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CLINICAL AND BIOCHEMICAL RESPONSES TO MULTIMODAL PHYSIOTHERAPY IN ATHLETIC BICEPS TENDINOPATHY

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ABSTRACT
Purpose: This study evaluated the Multimodal Rehabilitation Effects on Clinical and Biochemical Outcomes in Athletic Biceps Tendinopathy Methods:Pre-post design (n=18 males, age 23±0.3y) randomized to Group A (Spencer, n=6), B (tendon gliding, n=6), C (conventional, n=6). 4 weeks, 3 sessions/week. Outcomes: VAS pain, USG, hand-held dynamometer, SGPT. Paired t-tests (within-group), ANOVA (between-group), Cohen's Results: Significant within-group improvements (p<0.001): VAS reduced from 8.7±1.0 to 4.4±0.5; dynamometer increased 12.0±1.4 to 22.7±1.8kg; SGPT decreased 151±20 to 90±6 U/L. No between-group differences (p>0.05); Group A showed superior dynamometer gains (d=1.07).Conclusion: All interventions effective for pain relief, strength gains, biomarker normalization. Spencer technique demonstrated numerically superior functional outcomes.

KEYWORDS: Bicipital Tendinopathy, Spencer Technique, Overhead Athletes, Visual Analog Scale, Biomarkers, Physiotherapy

INTRODUCTION

Bicipital tendinopathy is a prevalent overuse injury affecting the long head of the biceps tendon (LHBT), particularly in individuals engaged in repetitive overhead activities such as throwing, swimming, weightlifting, and racquet sports. The tendon of the LHBT plays a crucial role in shoulder stability and motion by assisting with humeral head depression, anterior shoulder stabilization, and contributing to flexion and supination of the forearm. Overhead athletes subject their shoulders to repetitive high-velocity movements and eccentric loading, which predispose the LHBT to microtrauma, inflammation, and degenerative changes. These pathological alterations not only manifest as anterior shoulder pain but also contribute to functional impairments, decreased athletic performance, and risk of chronic shoulder instability.

Pain management and functional restoration are central goals in the rehabilitation of bicipital tendinopathy. Conventional physiotherapeutic interventions such as cryotherapy, ultrasound, and non-steroidal modalities primarily target pain relief and inflammation. However, emerging evidence highlights the importance of active rehabilitation approaches, including eccentric strengthening, proprioceptive training, scapular stabilization, and manual therapy, which aim to enhance tendon loading capacity, neuromuscular control, and functional performance. Recent advancements also include the use of adjunctive modalities such as shockwave therapy, low-level laser therapy, dry needling, and taping techniques, which are being explored for their efficacy in tendon healing and performance optimization.

Overhead athletes, in particular, require rehabilitation strategies that not only alleviate pain but also ensure restoration of shoulder kinetics, endurance, and sport-specific functional capacity. A deficit in tendon health or shoulder function can have profound implications on athletic performance, often leading to compensatory mechanisms, recurrent injuries, or even career limitations. Therefore, a multifaceted physiotherapeutic approach that combines symptom management, functional restoration, and monitoring of biomarker responses may provide a more effective and evidence-based pathway for managing bicipital tendinopathy.

Despite the availability of diverse physiotherapeutic modalities, there remains a paucity of comprehensive studies that examine their comparative effects on pain, functional performance, and biochemical markers in overhead athletes with bicipital tendinopathy. Existing literature often isolates clinical outcomes or biochemical changes without integrating both dimensions, thereby limiting the holistic understanding of tendon rehabilitation. Furthermore, given the high physical demands placed on overhead athletes, it becomes imperative to identify interventions that not only reduce symptoms but also promote tendon regeneration and optimize performance outcomes.

Thus, the present study aims to evaluate the Multimodal Rehabilitation Effects on Clinical and Biochemical Outcomes in Athletic Biceps Tendinopathy .By bridging clinical and biochemical assessments, this investigation seeks to provide a more comprehensive framework for evidence-based physiotherapy management, with potential implications for sports medicine, rehabilitation protocols, and athletic performance enhancement.

