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Effectiveness of Moderate Intensity Resistance Training With Blood Flow Restriction For Improving Strength And Quality of Life In Duchenne Muscular Dystrophy Patient: A Case Report

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ABSTRACT

Background: Duchenne Muscular Dystrophy (DMD) is a progressive X-linked neuromuscular disorder characterized by the absence of dystrophin, leading to muscle degeneration, weakness, and loss of functional abilities. While physical activity is essential to maintain strength and function, high-intensity exercise may accelerate muscle damage. Blood Flow Restriction training has emerged as a potential low-load alternative to safely enhance muscle performance in individuals with neuromuscular conditions. To evaluate the effectiveness of moderate-intensity resistance training combined with blood flow restriction in improving muscle strength in late non-ambulatory DMD patient.

Case Presentation: A single case study was conducted on a 9-year-old male with late non-ambulatory DMD (Stage 4, Brooke Functional Rating Scale). The intervention consisted of an 3-week moderate-intensity resistance training program combined with BFR, administered three times per week for 40 minutes. Exercises targeted upper and lower limb muscle groups using elastic bands and weight cuffs at 50% of maximum voluntary contraction. The Motor function measurement 36 scale were used as outcome measures to assess muscle strength.

Conclusion: post-intervention findings demonstrated measurable improvements in upper and lower limb muscle strength and enhanced MFM 36 scores across physical, emotional, and social domains, indicating better overall functional performance and Improved strength. Moderate-intensity resistance training combined with blood flow restriction appears to be a safe and effective approach for improving muscle strength and quality of life in late non-ambulatory Duchenne Muscular Dystrophy patients. This case highlights the potential of BFR-assisted physiotherapy as an adjunct rehabilitation strategy in progressive neuromuscular disorders.

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1. INTRODUCTION

Duchenne muscular dystrophy (DMD) is one of the most common inherited neuromuscular disorders (DMDs) in children, with an incidence of 1 in 3,500–5,000 newborn boys. DMD presents early in life with progressive muscle weakness, motor delays, and loss of ambulation, caused by the absence of the structural protein dystrophin. Most boys become wheelchair-dependent by around 12 years of age. Following this, a gradual loss of arm function occurs, leading to an increasing need for personal assistance with daily activities.

DMD significantly reduces life expectancy. Although new and promising drugs are emerging, no curative treatment currently exists. Corticosteroids help delay the loss of ambulation, preserve upper limb function and respiratory capacity, and when combined with ventilatory support, the median survival of patients with DMD has now increased into their 30s.Regular physical activity is essential to maintain health, functioning, quality of life and social participation.(1)

Currently, this disease has no cure. The main symptoms are muscle weakness, which progressively leads to a loss of function and independence, and, in advanced stages of the disease, a compromised respiratory system. Functional tests are performed during medical assessments of children with Duchenne muscular dystrophy.

The Motor Function Measurement test is used to measure patients' conditions before and after virtual task training. Due to its analytical simplicity, the Vignos scale is also used to evaluate functionality and overall muscle performance in neuromuscular diseases. The Egen Scale Classification was specially developed to measure the degree of functional impairment in daily living activities experienced by those with Duchenne muscular dystrophy.(2)

Our primary goal in treating boys with DMD is to help them to preserve their functional abilities as long as we can. Delaying loss of functional abilities is important for all daily life activities and can increase independence in boys with DMD. The gradual loss of the functional abilities during the course of this disease is mainly due to a progressive decrease in muscle strength and endurance.

Also, a secondary reduction of physical activity occurs due to limited physical and social activity. When the amount of energy cost a certain activity needs increases, the frequency of falling (with the need for help to stand up) increases, and the developing fear of falling leads to reduction of leg and arm functional abilities, which causes disuse of musculoskeletal and cardiorespiratory systems.(3)

In DMD patients, signs and symptoms appear around 2 to 5 years of age. Over time, muscle dystrophic changes overwhelm muscle growth, causing progressive difficulty in walking and patients lose ambulation. Muscles of DMD patients are characterized by variable degrees of atrophy, hypertrophy, muscle necrosis, regeneration, and fibrosis and the severity of muscle damage depends on age and muscle type.(4) In addition to muscle wasting, commonly observed clinical features of the disease include scoliosis, joint contractures, and calf pseudohypertrophy. DMD is caused by mutations that disrupt production of the dystrophin protein, the absence of which sensitizes muscle to contraction-induced damage.(5)

