Case Study of Rehabilitation of Extension Contracture of the Knee Joint

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Abstract

Background: Severe knee stiffness in a 3-year-old patient following slab application can significantly impact mobility and quality of life. Post-traumatic stiffness is often associated with improper rehabilitation, prolonged immobilization, or unaddressed intra-articular injuries. Early diagnosis and intervention are critical in pediatric cases to prevent long-term functional impairments.

Methodology: This case report discusses about 3-year-old patient presenting with severe knee stiffness from three years after slab application for fixed anterior tibial subluxation and fixed depression fracture of the posterior part of medial tibial condyle. The patient's medical history, clinical examination findings, and radiographic imaging were analyzed. The treatment approach involved a combination of physical therapy, pharmacological management.

Results: Initial clinical evaluation revealed significant loss of range of motion, particularly in flexion. Radiographic findings showed no residual fracture deformities but identified joint contracture. The patient underwent and intensive rehabilitation program, including passive stretching and active exercises. After 3 months of therapy the knee range of motion improved 70% from 5° to 84° and the patient regained functional mobility.

Conclusion: Severe knee stiffness in young children post-slab application is a preventable and manageable condition. Timely intervention, emphasizing early mobilization and appropriate rehabilitation, is crucial. This case highlights the importance of multidisciplinary approaches combining orthopedic and physical therapy expertise. Further studies are needed to optimize treatment protocols for similar cases in pediatric populations.

Keyword: Contracture, Knee joint, Rehabilitation, Flexion contracture**,** Extension contracture, Manual muscle testing.

INTRODUCTION

In children, severe knee stiffness and extension contracture after immobilization are uncommon but difficult side effects. Young children's fractures are frequently treated by immobilization with slabs or casts; however, extended immobilization can have negative effects, such as soft tissue contractures, muscular atrophy, and joint stiffness.

A child's functional mobility and quality of life may be greatly impacted by extension contracture of the knee joint, which is characterized by the inability to fully extend the knee. Numerous reasons, such as extended immobilization, muscular imbalance, joint adhesion, and insufficient therapy, can cause this syndrome.

Since a young child's musculoskeletal system is still developing and joint abnormalities can result in long-term incapacity if left untreated, knee stiffness and contractures are especially troubling. To restore appropriate joint function and avoid irreversible loss of mobility, early intervention with physical therapy and other rehabilitative therapies is essential. In this case study, we describe a 3- year-old kid who, after a slab was applied to treat a lower leg injury, developed severe knee stiffness and an extension contracture. The example emphasizes the possible advantages of preventative interventions to avoid joint problems in pediatric fractures, the significance of early mobilization, and the need for careful monitoring throughout post-treatment rehabilitation.

The largest synovial joint in the body, the knee joint, is essential for stability and mobility. The developmental stage of a 3-year-old child results in unique knee anatomy and biomechanics, including active growth plates, softer cartilage, and developing musculature. [1]

MATERIALS AND METHODS

It was a Case Study. Type of study design was experimental. We use Convenience Sampling and taken 1 sample. Duration of study from August 2024 to December 2024. Materials used in the study were record or data collection sheet, consent form, towel, Goniometer, inch tape, thera band and watch. Study performed in Gopal Narayan Singh University, Rohtas, Bihar, India.

Participants in the study were selected any male or female between the ages of 2 to 5 who have been clinically diagnosed with a extension contracture of knee, MMT less than 3 and knee flexion range below 10 degree. Subject with other bone or joint pathology and active or recent infection around the knee joint was not included in the study. Subject attendants informed about

the nature and purpose of the intervention prior to their enrollment in the study, and they asked to sign an informed consent form.

Patient came to Narayan Medical College & Hospital Physiotherapy OPD on 29 /08/2024 complaint of severe knee stiffness then initially I assessed patient throughout the following steps.