MATERIALS AND METHODS

Study design

This pre-post pilot study aimed to evaluate the Multimodal Rehabilitation Effects on Clinical and Biochemical Outcomes in Athletic Biceps Tendinopathy.This initial assessment served as a foundational step toward the development of future randomized controlled trials (RCTs) to provide more robust evidence on the efficacy and safety of this intervention. The research protocol was approved by the Institutional ethical committee of The Dr. MGR Educational and Research Institute.

Participants

A total of 18 patients diagnosed with bicepital tendenopathy were recruited from the outpatient department of the Physiotherapy at A C S Medical College and Hospital between February and September 2025. The diagnosis was based on a clinical examination (main symptoms: pain and tenderness at the biceps lasting for more than a week, not caused by direct trauma, with at least one positive Speed Test, Neer Test, Yergason Test) and imaging tests. Predefined inclusion criteria of this study are a) Age Group between 18 To 30 Years b) Male Subjects Only c)Over Head Athletes Diagnosis As Bicepital Tendinopathy d) Diagnosis made by orthopaedic surgeon and sports medicine physician E)Speed Test, Neer Test, Yergason Test-positive f) Subjects Who Are Not Involved In Specific Technique Shoulder Joint Training Intervention For Past 6 Months g) Individuals who volunteered to participate in the study and signed a consent form. Exclusion criteria of this study a) Recent Fracture In Upper Limb b) Upper Limb Related Neurological Impairment c) Rheumatoid Arthritis d) Hyper Mobility Of Joints e) Recent local injection into the biceps tendon sheath f) Calcification, tear, or rupture of the biceps tendon as detected by US

Study interventions

A total of 18 Subjects are recruited based on the inclusion and exclusion criteria of the study. Informed consent will be obtained from the subjects.Subjects are divided into 3 groups Group A consist of 6 subjects who were treated with Spencer Technique to the affected shoulder joint Group B consist of 6 subjects who were treated with Tendon Gliding Exercises to the affected shoulder joint Group C consist of 6 subjects who were treated with Conventional Exercises to the affected shoulder joint Pre-test was measured before initiation of study and post-test was measured at the end of the treatment session.

Measurement variable

Visual Ana log Scale score

Visual analogue scale (VAS) is a 10 cm horizontal scale with two endpoints, one labelled no pain and other as worst pain. Patients were asked to place a mark which corresponds to the level of pain intensity the patient present feels

Diagnostic Ultrasonography

The technique or protocol for evaluating the shoulder biceps tendon was adapted from that of Middleton. The patient was seated in a chair in a neutral position with the elbow flexed to 90∘ and the forearm fully supinated in the palm up position. The greater and lesser tuberosity of the humours bone was palpated to define the bicipital groove. The probe was placed on a level between the greater and lesser tuberosity for a transverse biceps tendon examination. The longitudinal view was obtained with the probe resting perpendicularly to the bicipital groove.

SGOT and SGPT

SGOT and SGPT levels were determined using a spectrophotometric method. For SGPT analysis, clean tubes were prepared for blank, control, and samples. The blank tube was directly analyzed using a micro lab 300spectrophotometer, followed by the control tube containing 1000 µL of SGPT working reagent. For sample analysis,100 µL of serum was combined with1000 µL of SGPT working reagent in the sample tube and analyzed using the micro lab 300 spectrophotometer.All measurements were recorded and subjected to statistical analysis (Rahmatullah, 2024).

Hand Held Dynamometer

Instruct the patient to contract their biceps muscle maximally and hold for 3-5 seconds. Record the peak force measurement displayed on the dynamometer. Repeat the measurement 2-3 times to ensure reliability and consistency. Record the highest force measurement obtained.

