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The effect of advanced thrower's ten exercise versus closed kinetic chain exercise along with conventional exercise on scapular stability and functional throwing performance among collegiate javelin throwers

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Abstract
Background: Scapular stability and optimal shoulder function are critical determinants of throwing performance and injury prevention in javelin throwers. Conventional exercise programs have been widely used to improve shoulder strength and function; however, targeted interventions such as Closed Kinetic Chain (CKC) exercises and advanced Thrower's Ten (TT) exercise protocols may offer added benefits by enhancing neuromuscular control and dynamic stability of the scapulothoracic and glenohumeral systems.
Objective: To compare the effects of Closed Kinetic Chain exercises combined with a conventional exercise versus advanced Thrower's Ten exercises combined with conventional exercise on scapular stability and functional throwing performance in collegiate young javelin throwers.
Methods: Forty male collegiate javelin throwers aged 18–22 years were randomly allocated into two intervention groups. Group A received a CKC exercise program integrated with conventional conditioning, while Group B performed advanced Thrower's Ten exercises alongside the same conventional exercise protocol. Interventions were conducted over an 8-week period, with sessions held 4 times per week. Outcome measures included functional throwing performance index and modified lateral scapular slide test. Pre- and post-intervention assessments were performed.
Results: Both intervention groups demonstrated significant improvements in scapular stability and functional throwing performance after the 8-week training period ($p < 0.05$). Group B (advanced Thrower's Ten + conventional exercise) showed greater enhancements in dynamic scapular control and throwing distance compared to Group A (CKC + conventional exercise) ($p < 0.05$). Additionally, the Thrower's Ten group exhibited superior gains in rotator cuff endurance and proprioceptive function.
Conclusion: Incorporating advanced Thrower's Ten exercises alongside conventional training appears to produce more pronounced improvements in scapular stability and functional throwing performance in young collegiate javelin throwers than Closed Kinetic Chain exercises combined with conventional exercise. These findings support the use of sport-specific, multi-planar strengthening protocols in the conditioning programs of overhead athletes to optimize performance and reduce injury risk.

Keywords: Scapular stability, javelin throwers, closed kinetic chain exercise, Thrower's Ten exercise, functional performance, collegiate athletes

Introduction
The javelin throw is a highly technical track and field event that requires explosive strength, biomechanical efficiency, coordination, and precise timing. Effective throwing involves a sequential transfer of energy from the lower limbs through the pelvis, trunk, shoulder complex, arm, and hand. This proximal-to-distal kinetic chain enables athletes to maximize javelin velocity while maintaining accuracy and control during release.
Young javelin throwers are vulnerable to scapular dysfunction due to repetitive overhead movements, inadequate conditioning, and improper training progression. Fatigue or weakness of scapular stabilizers, particularly the serratus anterior and lower trapezius, may impair scapulohumeral rhythm, force transfer, and deceleration during throwing.
Therefore, targeted scapular stabilization exercises are important for improving neuromuscular control, enhancing performance, and preventing injuries. Exercise approaches such as Advanced Thrower's Ten and closed kinetic chain training program are commonly used to improve shoulder stability, proprioception, strength, and endurance in overhead athletes.
The Advanced Thrower's Ten program combines scapular strengthening, rotator cuff conditioning, core stability, and sport-specific movements to optimize kinetic chain efficiency and throwing mechanics. Closed kinetic chain exercises improve shoulder stability by promoting muscle

co-contraction, proprioceptive feedback, and joint control, while unstable surfaces may further enhance neuromuscular adaptations. Conventional functional exercises also support improvements in scapular alignment, flexibility, strength, and coordination.
Scapular function can be assessed using the Lateral Scapular Slide Test, while throwing performance can be evaluated through the Functional Throwing Performance Index, which measures throwing accuracy and functional efficiency.

Objectives of the study

- To evaluate the effect of Advanced Thrower's ten exercises on scapular stability among collegiate javelin throwers.
- To evaluate the effect of Closed Kinetic Chain exercises on scapular stability among collegiate javelin throwers.
- To evaluate the effect of Advanced Thrower's ten exercises on functional throwing performance among collegiate javelin throwers.
- To evaluate the effect of Closed Kinetic Chain exercises on functional throwing performance among collegiate javelin throwers.
- To compare the effect of advanced thrower's ten exercise verses closed kinetic chain exercise on scapular stability and functional throwing performance among collegiate javelin throwers.

Methodology

Study Design

Pre-test and Post-test Experimental study design.

Study setting

The study was conducted Outpatient department in KG College of physiotherapy and KG Sports ground, Saravanampatti, Coimbatore.

