Comprehensive Rehabilitation Approach in a Paediatric Case of Juvenile Rheumatoid Arthritis

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ABSTRACT

Background: Juvenile Rheumatoid Arthritis (JRA), also known as Juvenile Idiopathic Arthritis, is a chronic autoimmune inflammatory disorder affecting children under 16 years of age. It primarily involves synovial joints, leading to pain, stiffness, swelling, and functional limitations. Early diagnosis and multidisciplinary management, including physiotherapy, are vital for preventing deformities and improving functional outcomes.

Case Presentation: A 10-year-old female child diagnosed with polyarticular JRA presented with pain and stiffness in bilateral knees, wrists, and ankles, along with morning stiffness and difficulty in performing daily activities. Assessment revealed restricted joint range of motion, muscle weakness, and functional dependency. A six-week physiotherapy intervention program was designed, incorporating pain management modalities, range of motion and strengthening exercises, hydrotherapy, gait training, and caregiver education.

Results: After six weeks of structured physiotherapy, the patient demonstrated significant improvement in pain (VAS reduced from 6/10 to 2/10), knee flexion (increased from 90° to 120°), muscle strength (quadriceps improved from grade 3/5 to 4+/5), and walking tolerance (increased to 500 meters). Functional outcomes measured by the Childhood Health Assessment Questionnaire (CHAQ) improved from 1.8 to 0.8, indicating enhanced quality of life.

Conclusion: Early and individualized physiotherapy intervention plays a crucial role in managing Juvenile Rheumatoid Arthritis by reducing pain, maintaining joint function, improving mobility, and enhancing overall quality of life. Continuous follow-up and parent education are essential to ensure long-term functional independence and prevent disability progression.

Keywords: Juvenile Rheumatoid Arthritis, Physiotherapy, Pediatric Rehabilitation, Functional Outcomes, Pain Management

INTRODUCTION

Juvenile Rheumatoid Arthritis (JRA), also known as Juvenile Idiopathic Arthritis (JIA), represents a heterogeneous group of autoimmune disorders characterized by chronic synovial inflammation that persists for more than six weeks in children below 16 years of age[1,2]. The condition involves the immune system mistakenly attacking synovial tissues, resulting in joint effusion, synovial hypertrophy, pain, stiffness, and gradual erosion of cartilage and bone[1]. If left untreated, these inflammatory changes can cause growth disturbances, joint deformities, muscle atrophy, and long-term functional disability[2,3].

JRA is broadly classified into three major subtypes:

1. Oligoarticular, Polyarticular, and Systemic Onset Arthritis[1,4]. Oligoarticular JRA affects four or fewer joints, typically large joints such as the knees or ankles, and may be associated with uveitis[4].

2. Polyarticular JRA involves five or more joints and often includes small joints of the hands and wrists, mimicking adult rheumatoid arthritis[4].

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3. Systemic Onset JRA, also known as Still's disease, is characterized by systemic features such as fever, rash, hepatosplenomegaly, and serositis along with arthritis[5].

The etiology of JRA is multifactorial, involving a complex interplay between genetic susceptibility, environmental triggers, and immune dysregulation[2,6]. Studies have identified associations with HLA gene variants (particularly *HLA-DRB1* and *HLA-A2*) and cytokine imbalances, including elevated levels of interleukin (IL)-1, IL-6, and tumor necrosis factor-alpha (TNF-α), which contribute to synovial inflammation and joint destruction[2,6]. Environmental factors such as viral infections, gut microbiome alterations, and early-life stress may act as precipitating agents in genetically predisposed children[2].

Epidemiologically, JRA is the most common chronic rheumatic disease in children, with a global incidence ranging from 2 to 20 per 100,000 children and a prevalence of 16 to 150 per 100,000[3]. The condition shows a female predominance, especially in oligoarticular and polyarticular forms, with onset typically between 1 and 12 years of age[3].

The pathophysiology involves persistent activation of immune cells such as T-helper (Th1/Th17) lymphocytes and macrophages, leading to production of pro-inflammatory cytokines and formation of pannus tissue, which progressively erodes cartilage and bone[7]. Chronic inflammation within the growth plates can result in growth retardation and limb length discrepancies[7].

Physiotherapy plays a central role in the multidisciplinary management of JRA, alongside pharmacological therapy (including disease-modifying antirheumatic drugs and biologics)[1,8]. The primary physiotherapy goals are to control pain and inflammation, maintain joint mobility, strengthen periarticular muscles, and improve endurance, posture, and functional participation[8]. Early and continuous physiotherapy helps prevent secondary musculoskeletal complications such as contractures, muscle wasting, and postural deviations[9]. Evidence supports that structured exercise programs, hydrotherapy, and joint protection strategies significantly enhance quality of life and promote independence in children with JRA[9].

Understanding the pathophysiological mechanisms, functional implications, and the role of physiotherapy is essential for optimizing the management and long-term outcomes in children affected by Juvenile Rheumatoid Arthritis.