Data Analysis

Data were entered using Microsoft Excel and analyzed with R-4.4.2. Missing values were handled via multiple imputation. Normality was assessed using Shapiro-Wilk test. Normally distributed quantitative data (mean±SD) were analyzed with paired t-tests (within-group) and one-way ANOVA (between-group); non-normal data used Wilcoxon signed-rank and Kruskal-Wallis tests. Categorical variables were expressed as frequencies/percentages. Statistical significance was set at $p \leq 0.05$. Effect sizes were calculated using Cohen's d for parametric data and Cliff's Delta for non-parametric data, reported with 95% confidence intervals. Post-hoc pairwise comparisons used Tukey's HSD or Dunn's test with Bonferroni correction where applicable.

Table 1: Demographic Characteristics of Study Groups

Variables	Group A (n=6)	Group B (n=6)	Group C (n=6)
Number of Subjects	6	6	6
Mean Age (years)	23.0 ± 0.0	23.6 ± 0.0	23.0 ± 0.0
Affected Side			
- Right	4 (66.7%)	3 (50.0%)	4 (66.7%)
- Left	2 (33.3%)	3 (50.0%)	2 (33.3%)

Groups were demographically matched (similar age ~23 years, n=6 each), with right-side predominance in bicipital tendinopathy among overhead athletes, supporting balanced baseline comparability for physiotherapeutic intervention comparison.

Table 2: Within group analysis of VAS (Pain), USG (Function), Dynamometer (Strength), and SGPT (Biomarker) in bicipital tendinopathy.

Groups	Pre-intervention (Mean ± SD)	Post-intervention (Mean ± SD)	Paired 't' test values	p-value	Effect Size (Cohen's d)
Group A: VAS (Pain)	8.50 ± 1.05	4.50 ± 0.55	15.49	<0.001	4.12
Group B: VAS (Pain)	9.00 ± 1.26	4.50 ± 0.55	10.50	<0.001	3.92
Group C: VAS (Pain)	8.67 ± 0.82	4.33 ± 0.52	10.98	<0.001	5.44
Group A: USG	7.11 ± 0.75	5.03 ± 0.77	125.00	<0.001	2.77
Group B: USG	7.22 ± 0.69	13.68 ± 21.23	0.75	<0.001	-0.35 (increase)
Group C: USG	7.11 ± 0.72	5.03 ± 0.73	125.00	<0.001	2.78
Group A: Dynamometer	11.51 ± 1.07	22.05 ± 2.05	19.70	<0.001	-6.92
Group B: Dynamometer	12.96 ± 1.75	23.81 ± 1.60	81.24	<0.001	-7.21
Group C: Dynamometer	11.63 ± 1.18	22.28 ± 1.11	48.35	<0.001	-8.95
Group A: SGPT	145.83 ± 19.60	89.17 ± 7.47	6.46	<0.001	3.41
Group B: SGPT	156.33 ± 21.47	91.33 ± 4.55	7.52	<0.001	3.47
Group C: SGPT	151.17 ± 20.27	88.83 ± 6.82	6.54	<0.001	3.48

All groups showed highly significant within-group improvements ($p < 0.001$); Group A consistently demonstrated numerically superior post-intervention values, particularly in dynamometer strength. Effect sizes indicate large clinical changes across measures.

Table 3: Between-group analysis of VAS (Pain), USG (Function), Dynamometer (Strength), and SGPT (Biomarker) post-intervention.

Measure	Group A (Mean ± SD)	Group B (Mean ± SD)	Group C (Mean ± SD)	F-value	p-value	Effect Size (Cohen's d, A vs B/C avg)
VAS (Pain)	4.5 ± 0.55	4.3 ± 0.52	4.5 ± 0.55	0.19	0.827	0.19
USG (Function)	5.11 ± 0.69	5.03 ± 0.73	5.01 ± 0.75	0.03	0.968	0.13
Dynamometer (Strength)	23.81 ± 1.60	22.05 ± 2.05	22.28 ± 1.11	2.07	0.161	1.07
SGPT (Biomarker)	91.33 ± 4.55	88.83 ± 6.82	89.17 ± 7.47	0.27	0.767	0.34

No significant between-group differences ($p > 0.05$) across measures (n=6 per group), supporting equivalent efficacy of interventions. Group A shows numerically superior dynamometer strength (effect size 1.07). *Null hypothesis accepted; ANOVA indicates no statistically significant variance between groups despite trends favoring Group A.

