P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (RJIF): 5.93
IJPESH 2025; 12(4): 415-420

https://www.kheljournal.com
Received: 25-06-2025
Accepted: 26-07-2025

Shivani Borse
Intern, Department of sports Physiotherapy, Dr. APJ Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences (Deemed to be University), Loni, Ahmednagar, Maharashtra, India

Pradeep Borkar
HOD & Professor, Department of sports Physiotherapy, Dr. APJ Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences (Deemed to be University), Loni, Ahmednagar, Maharashtra, India

Corresponding Author:
Shivani Borse
Intern, Department of sports Physiotherapy, Dr. APJ Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences (Deemed to be University), Loni, Ahmednagar, Maharashtra, India

Effect of multi-ball training on dynamic postural control and reaction time in table tennis players: A randomized control trial

Shivani Borse and Pradeep Borkar

Abstract
Background: The indoor game of table tennis, which has its roots in classic tennis, requires extraordinary ability, strategy, and quick movement. For successful strokes, players rely on rapid spatial movements, including as accelerating, decelerating, changing direction, and keeping balance. and Balance training enhances body awareness, strengthens the core, and lowers the chance of injury, especially when done on uneven surfaces. A modern table tennis strategy used by national teams, multi-ball training involves continuously delivering balls at varying speeds to improve players' coordination, response time, postural stability.
Aim: find out the Effects of multi- ball training on dynamic postural control and reaction time in table tennis players accuracy. Compared to single-ball practice, multi-ball training increases efficiency and intensity.
Objective: effect of multi ball training on dynamic postural control by Y- Balance test lower extremity in table tennis players.
Methodology: Participants were randomly divided into two groups, in which Group A (n=20) were given control group and Group B (n=20) experimental group for the duration of 4-weeks. The outcome measure was Y- balance test and Ruler drop test.
Result: Only the left-side Y-Balance Test for the experimental group showed a significant improvement
Conclusion: Short time Multi ball training is an effective improve to regular practice since it assists amateur table tennis players and improve their balance.

Keywords: Multi ball training, warm-up training, table tennis players, balance, Y-balance test, ruler drop test

Introduction
The modern game of table tennis evolved from the original racquet sport, tennis, which is played indoors and demands high levels of skill, strategy, and complex spatial movements including acceleration, deceleration, direction changes, quick footwork, and balance control. Historically, tennis has roots tracing back to ancient Egypt, with documented rules and court dimensions first appearing in 11th century France. Over centuries, changes in racket design were minimal, with head shape being the primary modification.
Tennis is one of the world's most popular sports, with around 75 million active players[1]. Injury rates range from 0.04–3.0 per 1000 playing hours, with most injuries being overuse-related (61–80%) such as knee, elbow, or shoulder tendinopathies rather than acute injuries. Repetitive mechanical overload, particularly in the shoulder, contributes to high injury prevalence (shoulder pain reported in 24% of players). Past injuries significantly increase long-term risks such as knee osteoarthritis, with lateral ankle sprains and chronic ankle instability also being common among athletes.
Balance is a critical factor in injury prevention, relying on proprioceptive, visual, and vestibular inputs to the CNS for neuromuscular control. Disturbances in these systems impair postural control, elevating injury risk. Consequently, balance training often incorporating resistance and unstable surfaces has been integrated into athletic conditioning to improve performance and injury resilience, especially in open-skill sports like tennis.
In table tennis, multi-ball training has emerged as a highly effective method for enhancing technical, tactical, and physical skills. Originating from the Chinese school, this method uses

high-density, varied ball feeds (50–100 balls per set) to simulate diverse game situations. Compared to single-ball training, multi-ball training offers greater intensity and repetition, improving movement efficiency, reaction time, multi-limb coordination, and fine motor skills. It compensates for limitations in traditional drills by varying spin, speed, placement, and trajectory, thereby accelerating skill acquisition and physical conditioning.

However, limited research exists on how neuromuscular fatigue influences dynamic postural control during multi-ball training. Understanding this relationship can help coaches and athletes design optimal pacing strategies to maximize performance while minimizing injury risk.