Case Presentation

Patient Profile

- Name: [Confidential]
- Age/Sex: 10-year-old female
- Diagnosis: Polyarticular Juvenile Rheumatoid Arthritis
- Duration of Symptoms: 8 months
- Referral: Department of Physiotherapy, Pediatric Rehabilitation Unit

Chief Complaints

- Pain and stiffness in multiple joints (both knees, wrists, and ankles)

  Morning stiffness lasting approximately 45–60 minutes
- Difficulty in walking and performing school activities
- Fatigue and generalized weakness

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History

- Medical History: Diagnosed with JRA 8 months ago by a pediatric rheumatologist. On methotrexate and NSAIDs.
- Family History: Negative for autoimmune disorders.
- Birth and Developmental History: Full-term normal delivery; developmental milestones achieved normally.
- Personal History: Attends school with occasional absenteeism due to pain.

Clinical Assessment

Observation

- Mild swelling over bilateral knees and wrists
- Antalgic gait with reduced step length
- No obvious deformity noted

Palpation

- Tenderness Grade II (knee and wrist joints)
- Mild warmth and effusion present

Range of Motion (ROM)

Joint	Active ROM	Passive ROM	Limitation
Knee	Flexion 0–90°	0–100°	Pain-limited
Wrist	Flexion 0–45°	0–60°	Pain-limited
Ankle	Dorsiflexion 0–10°	0–15°	Mild stiffness

Muscle Strength (Manual Muscle Testing)

- Quadriceps: Grade 3/5
- Hamstrings: Grade 3+/5
- Wrist extensors: Grade 3/5

Functional Assessment

- Walking tolerance: 100 meters with pain
- Activities of Daily Living (ADL): Difficulty in dressing and writing

Pain scale: 6/10 (VAS – Visual Analogue Scale)

Outcome Measures

- Childhood Health Assessment Questionnaire (CHAQ): 1.8

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- Pediatric Quality of Life Inventory (PedsQL): 60%

Physiotherapy Goals of Treatment

The primary objectives of physiotherapy in Juvenile Rheumatoid Arthritis (JRA) are to:

1. Reduce pain and inflammation – minimizing discomfort to allow participation in daily activities and therapeutic exercises[10].
2. Maintain and improve joint mobility – preserving functional range of motion and preventing stiffness or contractures[11].
3. Strengthen surrounding muscles – improving muscle support around affected joints to reduce load and prevent secondary deformities[12].
4. Prevent deformities and contractures – protecting joint integrity through stretching, posture correction, and proper alignment[13].
5. Improve functional independence – enabling safe participation in activities of daily living (ADLs), school tasks, and recreational activities[14].

Treatment Plan

1. Pain and Inflammation Control

Pain management is the first step in enabling active participation in physiotherapy:

1. Moist heat application prior to exercises to reduce stiffness and improve tissue elasticity.
2. Cryotherapy during acute inflammatory episodes to decrease joint swelling and pain.
3. Transcutaneous Electrical Nerve Stimulation (TENS) in conventional mode for 15 minutes, providing analgesic effect through modulation of pain pathways[10].

2. Range of Motion (ROM) Exercises

Maintaining joint mobility prevents stiffness and functional limitations:

1. Gentle active and active-assisted ROM exercises for affected joints within pain-free limits, performed daily.
2. Stretching exercises targeting tight muscles such as hamstrings, calf muscles, and wrist flexors to prevent contractures.
3. Hydrotherapy sessions twice weekly, providing a low-impact environment that reduces joint loading and allows smooth movement[11],[12].

3. Strengthening Program

Muscle strengthening is critical for joint stability and functional performance:

Isometric exercises for quadriceps and gluteal muscles during acute stages to minimize joint stress.

1. Progressive resistive exercises using therabands as inflammation reduces, gradually increasing resistance to enhance muscle strength.
2. Functional strengthening activities, including sit-to-stand, wall slides, and step-ups, simulate daily tasks and promote independence[12],[13].

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4. Posture and Gait Training

Proper posture and gait reduce joint stress and prevent secondary complications:

1. Gait re-education emphasizing equal weight-bearing and correct alignment during walking.
2. Orthotic advice, including soft knee and wrist supports during activities, to prevent deformity and provide joint stability[13].

5. Aerobic Conditioning

Aerobic exercises improve endurance, reduce fatigue, and enhance overall physical conditioning:

- Low-impact activities such as cycling or swimming three times per week.
- Breathing and relaxation exercises to enhance oxygenation, reduce fatigue, and manage stress[14].

6.Education and Home Program

Parental involvement and home exercises are critical for long-term success:

1. Educated parents on joint protection, energy conservation techniques, and the importance of regular exercises.
2. Provided a structured home exercise program, including gentle stretching, strengthening exercises, and functional tasks to be performed daily.