Moderate-intensity training (MIT) to improve mobility, aerobic capacity, and cardiovascular health (6) Exercise training is defined as a structured physical activity prescribed by the type, intensity, duration and frequency in order to improve functions of the cardiorespiratory,

muscular and nervous system. For persons with DMD, there is uncertainty considering what type, level and intensity of exercise training are most beneficial. Regular submaximal exercise may maintain muscular strength and prevent secondary disuse atrophy Intensive eccentric muscle exercise, where the muscle is both activated and lengthened, in addition to high-resistance exercise, may exacerbate muscle damage and should be avoided (7)

Muscular dystrophies can benefit from muscular exercise remains debated. Physical exercise can have numerous psychological and physiological positive effects for the general population, such as improvements in self-estimate and plasma endorphin concentrations. But because of muscle degeneration in muscular dystrophy, there may be the risk of exercise-induced adverse effects such as overwork weakness following supramaximal, high intensity exercise. Guidelines for the prescription of physical exercise are based on low-quality evidence, which limits their confidence in strengthening and aerobic fitness training programs(8)

Blood flow restriction training (BFR) is a rehabilitation method in which a pneumatic cuff or elastic band is applied proximally on the limb to partially restrict arterial inflow and fully occlude venous outflow during exercise. This controlled restriction allows individuals to perform low-load resistance exercise while achieving physiological benefits similar to those produced by high-intensity resistance training. In healthy populations, BFR has been shown to increase muscle strength, hypertrophy, and endurance, and to enhance vascular and hormonal adaptations. Because many individuals with neurologic or neuromuscular disorders (such as stroke, multiple sclerosis, spinal cord injury, or muscular dystrophies) have limited ability to perform high-intensity exercise, BFR offers a potentially valuable low-intensity alternative that could improve muscle performance without causing excessive fatigue or mechanical stress. (9) It has been shown that training with low BFR load (20–30% of 1 repetition maximum, 1 RM) encourages muscular hypertrophy and strength gains comparable to those normally observed after training programs with high load. The application of the BFR technique can produce short- and medium term benefits in increasing strength, muscle density and cardiovascular endurance in patients with chronic pathologies. (10) This case study aims to assess the impact of a structured moderate-intensity resistance training program on strength and quality of life in a 9-year-old boy with late non-ambulatory DMD.

2. CASE REPORT

A 9Yr old male, belonging to upper middle socioeconomic class (as per Kuppuswamy scale) diagnosed with Duchenne muscular dystrophy (Stage 4, BFRS) initially with the pre symptomatic stage for 4 years. His parents saw that he feels difficulty in getting up and walking so, they decided to start physiotherapy treatment for the boy to improve his strength and his quality of life.

Patient Information

Name: Master Xxx
Age: 9 years old
Gender: Male
Educational Status: Grade 4

Chief Complaint

The patient presents with progressive difficulty in standing and walking, frequent falls, decreased lower limb strength, and increased muscle fatigue, significantly affecting daily activities.

History of Present Illness

The patient was diagnosed with Duchenne muscular dystrophy 4 years ago at the stage of presymptomatic stage. He complains of reduced muscle strength, decreased ability for activities of daily living, and increasing difficulty standing, walking, and making turns. Now, He was in Late ambulatory stage, undergoing physiotherapy treatment in the rehab centre at Bangalore.

Past Medical History

At the age of 5, he experienced a fall and got fractured & treated with plaster of Paris (POP) and limb immobilization. Following this, he has difficulty in standing and walking, as well as fear of falling. There is no history of any developmental delay. Birth history, including APGAR score, was normal.

Family History

There is no history of consanguineous marriage.