Methodology

The study was carried out in the Pravara Institute of Medical Sciences' Sports Physiotherapy Department between August 2024 and June 2025. The eligibility criteria were used to evaluate potential participants. Before having baseline evaluation, eligible participants who were interested to participate in the study had to provide their informed consent after receiving written and verbal information about it. Demographic information and a baseline evaluation of the study outcome measures were documented prior to the intervention period. The intention-to-treat method was used to examine the data.

Result: Awaited and will be produced at the time of presentation.

Conclusion: Awaited and will be produced at the time of presentation.

Participants

Participants included

- Amateur table tennis players.
- Both male and females.
- Age group 18 to 35years.
- Participants who are willing to participate.
- Participants fulfilling PAR Q+

Participants were excluded if

- Any type of acute and severe systemic illness.
- Any recent surgical and medical history which will affect performance.
- Psychologically unstable participants.

Study setting

The study was conducted at the Department of Sports Physiotherapy, Dr. A.P.J Abdul Kalam College of Physiotherapy, Loni.

Study duration: August 2024 to August 2025

_____.

Sample size calculation

Open Epi software was used to determine the sample size, which had a 95% confidence interval and an 80% power. Based on the previously mentioned hypotheses, 40 individuals were required for the investigation. In light of the 10% attrition rate, extra samples were filtered out.

Outcome measures

The participants' dynamic balance and reaction time was measured using the Y-balance test (r=0.85) and ruler drop test(r=0.8) respectively.

Procedure

Before commencement, this study was approved by the Ethical Committee of Dr. APJ Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences, Loni. A total of 52 participants were screened based on the inclusion and exclusion criteria, and 40 participants were selected for the study. Informed written consent was explained, signed, and obtained from the participants regarding the procedure before the study. Baseline measurements of dynamic balance and reaction time of the participants were done before the treatment. Multiball training was performed for 30-40 min., followed by Cool down. Post-intervention assessment of both outcome measures done along with data analysis

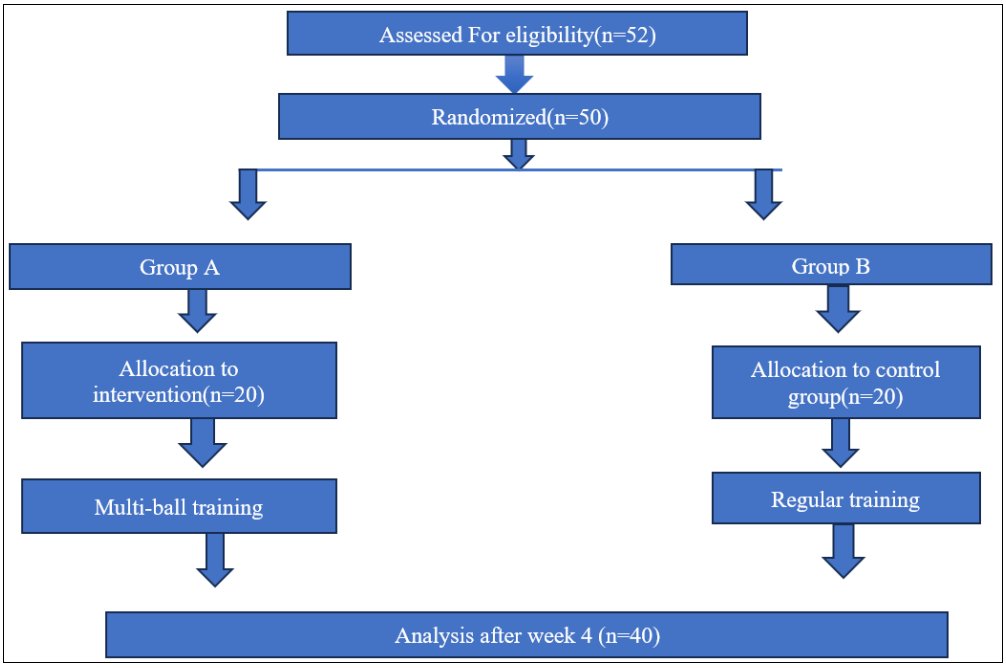

Fig 1: Consort diagram

Table 1: Experimental group exercises

Type	Training	Duration
Warm-up	Arm curls Sustained wrist flexion and extension B/L knee to chest and single knee to chest	10 reps x 2 sets
Intervention	1. Forehand counter 2. Backhand counter 3. Cross backhand counter 4. Squat jump 5. Sit ups 6. Push up	10-15min
Cool-down	Deep breathing exercises, Whole body vibration platform for 2 mins	5-10min