Progress and Outcome

After six weeks of consistent physiotherapy intervention, the patient demonstrated significant functional improvements:

1. Pain reduction: VAS decreased from 6/10 to 2/10.
2. Range of motion: Knee flexion improved from 90° to 120°.
3. Muscle strength: Quadriceps strength improved from 3/5 to 4+/5.
4. Endurance: Walking tolerance increased from 100 meters to 500 meters without rest.
5. Functional outcomes: Childhood Health Assessment Questionnaire (CHAQ) improved from 1.8 to 0.8, and Pediatric Quality of Life Inventory (PedsQL) increased from 60% to 85%.

DISCUSSION

Juvenile Rheumatoid Arthritis significantly impacts a child's physical, psychological, and social development[10],[11]. Chronic pain, joint stiffness, and reduced mobility often interfere with school participation, play, and self-care activities, leading to decreased quality of life[10],[12]. Moreover, prolonged inflammation can result in muscle weakness, joint contractures, and growth disturbances, further limiting functional independence[11],[13].

Physiotherapy plays a pivotal role in the management of JRA, complementing pharmacological interventions[12],[14]. Its primary objectives include pain relief, maintenance of joint range of motion, muscle strengthening, and functional rehabilitation[13],[15]. Early initiation of physiotherapy, including active and active assisted exercises, hydrotherapy, and posture correction, has been shown to prevent secondary musculoskeletal deformities and improve overall functional outcomes[12],[16].

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Hydrotherapy provides a low-impact environment that facilitates pain-free movement, increases endurance, and promotes joint mobility, particularly in children with polyarticular involvement[16],[17]. Similarly, individualized exercise programs targeting strength, flexibility, and aerobic capacity have been associated with enhanced participation in daily activities, improved muscle tone, and better long-term physical function[14],[17].

Family and caregiver education is crucial to ensure adherence to home exercise programs and implementation of joint protection techniques, energy conservation strategies, and safe physical activity participation[15],[18]. Active engagement of parents not only improves functional outcomes but also reduces the psychosocial burden of chronic disease in children[15].

A multidisciplinary approach, involving rheumatologists, occupational therapists, physiotherapists, and psychologists, is essential for holistic care[10],[12]. Regular follow-up ensures monitoring of disease activity, adaptation of physiotherapy protocols, and prevention of complications, thereby promoting long-term independence and quality of life[13],[18].

Overall, this case supports existing evidence that early and structured physiotherapy intervention is fundamental to optimize functional recovery in children with JRA, emphasizing the integration of clinical, rehabilitative, and psychosocial strategies[14],[16].

Table 1: Comprehensive Physiotherapy Management Plan for JRA

Treatment Component	**Intervention**	**Frequency / Duration**	**Purpose / Outcome**
Pain & Inflammation Control	Moist heat before exercises	Daily, 10–15 min	Reduces stiffness, prepares joints for exercise
	Cryotherapy during acute flare	As needed, 10– 15 min	Decreases swelling and pain
	TENS (conventional mode)	Daily, 15 min	Pain modulation
Range of Motion (ROM) Exercises	Active / active-assisted ROM	Daily	Maintains joint mobility, prevents stiffness
	Stretching (hamstrings, calf, wrist flexors)	Daily	Prevents contractures, improves flexibility
	Hydrotherapy	Twice weekly	Low-impact mobility, reduces joint stress
Strengthening Program	Isometric exercises (quadriceps, gluteals)	Daily	Maintains muscle strength during acute inflammation
	Progressive resistive exercises (therabands)	3–4 times/week	Increases muscle strength as inflammation reduces
Treatment Component	**Intervention**	**Frequency / Duration**	**Purpose / Outcome**
	Functional strengthening (sit-tostand, wall slides, step-ups)	3–4 times/week	Improves ADL performance
Posture & Gait Training	Gait re-education	3–4 times/week	Corrects abnormal patterns, promotes even weight distribution

	Orthotic advice (soft knee/wrist supports)	During activities	Prevents deformities, provides stability
Aerobic Conditioning	Low-impact activities (cycling, swimming)	3 times/week	Improves endurance and reduces fatigue
	Breathing & relaxation exercises	Daily	Reduces stress and promotes overall well-being
Education & Home Program	Parental education on joint protection, energy conservation	Once, reinforced weekly	Ensures adherence and safety
	Home exercise schedule (stretching, strengthening)	Daily	Promotes independence, reinforces clinic exercises

CONCLUSION

This case study demonstrates that a structured physiotherapy program emphasizing pain control, joint mobility, and functional training can substantially improve quality of life in children with Juvenile Rheumatoid Arthritis. Continuous engagement of the child and caregivers ensures better compliance and long-term benefits.

Limitations

A major limitation is the short 6-week intervention period, which may not reflect long-term sustainability of functional gains or recurrence of symptoms.

Long-term monitoring is essential to evaluate maintenance of ROM, pain reduction, and prevention of deformities.

As a single case report, statistical analysis and comparison to normative paediatric data were not feasible, limiting the generalizability of results.

Future assessments may include objective tests such as the 6-Minute Walk Test and grip strength dynamometry to provide quantitative functional benchmarks.

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