Medical History

The patient is currently on steroid tablets, prescribed by National institute of mental health and neuro sciences (NIMHANS) Bangalore

General Observation

Sign: Gowers sign present
Posture: Kyphotic in both standing and supine lying positions
Body Build: Mesomorphic
Chest Symmetry: Barrel-shaped
External Appliances: Patient Ambulates with the help of HKAFO
Gait Pattern: Waddling Gait with Lordotic Posture

Motor Examination

ASSESSMENT	UPPER LIMB	LOWER LIMB
Range of motion	Normal	Knee and Ankle Rom Reduced
Muscle power	Normal	2/5 all group of muscles
Tightness/ Deformity	None Observed	Knee flexor and calf tightness
DTR	2+ Normal	2+ Normal
Muscle Bulk	None Observed	Pseudohypertrophy of calves
Muscle Tone	Hypotonia (flaccid)	Hypotonia (flaccid)

3. METHODOLOGY

1. Patient is diagnosed with Duchenne muscular dystrophy by the NIMHANS Bangalore
2. The patient will be evaluated pre and post the intervention MIRT and BFR with Motor function measurement
3. Motor function measurement: Assessed for the strength of both upper and lower limb
4. Intervention given for 3 weeks of Treatment duration

Intervention:

A. Moderate Intensity Training

Exercises focused on

1. Upper limb

- Elbow flexors
- Elbow extensors,
- Shoulder Flexion

2. Lower limb

- Hip flexors,
- Knee extensors

Muscle Groups Using Elastic Bands And Weight Cuffs. Each session consisted of a warm-up (5 minutes), resistance exercises (30 minutes), and cool-down (5 minutes). Progression was made every two weeks based on tolerance and absence of fatigue.

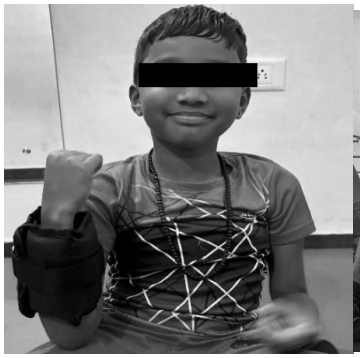
B. Blood Flow Restriction Training

DMD patients cannot tolerate heavy resistance due to muscle fragility. BFRT allows safe low-intensity strength training to preserve muscle mass, reduce atrophy, and improve functional ability.

Protocol: Both Upper and lower limb same intervention with BFR

- Cuff applied to proximal limb
- Pressure: 50–60% limb occlusion
- Load: 20–30% 1RM
- Reps: 30 + 15×3 sets
- Frequency: 2–3 times/week

A. Moderate Intensity Training



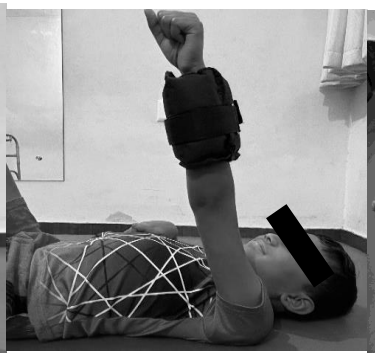


Figure 1. Elbow Flexion and Extension Figure 2. Shoulder Flexion Figure 3. Knee Extension