Data analysis and results

The Statistical Analysis will be done by descriptive statistics as mean, SD, percentage and proportions, etc. Student's paired and unpaired t test will be applied to find out any difference between two means for quantitative data at 5% and 1% level of significance. Chi-Square test will be applied to find out association between two qualitative variables at 5% and 1% level of significance.

Table 2: Comparison of various parameters at Post assessment in Group A and Group B

	Post assessment group A	Post assessment group B	Student's Unpaired 't' test value	'p' value and significance
Y balance test right side				
Anterior	58.26±7.29	58.13±8.48	0.5241	p=0.1547, not significant
Posteromedial	58.96±7.06	58.65±10.43	0.2214	p=0.1526 not significant
Posterolateral	59.82±8.17	59.08±8.92	0.1014	p=0.1102, not significant
Composite score	58.93±7.70	59.12±8.55	0.5746	p=0.1090, not significant
Y balance test left side				
Anterior	59.37±7.75	53.27±7.54	2.8549	p=0.0014, significant
Posteromedial	60.09±7.68	54.36±8.08	3.2265	p=0.0076, significant
Posterolateral	60.92±8.30	55.89±7.88	2.3311	p=0.0012, significant
Composite score	60.08±7.87	55.36±8.12	2.9874	p=0.0019, significant

From the above table, by applying Student's Unpaired 't' test there is no significant difference seen in the mean values of Y balance test Right side at Post assessment in Group A (Experimental) and in Group B (Control).

And by applying Student's Unpaired 't' test there is a significant difference seen in the mean values of Y balance test Left side at Post assessment in Group A (Experimental) and in Group B (Control).

Table 3: Comparison of reaction time at post assessment in group A and in group B

Reaction time [ruler drop test]	Group A (Experimental) Post assessment	Group B (control) Post assessment	Student's Unpaired 't' test value	'p' value and significance
	Mean ± SD	Mean ± SD		
Distance	10.95±3.03	10.195±2.37	0.9847	p=0.1013, not significant
Reaction time (in Sec.)	0.144±0.04	0.1415±0.017	0.1236	p=0.1001, not significant

From the above table, by applying Student's Unpaired 't' test there is no significant difference seen in the mean values of Reaction time [Ruler drop test] Distance and reaction time at Post assessment in Group A (Experimental) and in Group B (Control).

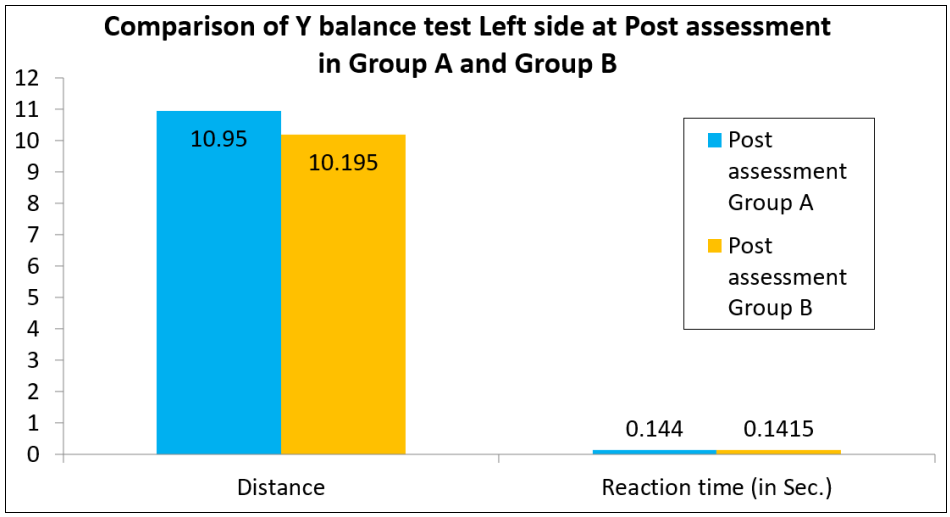

Fig 2: Comparison of Y balance test left side at post assessment in group A and group B