Study duration

The study was conducted over a period of 6 months. The duration of training was 6 weeks. The frequency of the training is 5 times a week and each training was a period of 60 minutes.

Study sample & subject

40 male collegiate javelin throwers were included based on the inclusion and exclusion criteria.

Sampling method

All 40 subjects who satisfied inclusion and exclusion criteria were randomly selected and assigned equally into two groups. Group A (n=20) and Group B (n=20) by using simple random sampling method.

Inclusion criteria

The study included active male collegiate javelin players aged 18–23 years with more than one year of throwing experience. Participants had competed in at least 2–3 events, were not involved in any specific strength training programs, and were willing to participate voluntarily in the research.

Exclusion criteria

Participants were excluded if they had a history of musculoskeletal, cardiovascular, or neurological disorders, scapular dyskinesia, capsulitis, tendinitis, recent surgery, or upper limb fractures. Individuals unwilling to participate or those with irregular training schedules were also excluded from the study.

Variables

Independent variables

- Advanced throwers ten exercise.
- Closed kinetic chain exercise

Dependent variables

- Scapular stability.
- Functional throwing performance.

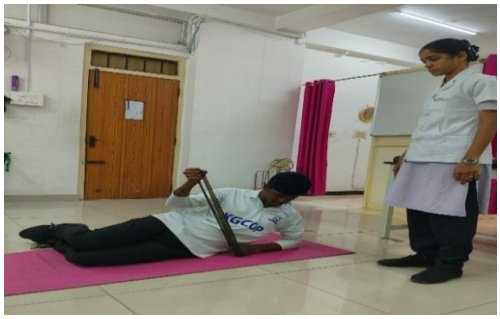
Outcome measures

- Modified lateral scapular slide test.
- Functional throwing performance index.

Procedure

Participants were informed about the study protocol, risks, and rights before providing written consent. Demographic details, injury history, and training status were collected through a questionnaire. Forty male collegiate javelin players underwent pre-test assessment of scapular stability and throwing performance using the Modified Lateral Scapular Slide Test and Functional Throwing Performance Index.
Forty eligible participants were randomly divided into Group A and B (n=20 each). Group A performed Advanced Thrower's Ten exercises (rotator cuff tubing, full can, rows, curls, triceps extension, wrist exercises, and lateral slides). GROUP B received closed kinetic chain exercises (one-leg stance, low row, scapular clock, wall washes, push-ups, and seated push-ups), Both groups followed 60-minute sessions including warm-up, conventional exercises, intervention, and cool-down.

Advanced throwers ten exercise



Side lying external rotation strengthening

Closed kinetic chain exercise

Push - UP

Conventional exercise

Hurdle step exercise

Table 1: Demographic data age group classification for group A & B

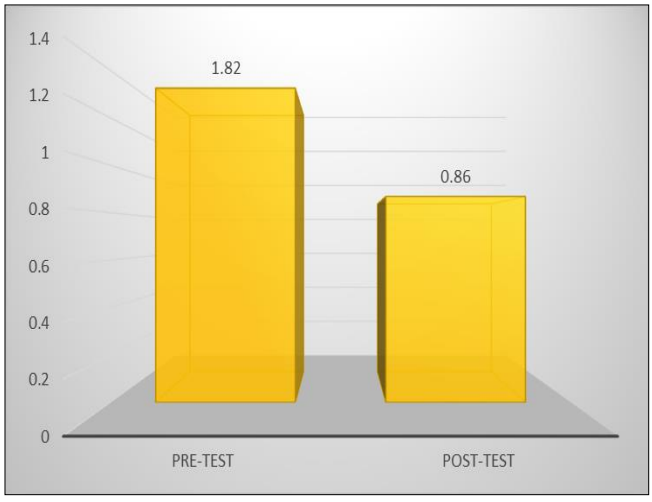
S.no	Age	Group a (n = 20)	Group b (n = 20)
1	18 - 20	15	16
2	21 - 23	5	4

Table 2: Comparison of post test values of modified lateral scapular test of group A & B

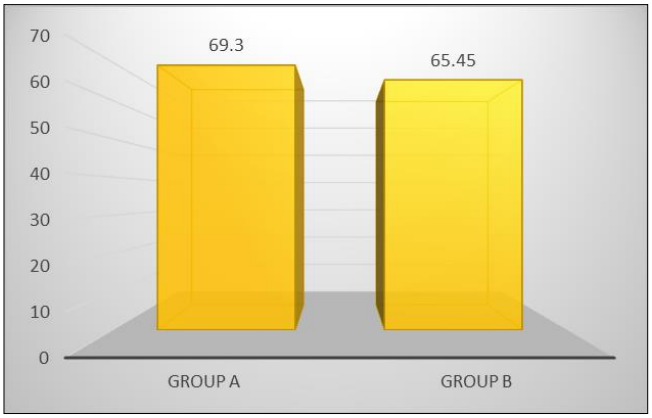
S.no	Dbp	Mean	Mean difference	Standard deviation	'T' value
1	Group a	1.825	0.3145	0.1702	7.1208
2	Group b	0.868		0.1002	