B. With Blood Flow Restriction Training

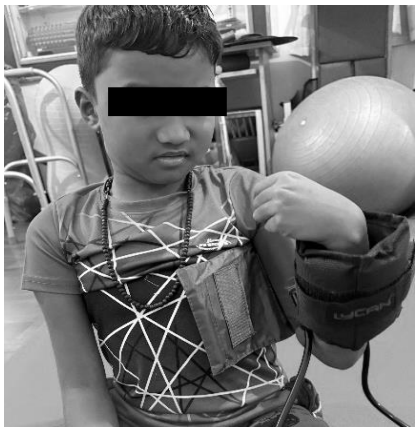


Figure 4. Elbow Flexion and Extension

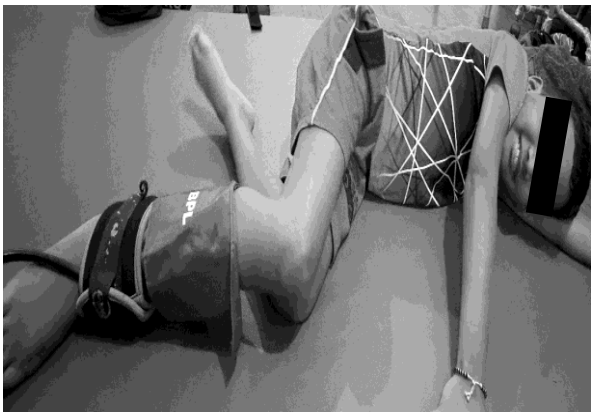


Figure 5. Knee Extension

4. DISCUSSION

Motor Function Measurement 36 Pre & Post Scoring

This case study demonstrated that moderate intensity resistance training combined with blood flow restriction (BFR) was effective in improving muscle strength and quality of life in a late non-ambulatory patient with Duchenne Muscular Dystrophy (DMD). The results align with emerging evidence that BFR allows low-load exercise to induce muscle adaptations similar to high-load training without exacerbating muscle damage, which is critical in DMD given the fragility of dystrophic muscle fibres (Loenneke et al., 2013). BFR works by partially occluding blood flow during exercise, creating a hypoxic environment that stimulates muscle hypertrophy and strength gains even at low intensities (Ma et al., 2024). This is particularly beneficial in DMD, where high-intensity or eccentric contractions risk accelerating muscle degeneration (Hammer et al., 2021). The improved Hammersmith functional motor scale scores in our patient suggest functional benefits across physical, emotional, and social domains, underscoring BFR's potential to enhance overall quality of life (Cruickshank et al., 2022). Moderate intensity exercise alone has been shown to improve cardiovascular function and muscle performance in DMD and animal models, without exacerbating dystrophic pathology (Zelikovich et al., 2019). Our findings support this by showing strength improvements after a 3-week intervention without adverse events. Importantly, BFR training may also promote beneficial molecular responses such as increased angiogenesis and satellite cell proliferation, which may aid muscle repair and regeneration in muscular dystrophies (Loenneke et al., 2013). Previous research highlights that safe exercise protocols for DMD must avoid overworking fragile muscles while maximizing functional preservation (Lott et al., 2020). This study's moderate intensity BFR training protocol, using 20-30% of maximal voluntary contraction and controlled occlusion pressure, fits within these guidelines and was well tolerated. The improvements in upper and lower limb strength demonstrated, along with preserved range of motion, provide evidence for BFR-assisted physiotherapy as a feasible rehabilitation adjunct in progressive neuromuscular diseases (Hedt et al., 2022; Ma et al., 2024).

Limitations include the single-patient design and short intervention period. Future research with larger cohorts and longer follow-ups is needed to establish the long-term safety and efficacy of BFR in DMD. Understanding individual responses and optimizing protocols for paediatric populations will also be critical (ClinicalTrials.gov, 2015).

ITEMS Domain I Standing &Transfer	TASK DESCRIPTION	PRE SCORING	POST SCORING
D1-1	Sit to stand	0	0
D1-2	Stand without support	0	0
D1-3	Stand with feet together	0	0
D1-4	Stand on one leg	0	0
D1-5	Rise from floor	0	1
D1-6	Maintain quiet standing	0	0
D1-7	Walk a few steps	0	0
D1-8	Turn/pivot in standing	0	0
D1-9	Rise from squat/half kneeling	1	1
D1-10	Step onto small blocks	0	0
D1-11	Sit to floor transition	1	1
D1-12	Floor to sit transition	0	1
D1-13	Supine to sitting on edge	2	3
ITEMS Domain II Axial & Proximal F^n	TASK DESCRIPTION	PRE-SCORING	POST SCORING
D2-1	Roll back to side	1	2
D2-2	Roll side to back	1	2
D2-3	Sit without support	2	3
D2-4	Forward reach in sitting	2	3
D2-5	Lift arms forward	2	3
D2-6	Lift arm sideways	2	3
D2-7	Hands to head	2	3
D2-8	Hands to mouth	3	3
D2-9	Sit to supine	2	3
D2-10	Supine to sit	2	3
D2-11	Trunk upright while moving arms	2	3
D2-12	Forward bend and return in sitting	1	2
DOMAIN D3 Distal motor F^n	TASK DESCRIPTION	PRE-SCORING	POST SCORING
D3-1	Open and close hand	2	3
D3-2	Pick up small object	2	3
D3-3	Thumb finger opposition	2	3
D3-4	Grip and release object	1	2
D3-5	Wrist movement control	2	3
D3-6	Ankle/toe dorsiflexion	1	2
D3-7	Finger to target test	2	3

In summary, this study adds to the growing body of literature supporting BFR combined with moderate resistance training as a promising, low-load intervention to improve muscle strength and quality of life in DMD patients, addressing an unmet need for safe exercise strategies in this population.