Patient Assessment

- Name: Master Aditya Kumar
- Age: 3 years
- Gender: Male
- DOA: 29.08.2024
- Parent/Guardian Name: Suraj Kumar
- Contact Number: 8235285283
- CC: Left severe knee stiffness with difficulty in sitting and walking for 1.5 years.
- HOI: Patient came in orthopedic ward with Complaint of difficulty in sitting.
- Onset: Gradual, Noticed 1year ago
- Duration: 2 years.
- Associated symptoms: Pain during movement, difficulty in standing or walking and reduced range of motion.
- Aggravating factors: During Knee flexion
- Relieving factors: Rest
- Past Medical History: Fall from stairs when patient was 7 months old.
- Birth history: Normal
- History of trauma: Yes
- Any previous medical history: Yes (Slab application for one month)
- Surgical History: No
- Family History: No any kind of family history

ON OBSERVATION

- Build: Normal mesomorphic
- Posture: Supine lying
- Any bandages & Scars: Not applicable

- Attitude of the limbs: Poor flexibility muscular imbalances in the left leg.
- Deformities: Present
- Type of gait: Decreased knee flexion during the swing phase

ON PALPATION

- Tenderness – Absent
- Warmth – Normal
- Tone – Spastic (Grade 3 left quadriceps muscles)

MUSCLES OF KNEE	Rt.	Lt.
Flexors	5	2
Extensors	5	3

Table no: 1 Manual Muscle Testing (MMT)

	Movement	Right Active	Left Passive	Right Passive	Left Active
Knee Joint	Flexion	130-135º	0-10º	130-135º	0-5º
	Extension	0º	0º	0º	0º

Table no: 2 Range of motion measurement before treatment during assessment

Knee Reflex	Left	Right
	2+	2+

Table no: 3 Reflexes

Area	Rt.(cm)	Lt.(cm)
Thigh	10 cm	11 cm
Calf	6 cm	6 cm

Table no: 4 Muscle Girth

Side	Rt.(cm)	Lt.(cm)
True	18 cm	18 cm
Apparent	22 cm	22 cm

Table no: 5 Limb Length

Phases of Rehabilitation

Phase 1: Acute Phase (0-4weeks)

1. Goals: Protect the injured area, Prevent further contracture.

2. Gentle Passive Range of Motion (PROM): Begin gentle PROM exercises to the knee within the tolerance of the child, focusing on knee flexion. Aim for no more than 10-15 degrees of passive knee flexion initially. Use the child's pain threshold as a guide to avoid overstretching.
3. Positioning: Educate parents on the importance of positioning the leg in slight flexion to minimize contracture.
4. Weight-bearing status: Early weight-bearing avoided.
5. Education: Teach parents show to perform passive stretching and positioning at home.

Phase 2: Sub acute Phase (4-8weeks)

1. Goals: Gradually increase knee flexion and improve knee flexion. Prevent muscle atrophy and maintain joint mobility.
2. Management: Active-Assisted Range of Motion (AAROM): Encourage flexion within the pain- free range. Active flexion exercises can be performed in sitting or lying down. Hamstring stretches can be done gently using the therapist's hands or a towel.
3. Strengthening: Begin quadriceps strengthening with isometric exercises (e.g., quad sets) and progress to dynamic strengthening (e.g., leg raises, squats) as tolerated hamstring exercises should also be integrated. Encourage weight shifts and standing balance exercises as the child becomes more stable.
4. Manual Therapy: Soft tissue mobilization and gentle joint mobilizations to improve knee joint mobility, especially if the child shows signs of stiffness.

Phase 3: Intermediate Phase (8-16weeks)

1. Goals: Improve knee ROM. Enhance strength and stability.
2. Management: Active Range of Motion (AROM): Encourage full AROM in all directions (flexion and extension).
3. Strengthening: Continue to focus on strengthening the quadriceps and hamstrings with progressive exercises. Isokinetic strengthening squats and lunges (modified for age and developmental abilities) are helpful.
4. Functional Exercises: Begin functional tasks such as standing, walking, and stair climbing.
5. Proprioception and Balance: Introduce balance exercises such as standing on one leg (supported as necessary), and use of balance boards or unstable surfaces.