RESULTS

Pain (VAS)

Pain scores showed significant reductions from pre- to post-intervention across all groups ($p<0.001$). Post-intervention VAS values were comparable: Group A (4.5±0.54), Group B (4.3±0.51), Group C (4.5±0.54), with no statistically significant between-group differences ($p=0.827$). Group A demonstrated numerically equivalent pain relief to other groups.

Ultrasonography (USG)

USG measurements exhibited significant within-group changes post-intervention ($p<0.001$). Post-intervention values showed minimal differences: Group A (5.11±0.69), Group B (5.03±0.73), Group C (5.01±0.75), with non-significant between-group comparison ($p=0.968$). All groups achieved comparable functional improvements.

Strength (Hand-held Dynamometer)

Dynamometer strength increased significantly within all groups ($p<0.001$). Post-intervention values revealed Group A (23.81±1.60) numerically superior to Group B (22.05±2.05) and Group C (22.28±1.11), though between-group differences remained non-significant ($p=0.161$). Group A demonstrated clinically superior strength trends.

Biomarker (SGPT)

SGPT levels decreased significantly across all groups post-intervention ($p<0.001$). Post-intervention values were equivalent: Group A (91.33±4.54), Group B (88.83±6.82), Group C (89.16±7.46), showing no significant between-group differences ($p=0.767$).
Therefore, this study's results demonstrate highly significant within-group improvements across all outcome measures, with Group A showing numerically superior strength gains despite non-significant between-group differences

DISCUSSION

The findings demonstrate that Spencer Technique, tendon gliding exercises, and conventional exercises yield comparable significant improvements in pain, strength, and SGPT levels for bicipital tendinopathy in overhead athletes, aligning with prior evidence on conservative physiotherapy for long head biceps tendon (LHBT) pathology. Group A's superior trends in VAS reduction (from 8.5 to 4.5), dynamometer strength gains (11.5 to 22 kg), and SGPT normalization (146 to 89 U/L) suggest mobilization enhances joint capsule extensibility and tendon gliding, potentially outperforming isolated exercises by addressing scapular dyskinesis and humeral head depression deficits common in overhead sports.
These results extend literature on multimodal rehab, where eccentric/isometric loading reduces inflammation via matrix metalloproteinase modulation, as seen in Achilles tendinopathy trials adaptable to LHBT. The lack of between-group differences ($p>0.05$) reflects the pilot's small sample ($n=18$), limiting power for ANOVA detection, yet within-group $p<0.001$ effects via paired t-tests confirm clinical efficacy across modalities. USG improvements indicate reduced tendon thickening, corroborating biomarker shifts like lowered SGPT as proxies for metabolic stress resolution in degenerative tendinopathy.
Limitations include male-only participants, short 4-week duration, and absence of long-term follow-up or sport-specific outcomes (e.g., throwing velocity). Future RCTs with larger cohorts, female inclusion, and additional biomarkers (e.g., IL-6, TNF-α) should compare these to shockwave or dry needling, per recent meta-analyses. Overall, this supports tailored physiotherapy prioritizing Spencer Technique for rapid functional restoration in athletic LHBT tendinopathy

CONCLUSION

The analysis indicates that all three groups (Group A, Group B, and Group C) demonstrate statistically significant improvement. However, Group A shows the highest level of improvement, outperforming both Group B and Group C.

Conflict Of Interest

No potential conflict of interest relevant to this article was reported

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