5. CONCLUSION

The findings of this study indicate that incorporating moderate-intensity training combined with blood flow restriction (BFR) produces significant improvements in muscle strength and overall quality of life among individuals with Duchenne Muscular Dystrophy (DMD). This intervention offers a promising therapy to maintain muscle performance and quality of life while minimizing muscle damage risks. The observed enhancement in functional performance, as assessed through the Motor Function Measure-36 (MFM-36), underscores the potential of this combined intervention as a feasible and effective adjunct to traditional physiotherapy approaches for DMD. Further large-scale and longitudinal studies are encouraged to validate these results and to explore the long-term safety and adaptability of BFR training within this clinical population.

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CONFLICT OF INTEREST:

Authors declare that there is no conflict of interest.

REFERENCES

[1] Hammer S, Toussaint M, Vollsæter M, NESBJØRG M, Røksund OD, Reychler G, Lund H, Andersen T. Exercise training in Duchenne muscular dystrophy: a systematic review and meta-analysis. Journal of rehabilitation medicine. 2021 Dec 14;54:985.

[2] Baeza-Barragán MR, Manzanares MT, Vergara CR, Casuso-Holgado MJ, Martín-Valero R. The use of virtual reality technologies in the treatment of Duchenne muscular dystrophy: systematic review JMIR mHealth and uHealth. 2020 Dec 8;8(12):e21576.

[3] Abd El Aziz AS, Abd ElAziz HG, Ali MS. Efficacy of two intervention approaches on functional walking capacity and balance in children with Duchene muscular dystrophy. Journal of musculoskeletal & neuronal interactions. 2021;21(3):343.

[4] Capitanio D, Moriggi M, Torretta E, Barbacini P, De Palma S, Viganò A, Lochmüller H, Muntoni F, Ferlini A, Mora M, Gelfi C. Comparative proteomic analyses of Duchenne muscular dystrophy and Becker muscular dystrophy muscles: changes contributing to preserve muscle function in Becker muscular dystrophy patients. Journal of Cachexia, Sarcopenia and Muscle. 2020 Apr;11(2):547-63.

[5] Roberts TC, Wood MJ, Davies KE. Therapeutic approaches for Duchenne muscular dystrophy. Nature Reviews Drug Discovery. 2023 Nov;22(11):917-34.

[6] Sigoli E, Antão RA, Guerreiro MP, de Araújo TO, Santos PK, da Roza DL, Rassier DE, Cornachione AS. Effects of low-intensity and long-term aerobic exercise on the psoas muscle of mdx mice: an experimental model of Duchenne muscular dystrophy. International Journal of Molecular Sciences. 2022 Apr 19;23(9):4483.

[7] Boyne P, Dunning K, Carl D, Gerson M, Khoury J, Rockwell B, Keeton G, Westover J, Williams A, McCarthy M, Kissela B. High-intensity interval training and moderate-intensity continuous training in ambulatory chronic stroke: feasibility study. Physical therapy. 2016 Oct 1;96(10):1533-44.

[8] Hammer S, Toussaint M, Vollsæter M, NESBJØRG M, Røksund OD, Reychler G, Lund H, Andersen T. Exercise training in Duchenne muscular dystrophy: a systematic review and meta-analysis. Journal of rehabilitation medicine. 2021 Dec 14;54:985.

[9] Gianola S, Castellini G, Pecoraro V, Monticone M, Banfi G, Moja L. Effect of muscular exercise on patients with muscular dystrophy: a systematic review and meta-analysis of the literature. Frontiers in neurology. 2020 Nov 12;11:958.

[10] Mañago MM, Kimbrell K, Hager ER, Dwight H, Owens J, Bade M. Clinical use of blood flow restriction in people with neurologic conditions: a cross-sectional survey. Journal of Physical Therapy Science. 2022;34(4):275-83.

[11] Vinolo-Gil MJ, Rodríguez-Huguet M, Martin-Vega FJ, Garcia-Munoz C, Lagares-Franco C, Garcia- Campanario I. Effectiveness of blood flow restriction in neurological disorders: a systematic review. In Health care 2022 Nov 30 (Vol. 10, No. 12, p. 2407). MDPI