y Balance test (Right) were 86.5250±18.0450 and 78.7500±19.3036 respectively. Whereas, Mean ± SD for Y balance test (left) were 85.6000±14.8654 and 79.3500±15.3300 respectively. The t-value for Y Balance test (Right) is 5.7147 and t-value for Y balance test (left) is 1.9934.
Mean ± SD for Illinois agility test were 20.9650±1.3231 and 21.6375±1.3422 respectively. The t value is 2.7351.

Table 3: Between-group analysis on Y Balance and Illinois Agility Test

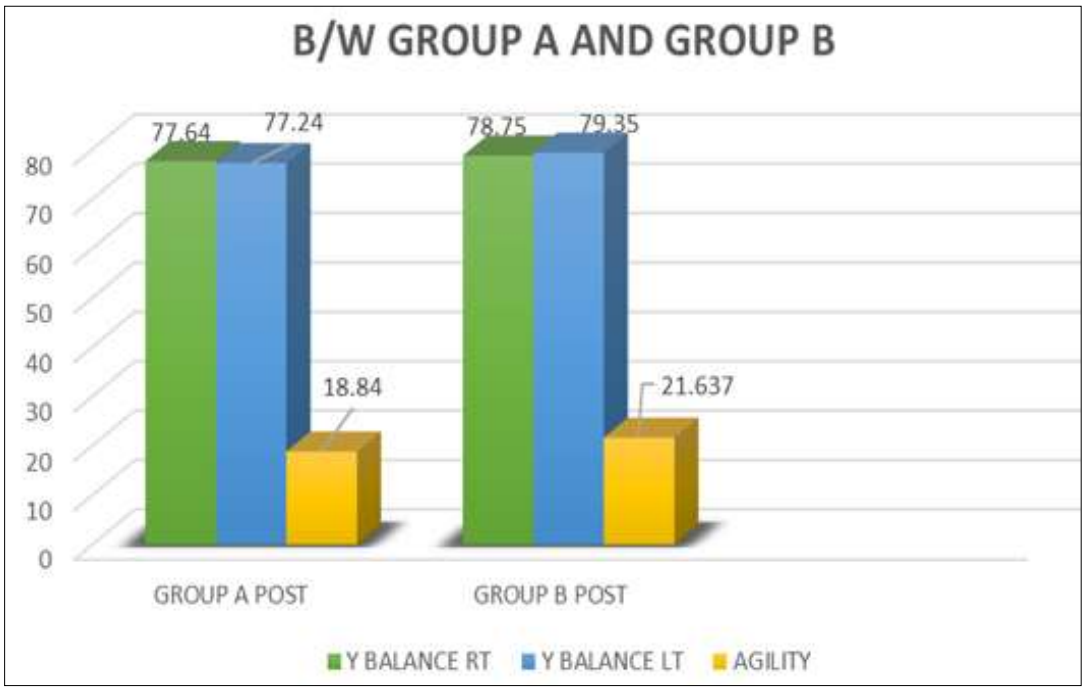
Outcomes	Group a (intervention) Mean ± SD	Group b (conservative) Mean ± SD	T Value	P Value
Y Balance Right	77.640000±12.578700	78.750000±19.303600	0.1046	0.9196
Y Balance Left	77.240000±12.624700	79.350000±15.330000	0.2271	0.8268
IAT	18.840±1.6683	21.637±1.342	2.7132	0.0301



Graph 2: Within group analysis for Group B on Y balance test and Illinois agility test

As shown in the table 3, the Mean ± SD of Y Balance test (Right) of Group A (Intervention) were 77.640000± 12.578700 and Group B (Control) 78.750000± 19.303600 respectively and Mean ± SD of Y balance test (left) was of Group A were 77.240000± 12.624700 and Group B 79.350000±15.330000 respectively. The t value of Y balance Right and Left is 0.1046 and 0.2271 respectively.

Mean ± SD of Illinois Agility test Group A were 18.840± 1.6683 and Group B was 21.637±1.342 respectively. The t value is 2.7132.



Graph 3: Between group analysis on Y Balance and Illinois Agility Test

Discussion

The aim of the study was to determine the effect of footwork exercises on agility and balance among badminton players. The results indicate that the execution of footwork exercises seems effective in improving agility and balance among badminton players, with a significant increase in balance and agility in the 4-week intervention period in the intervention group (Group A). As shown in Table 1, Mean ± SD for Group A (Experimental) for Illinois agility test were 19.790±1.6283 and 18.840±1.6683 respectively which shows improvement in agility performance. While Control Group B shows no significant difference in agility performance as shown in

Table 2. Mean ± SD for the Illinois agility test were 20.9650± 1.3231 and 21.6375±1.3422 respectively. Also, the experimental Group A showed a significant difference in agility in Illinois agility as compared to the Control group B as shown in table 3. Mean ± SD of Illinois Agility test Group A were 18.840±1.6683 and Group B were 21.637±1.342 respectively. These findings stand by several such studies, which have suggested that footwork exercises can boost their agility and balance as they increase the neural connections with foot movements which imitate the on-field quick decision-making to hit the shuttle effectively to their opponent [22].