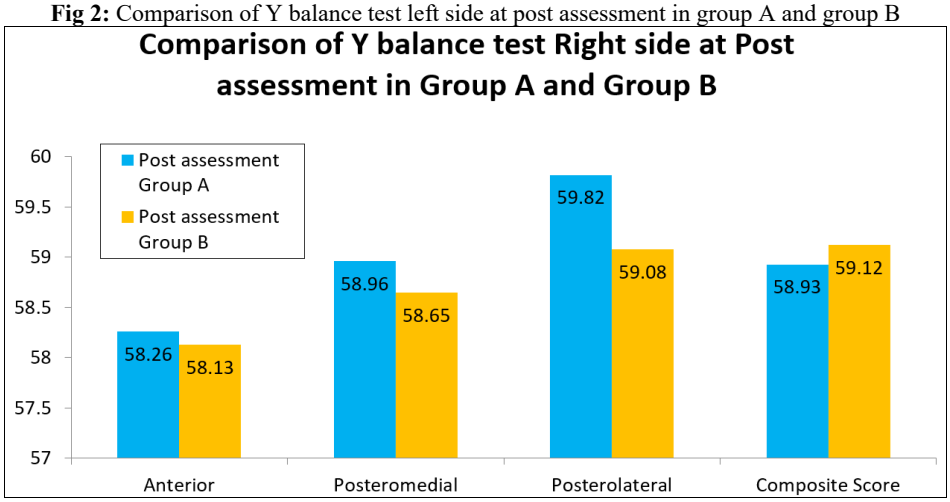

Fig 3: Comparison of Y balance test right side at post assessment in group A and group B

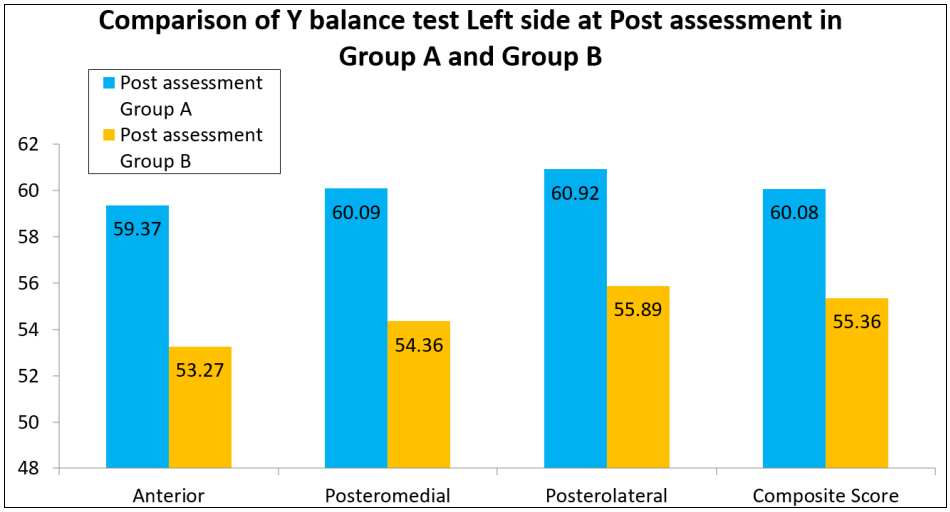

Fig 4: Comparison of Y balance test left side at post assessment in group A and group B

Interpretation

Group A

Experimental group

1) Warm-up (5–7 minutes) focuses on activating the muscles, especially arms, wrists, and lower limbs, while improving joint mobility and blood circulation before intense activity.
2) Multi-ball training (10–15 minutes) involves a combination of technical drills (forehand, backhand, cross-backhand counters) and physical conditioning exercises (squat jumps, sit-ups, push-ups) to improve stroke technique, reaction speed, agility, strength, and endurance.
3) Cool-down (5–7 minutes) uses deep breathing to relax and recover the body and whole-body vibration to aid muscle relaxation and reduce post-training soreness.