Phase 4: Advanced Phase (16+weeks)

1. Goals: Full ROM, Full strength and functional return.
2. Internation: Continue strengthening exercises with a focus on improving endurance and agility.
3. Gait Training: Work on gait normalization if the child is experiencing any walking abnormalities.
4. Sports/Functional Skills: If the child is involved in play or sports, integrate more dynamic movements and activities into therapy to improve functional abilities.

Long-Term Maintenance:

- Home Exercises: Develop a tailored home exercise program for the parents follow, focusing on stretching, strengthening, and functional movements.
- Regular Follow-up: Continued follow-up with the physiotherapist to ensure long-term ROM and strength maintenance. [11]

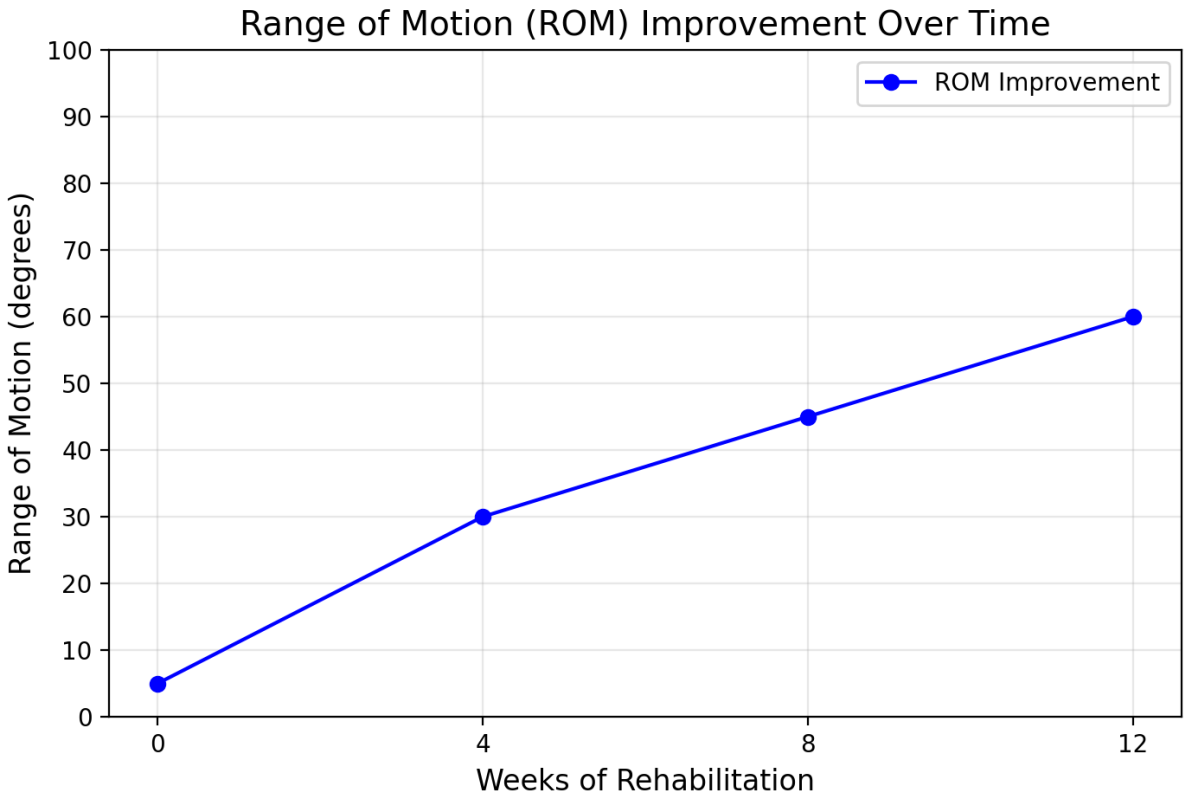
KNEE MUSCLES	Rt.	Lt.
Flexors	5	4
Extensors	5	4