Table 3: Comparison of post test values of functional throwing performance index of group A & B

S.no	Dbp	Mean	Mean diference	Standard deviation	'T' Value
1	Group A	69.3	3.85	5.17	2.3372
2	Group B	65.45		5.25	



Graph I: Comparison of post – test values of modified lateral scapular slide test



Graph – II: Comparison post – test values of functional throwing performance index

Results

Tables I summarize the age characteristics of participants in Groups A and B. Within-group analysis using paired *t*-tests revealed statistically significant improvements in both the modified lateral scapular slide test (Group A: t=7.6006; Group B: t=8.2122) and the functional throwing performance index (Group A: t=34.1223; Group B: t=20.2921) following the intervention.

Between-group comparison using unpaired *t*-tests identified significant differences in post-intervention scores for the modified lateral scapular slide test (t=7.1208) and functional throwing performance index (t=2.3372). While both interventions were effective, the addition of the Advanced Thrower's Ten exercise program to conventional training produced superior gains in scapular stability and throwing performance, thereby supporting the study's alternative hypothesis.

Discussion

The present study compared the effects of Advanced Thrower's Ten (ATT) versus Closed Kinetic Chain (CKC) exercises, combined with conventional training, on scapular stability and functional throwing performance in collegiate javelin throwers. Although both interventions produced significant improvements, the ATT group achieved greater gains in scapular stability and throwing performance, suggesting superior effectiveness for overhead athletes.

The enhanced outcomes with ATT exercises may be attributed to their sport-specific design, incorporating progressive resistance, multiplanar movements, and eccentric muscle training. These adaptations improve rotator cuff and scapular stabilizer strength, endurance, neuromuscular control, and shoulder stability, particularly during the deceleration phase of throwing. CKC exercises likely improved performance by increasing proprioception, co-contraction of shoulder stabilizers, and dynamic scapular control through weight-bearing activities. Both programs may enhance kinetic chain efficiency and energy transfer during throwing; however, the greater benefits observed with ATT exercises indicate that their focus on overhead movement patterns provides a more effective approach for improving functional performance and reducing injury risk in collegiate javelin throwers.

Conclusion

This study compared the effects of Advanced Thrower's Ten (ATT) versus Closed Kinetic Chain (CKC) exercises, each combined with conventional training, on scapular stability and functional throwing ability in collegiate javelin throwers. Forty participants were randomly assigned to ATT or CKC groups, with outcomes assessed using the Functional Throwing Performance Index and the Modified Lateral Scapular Slide Test.

Both groups demonstrated significant post-intervention improvements. However, the ATT program produced greater gains in scapular stability, functional throwing performance, strength, and injury prevention than the CKC program, indicating that ATT exercises are a more effective training strategy for collegiate javelin throwers.