Group B

Control group

1) Warm-up (5–7 minutes)

Arm curls, sustained wrist flexion/extension, and bilateral/single knee-to-chest stretches activate the muscles

and joints, increase blood flow, improve flexibility, and reduce the risk of injury.

2) Main Workout (10–15 minutes)
Squat jumps, sit-ups, and push-ups target major muscle groups of the upper body, lower body, and core building strength, endurance, explosive power, and core stability.

3) Cool-down (5–7 minutes)
Deep breathing and use of a whole-body vibration platform help gradually return the heart rate to normal, relax muscles, promote circulation, and support faster recovery.

Discussion

The present study investigated the effect of a three-week multiball training program on balance and reaction time in amateur table tennis players. The experimental group showed significant improvement in the non-dominant (Left) limb on the Y-Balance Test in anterior, posteromedial, and posterolateral directions ($p<0.05$), whereas the dominant (Right) limb showed no significant changes. No significant improvement was observed in reaction time within or between groups, and no gender-based differences were found.

Multiball training, being a high-repetition, sport-specific task, demands rapid body position changes, dynamic weight shifting, and continuous lower-limb adjustments. These factors enhance neuromuscular control and proprioceptive efficiency. The greater improvement in the non-dominant limb may be due to its lower baseline usage in play and daily activities, making it more adaptable to neuromuscular training. This finding aligns with previous research showing under-utilized limbs respond more strongly to proprioceptive and perturbation-based training. Sport-specific training that mimics competition demands, as emphasized by Paillard and Noé, is particularly effective in improving balance through stimulation of proprioceptive, vestibular, and visual systems.

Reaction time did not improve significantly, likely due to the short intervention duration and the non-sport-specific nature of the ruler drop test. Table tennis reaction time involves complex anticipatory processing, spatial positioning, and decision-making, which are not fully captured by simple visual-motor tasks. Previous studies suggest longer training periods (≥6 weeks) or cognitively demanding, sport-specific drills are needed for measurable improvements.

The control group, performing only routine drills, showed no significant changes, highlighting the need for targeted, progressive, and unstable training stimuli to elicit neuromuscular adaptations. Minor non-significant gains in the control group may be attributed to test familiarity or placebo effects, but overall, results reinforce the effectiveness of multiball training as a simple, safe, and accessible method to improve dynamic balance in table tennis players.

Conclusion

short-duration Multiball Training appears to be an effective method for improving dynamic balance in amateur table tennis players. Incorporating such training into regular routines may offer significant benefits in performance. These findings support the inclusion of Multiball Training as an effective balance-enhancing strategy for amateur Table tennis layers.

Clinical implications

Multiball training is a simple, low-cost, and easily implemented method that can be integrated into regular training to enhance dynamic postural control, reaction time, and overall performance in table tennis players.

Limitations of the study

- **Sample homogeneity:** The study focuses on a specific demographic college students which may limit the generalization of the findings to other age groups or populations.
- **Lack of longitudinal data:** Without longitudinal tracking, it's difficult to determine the long-term effects of e-gaming on health, including whether certain conditions improve or worsen over time.
- **Potential confounding variables:** Factors such as participants' prior health conditions, physical activity levels, and ergonomic gaming setups were not controlled for, which could influence the results.
- **Sample population:** the study was conducted on amateur table tennis players, so the results may not be generalization to professional athletes.

Future scope

- Future research can assess the direct impact of multiball training on table tennis performance indicators like rally duration, error rate, or win percentage.
- Conducting the study on a larger, more diverse population including athletes from different skill levels and age groups can help improve the generalizability of results.
- Integration of EMG or motion capture analysis can provide a deeper understanding of the neuromuscular mechanisms underlying the observed improvements.

Funding: This study was not funded.

Conflict of interest: There is no conflict of interest between the authors.