The values of study revealed is supported by Gusliandi, F & Ramadi et al. [5] where they found that footwork exercises had enhanced the agility among the badminton players after 16 weeks of training 3 times a week on one group pre-test post-test design. Similarly, Chandrakumar, N & Ramesh [23], found that on 8 weeks of training thrice in a week with ladder drills given in one group and Speed agility quickness (SAQ) training in another among sports club badminton players had shown an improvement on speed and agility where ladder drills showed better results on agility and SAQ training had better outcomes on speed. Whereas, these results are in accordance with Dr. Sethu [24] who found that plyometrics and ladder training gave similar improvement on speed, power and agility among the footballers after an 8-week intervention but the ladder training gave much better results on agility on comparing the two training methods on parameters like sprinting speed, Vertical explosive power and agility among the male football players. These findings are in line with M. Srinivasan, Sathishkumar [25] where they found significant improvement in agility and on vertical jump test on 6 weeks of training period conducted thrice a week among the volleyball players on fitness variables like agility and explosive power. Likewise, Nawan Primasoni, Donny Mahendra Prakosa, *et al.* [26] established that both shuttle run and three-corner drill show a significant effect on agility. However, the shuttle run has shown better improvement than the three corner drills among the soccer players on training for 3 days in a week for 16 times.

On the contrary, Roopchand-Martin S, Chong RA, Facey A et al. [27], found that both the groups of video game dance group and the ladder drills group had significant improvement on agility however, the video game dance group showed better results as compared to the ladder drill group on 6 weeks of intervention carried out thrice in a week among the volleyball players.

The data of this study also indicated that on 4 weeks of intervention thrice a week the footwork exercises helped in improving the balance among the experimental group on assessing with the Y balance test as shown in Table 1. Mean ± SD were 74.4680±12.0574 and 77.6400±12.5787 respectively for Y Balance test (Right) Whereas, Mean ± SD for Y balance test (left) were 74.4440±12.4527 and 77.2400±12.6247 respectively. Whereas, the control group B shows not much of a significant difference on assessing with the Y balance test as shown in Table 2. Mean ± SD for Y Balance test (Right) were 86.5250±18.0450 and 78.7500±19.3036 respectively. Whereas, Mean ± SD for Y balance test (left) were 85.6000± 14.8654 and 79.3500±15.3300 respectively. There was no significant difference where the values were more or less equal on Y balance test between the experimental group and the control group as shown in Table 3. Mean ± SD of Y Balance test (Right) of Group A (Intervention) were 77.640000±12.578700 and Group B (Control) 78.750000± 19.303600 respectively and Mean ± SD of Y balance test (left) of Group A were 77.240000±12.624700 and Group B 79.350000±15.330000 respectively. These outcomes are supported by Heng Choon Meng, Jeffrey Low Fook Lee [28], who found that after 4 weeks of intervention administered thrice a week the dynamic balance among the children had improved and also on conducting a retention test the experimental group had better results on dynamic balance compared to the control group. The findings are in accordance with Ng RSK, Cheung CW, and Raymond KWS [29], where they administered agility ladder drills for 6 weeks for 3 days a week in the experimental group and the control group continued their routine exercises and concluded that the dynamic balance was enhanced significantly among the school boys. Furthermore, the statistics are in line with Restu Wahyuni, Yudik Prasetyo, *et al.* [30], who they concluded that drill training had improvement in enhancing the balance among the badminton athletes on 4 weeks of training for 3 days in a week by one group pre-test-post-test design. Similarly, this study is also supported by Yüksel MF, Aydos Latif [31], who concluded that shadow training has shown better results on balance and other parameters like flexibility, sprinting speed, explosive power and anaerobic power as compared to classical badminton training where 2 days shadow training and other 2 days classical badminton training per week for 12 weeks were administered.

Conclusion

The present study concludes that footwork exercises show a significant effect on both agility as well as balance in the intervention group (Group A) among badminton players of Vadodara on administering the Illinois agility test and Y Balance test respectively as compared to the control group (Group B).

Clinical implication

On the basis of the findings of the present study footwork exercises can be a major part of the routine exercises among the badminton players for enhanced performance and reduction of injuries in order to enhance their agility and dynamic balance.

Limitations

Small sample size, Unequal ratio of Male and Female participants.

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