References

1. Mandal S, Ghosh S. The science behind the javelin throw: Insights from Olympic-level research and practice. International Journal of Current Science. 2025;15(4):412-423.
2. Bondarenko KK, Bondarenko AE, Borovaya VA, Primachenko PV, Shilko SV. Kinematic and dynamic parameters of final stage of javelin throwing. Russian Journal of Biomechanics. 2022;26(1):95-107.
3. Manske R, Ellenbecker T. Current concepts in shoulder examination of the overhead athlete. International Journal of Sports Physical Therapy. 2013;8(5):554-578.
4. Terry GC, Chopp TM. Functional anatomy of the shoulder. Journal of Athletic Training. 2000;35(3):248-255.
5. Ribeiro A, Pascoal AG. Resting scapular posture in healthy overhead throwing athletes. Manual Therapy. 2013;18(6):547-550.
6. De Mey K, Danneels L, Cagnie B, Borms D, T'Jonck Z, Van Damme E, *et al*. *Shoulder muscle* activation levels during four closed kinetic chain exercises with and without Redcord slings. The Journal of Strength & Conditioning Research. 2014;28(6):1626-1635.
7. Bera P, Bhura P, Bhura C, Shah SF. Effects of advanced throwers ten programme to measure strength, power and endurance in overhead athletes.
8. Moon SE, Kim YK. *Scapular dyskinesis* and lateral scapular slide tests to assess scapular dyskinesis with chronic neck pain in office workers.
9. Kazi E. Effect of thrower's ten exercise program on scapular dyskinesia and throwing accuracy in cricket bowlers. International Journal of Physiotherapy and Research. 2021;9(5):4008-4012.
10. Boudreau SL, Mattes LL, Lowenstein NA, Matzkin EG, Wilcox IIIRB. Customizing functional rehabilitation and return to sport in the female overhead athlete. Arthroscopy, Sports Medicine, and Rehabilitation. 2022;4(1):e271-e285.
11. Mappanyukki AA, Haeril H, Aksir MI. Training methods for javelin throwing skills: literature review. Competitor: Jurnal Pendidikan Kepelatihan Olahraga. 2025;17(1):242-247.
12. Kibler WB, Stone AV, Zacharias A, Grantham WJ, Sciascia AD. Management of scapular dyskinesis in overhead athletes. Operative Techniques in Sports Medicine. 2021;29(1):150797.
13. Ellenbecker TS, Aoki R. Step by step guide to understanding the kinetic chain concept in the overhead athlete. Current Reviews in Musculoskeletal Medicine. 2020;13(2):155-163.
14. Kawai K, Funasaki H. Effectiveness of rotator cuff exercises for throwing injuries of the shoulder: comparison between closed/open kinetic chains. Rigakuryoho Kagaku. 2022;37(5):511-515.
15. De Mey K, Danneels L, Cagnie B, Borms D, T'Jonck Z, Van Damme E, *et al*. *Shoulder muscle* activation levels during four closed kinetic chain exercises with and without Redcord slings. The Journal of Strength & Conditioning Research. 2014;28(6):1626-1635.
16. Wright AA, Ness BM, Donaldson M, Hegedus EJ, Salamh P, Cleland JA. Effectiveness of shoulder injury prevention programs in an overhead athletic population: a systematic review. Physical Therapy in Sport. 2021;52:189-193.
17. Henning L, Plummer H, Oliver GD. Comparison of scapular muscle activations during three overhead throwing exercises. International Journal of Sports Physical Therapy. 2016;11(1):108.
18. Patel P, Vaishnav J. Rehabilitative and preventive effects of the thrower's ten program in overhead athletes: a systematic review. Cureus. 2025;17(10).
19. Rahmanas RA, Jothilingam M, Sridhar S. Effects of 8-weeks throwers ten program vs plyometric training on shoulder performance in overhead athletes-a pilot study. Indian Journal of Physiotherapy & Occupational Therapy. 2025;19(4).
20. Shadmehr A, Azarsa MH, Jalaie S. Inter-and intrarater reliability of modified lateral scapular slide test in healthy athletic men. BioMed Research International. 2014;2014:384149.
21. Ozunlu N, Tekeli H, Baltaci G. Lateral scapular slide test and scapular mobility in volleyball players. Journal of Athletic Training. 2011;46(4):438-444.
22. Shadmehr A, Sarafraz H, Blooki MH, Jalaie SH, Morais N. Reliability, agreement, and diagnostic accuracy of the modified lateral scapular slide test. Manual Therapy. 2016;24:18-24.
23. Liu H, Leigh R, Yu B. Sequences of upper and lower extremity motions in javelin throwing. Journal of Sports Sciences. 2010;28(13):1459.
24. Reinold MM, Wilk KE, Andrews JR. Current concepts in the evaluation and treatment of the shoulder in overhead throwing athletes, part 2: injury prevention and treatment. Sports Health: A Multidisciplinary Approach. 2010;2(2):101.
25. Garrison CJ, Arnold A, Macko MJ, Conway JE. Baseball players diagnosed with ulnar collateral ligament tears demonstrate decreased balance compared to healthy controls. Journal of Orthopaedic & Sports Physical Therapy. 2013;43:752-758.
26. Cheatham SW, Shimamura K, Kolber MJ. Difference in hip range of motion among collegiate pitchers when compared to youth and professional baseball pitcher data. Journal of the Canadian Chiropractic Association. 2016;60(3):233-240.
27. Wilk KE, Yenchak AJ, Arrigo CA, Andrews JR. The advanced throwers ten exercise program: a new exercise series for enhanced dynamic shoulder control in the overhead throwing athlete. The Physician and Sportsmedicine. 2011;39(4):90-97.
28. Zaras N, Spengos K, Methenitis S, Papadopoulos C, Karampatsos G, Georgiadis G, *et al*. Effects of strength