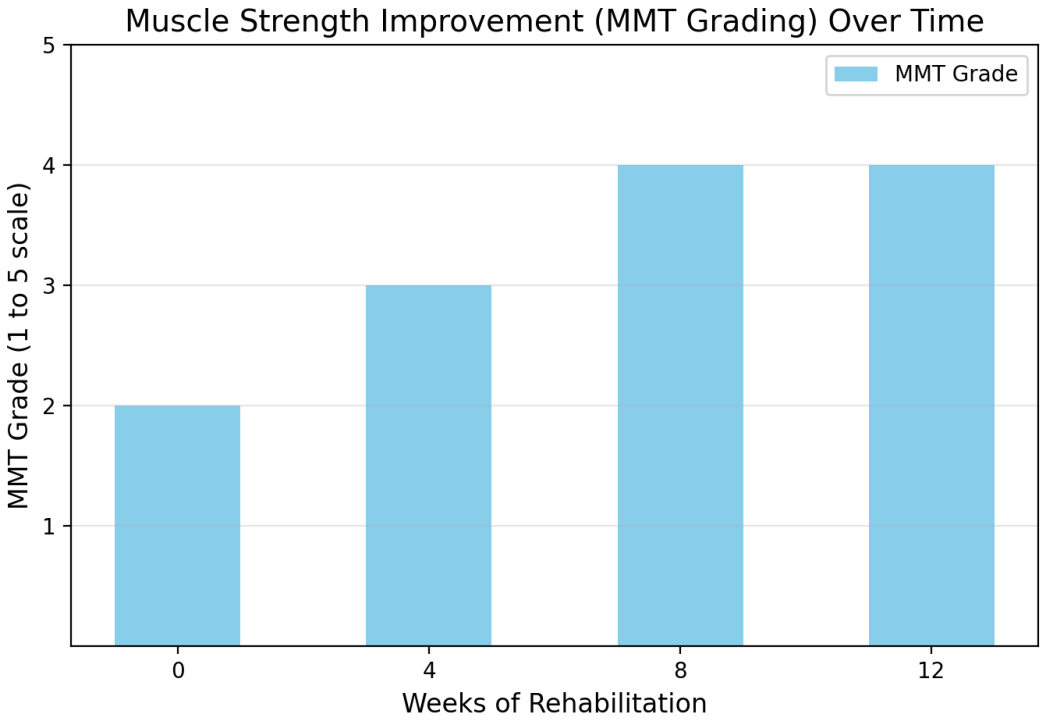
Table No: 6 Post Rehabilitation MMT

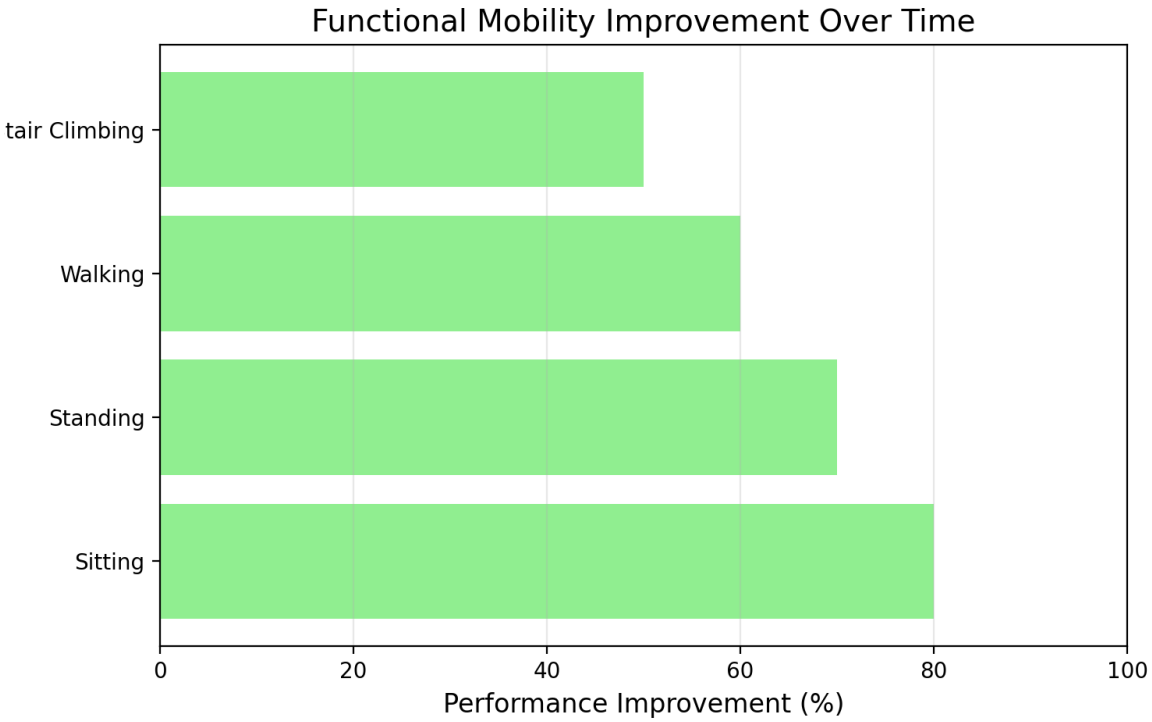
Knee Joint	Movement	Right Active	Left