References

1. Hjelm N, Werner S, Renström P. Injury risk factors in junior tennis players: a prospective 2-year study. Scand J Med Sci Sports. 2012 Feb;22(1):40-48.
2. Saleh SF. Effects of training with multi-balls on some visual abilities and counter-attack skills of junior table tennis players. J Appl Sports Sci. 2015 Jun 1;5(2):170-180.
3. Jumarsa AH, Marnita S. The effect of multiball training method against backhand drive stroke accuracy in table tennis. In: 1st Progress in Social Science, Humanities and Education Research Symposium (PSSHERS 2019); 2020 Aug 25; Atlantis Press. p. 806-8.
4. Gu Y, Yu C, Shao S, Baker JS. Effects of table tennis multi-ball training on dynamic posture control. PeerJ. 2018;6:e6262.
5. Humphrey JA, Humphrey PP, Greenwood AS, Anderson JL, Markus HS, Aljunied A. Musculoskeletal injuries in real tennis. Open Access J Sports Med. 2019 May 23;10:81-86.
6. Gu Y, Yu C, Shao S, Baker JS. Effects of table tennis multi-ball training on dynamic posture control. PeerJ. 2018;6:e6262.
7. Hynes S. Keeley Rules or How to Play Tennis on Social Security. Sewanee Rev. 2013;121(2):280-286.
8. Pas HI, Pluim BM, Kilic O, Verhagen E, Gouttebarge V, Holman R, *et al*. Effectiveness of an e-health tennis-specific injury prevention programme: randomised

controlled trial in adult recreational tennis players. Br J Sports Med. 2020 Sep 1;54(17):1036-1041.
9. Keelins A, Nikolaidis PT, Moore IS, Rosemann T, Knechtges B. Risk factors for upper limb injury in tennis players: a systematic review. Int J Environ Res Public Health. 2020 Apr 16;17(8):2744. DOI:10.3390/ijerph17082744. PMID: 32316156; PMCID: PMC7215945.
10. Sannicandro I, Cubano G, Rosa RA, Piccinni A. Balance training exercises decrease lower-limb strength asymmetry in young tennis players. J Sports Sci Med. 2014 May 1;13(2):397-402. PMID: 24790496; PMCID: PMC3990896.
11. Steib S, Zech A, Hentschke C, Pfeifer K. Fatigue-induced alterations of static and dynamic postural control in athletes with a history of ankle sprain. J Athl Train. 2013 Mar 1;48(2):203-208.
12. Abutaleb EE, Mohamed AH. Effect of induced fatigue on dynamic postural balance in healthy young adults. Bull Fac Phys Ther. 2015 Dec 20;20(2):161-167.
13. Gribble PA, Hertel J, Renegar CR, Buckley WE. The effects of fatigue and chronic ankle instability on dynamic postural control. J Athl Train. 2004 Oct;39(4):321-329.
14. Giampaolo F, Levey J. Championship tennis. Champaign (IL): Human Kinetics; 2013 Mar 21.
15. Halim V, Putera HD. The most common injuries in tennis players and prevention strategies: a literature review. Orthop J Sports Med. 2023 Feb 1;11(2 Suppl).
16. Buckley TA, Oldham JR, Watson DJ, Murray NG, Mukasey BA, Evans KM. Repetitive head impacts in football do not impair dynamic postural control. Med Sci Sports Exerc. 2019 Jan;51(1):132-140.
17. Rodica T, Nurmi E. The effects of leg muscle strength exercises on students' front kick abilities in Pencak Silat extracurricular activities at KH. Ahmad Dahlan Islamic Boarding School Taluk Kuantan. In: 1st Progress in Social Science, Humanities and Education Research Symposium (PSSHERS 2019); Atlantis Press; c2020, p. 887-890.
18. Zech A, Steib S, Hentschke C, Eckhardt H, Pfeifer K. Effects of localized and general fatigue on static and dynamic postural control in male team handball athletes. J Strength Cond Res. 2012 Apr 1;26(4):1162-1168.
19. Zech A, Steib S, Hentschke C, Eckhardt H, Pfeifer K. Effects of localized and general fatigue on static and dynamic postural control in male team handball athletes. J Strength Cond Res. 2012 Apr 1;26(4):1162-1168.
20. Seyed HH, Asghar NA. The role of leg and trunk muscles proprioception on static and dynamic postural control. Citius Altius Fortius. 2010;26(1):83-89.