vs. ballistic-power training on throwing performance. Journal of Sports Science & Medicine. 2013;12(1):130.
29. Kim PS, Mayhew JL, Peterson DF. A modified YMCA bench press test as a predictor of 1-repetition maximum bench press strength. Journal of Strength and Conditioning Research. 2002;16(3):440. doi:10.1519/1533-42872002016 21.
30. Harris C, Wattles AP, DeBeliso M, Sevene-Adams PG, Berning JM, Adams KJ. The seated medicine ball throw as a test of upper body power in older adults. Journal of Strength and Conditioning Research. 2011;25(8):2344-2348.
31. Noguchi M, Chopp JN, Borgs SP, Dickerson CR. Scapular orientation following repetitive prone rowing: implications for potential subacromial impingement mechanisms. Journal of Electromyography and Kinesiology. 2013;23(6):1356-1361.
32. Kowalski KL, Connelly DM, Jakobi JM, Sadi J. Shoulder electromyography activity during push up variations: a scoping review. Shoulder & Elbow. 2021;17585732211019373.
33. Aginsky KD, Lategan L, Stretch RA. Shoulder injuries in provincial male fast bowlers-predisposing factors. South African Journal of Sports Medicine. 2004;16(1):25-28.
34. Lin DJ, Wong TT, Kazam JK. Shoulder injuries in the overhead-throwing athlete: epidemiology, mechanisms of injury, and imaging findings. Radiology. 2018;286(2):370-387.
35. Escamilla RF, Hooks TR, Wilk KE. Optimal management of shoulder impingement syndrome. Open Access Journal of Sports Medicine. 2014;5:13-24.
36. Ehsani F, Taghizadeh DELKHOUSHC, Mirmohammadkhani M, Ehyaie H. A comparison of two exercise protocols in athletes with primary subacromial impingement syndrome: a randomized clinical trial. Journal of Sport Rehabilitation. 2024;33(1):1-11. doi:10.1123/jsr.2023-0332
37. Neumann DA. Kinesiology of the musculoskeletal system: foundations for rehabilitation. 3rd ed. St. Louis: Mosby/Elsevier;2017.
38. Ishii S, Palmer AK, Werner FW. An anatomic study of ligamentous structure of the triangular fibrocartilage complex. Journal of Hand Surgery American. 1998;23(6):977-985.
39. Sciascia A, Cromwell R. Kinetic chain rehabilitation: a theoretical framework. Rehabilitation Research and Practice. 2012;2012:853037.
40. Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology part I:pathoanatomy and biomechanics. Arthroscopy. 2003;19(4):404-420.
41. Al JUMAILYJG, Al-Mousawi SQ. The effect of exercises according to the ranges of arm movement and their effect on muscle strength, and some biomechanical variables, and javelin throwing achievement for young people. In: International Conference on Computing, Intelligence and Data Analytics. Cham: Springer Nature Switzerland;2024. 263-273.
42. Sarıca O, Gencer YG. The effect of resistance band exercises on the speed, agility, balance and strength required for hit shooting in mounted javelin athletes. International Journal of Sports Engineering and Biotechnology. 2024;2(1):27-34.
43. Andhare DN, Yeole U, Salvi MA. Effect of throwers ten program on performance in fast bowlers “randomized control trail”. Journal of Clinical and Medical Research. 2018;6:12.
44. Oyama S, Palmer TG. Effectiveness of core exercise training programs designed to enhance ball-throwing velocity in overhead athletes:a systematic review. Strength & Conditioning Journal. 2023;45(2):177-187.
45. Allègue H, Chelly MS. Effect of an 8-week combined isometric-plyometric and sprint training programme on the physical performance of junior handball players. European Journal of Sports Science Technology. 2025;15(Special issue):605-621.
46. Bera P, Bhura P, Bhura C, Shah SF. Effects of advanced throwers ten programme to measure strength, power and endurance in overhead athletes.
47. Sarıca O, Gencer YG. The effect of resistance band exercises on the speed, agility, balance and strength required for hit shooting in mounted javelin athletes. International Journal of Sports Engineering and Biotechnology. 2024;2(1):27-34.
48. Köhler HP, Schödlbauer M, Witt M. How the acceleration phase influences energy flow and the resulting joint moments of the throwing shoulder in the deceleration phase of the javelin throw. Frontiers in Sports and Active Living. 2024;6:1445455.
49. Herbert W, Vanja R, Matthias H. Effectiveness of specific professional training in male elite adolescent team handball players. Sports. 2025;13(6):193.
50. Al JUMAILYJG, Al-Mousawi SQ. The effect of exercises according to the ranges of arm movement and their effect on muscle strength, and some biomechanical variables, and javelin throwing achievement for young people. In: International Conference on Computing, Intelligence and Data Analytics. Cham: Springer Nature Switzerland;2024. 263-273.