Passive	Right Passive	Left Active
	Flexion	130-135⁰	0-10⁰	80-90⁰	50-60⁰
	Extension	0⁰	0⁰	0⁰	0⁰

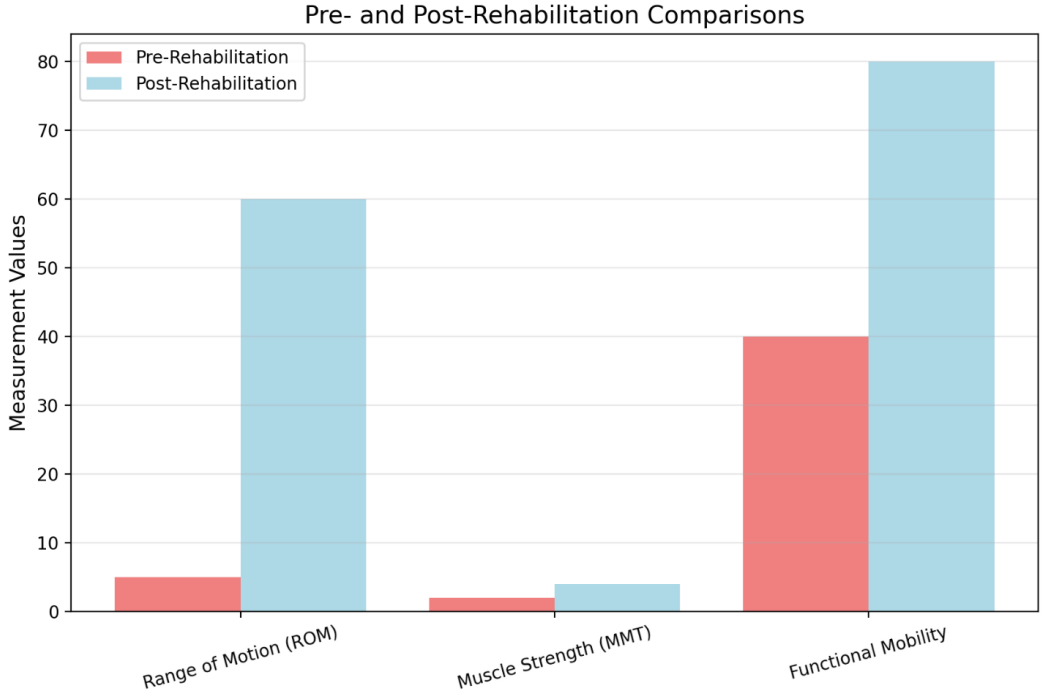
Table No: 7 Post Rehabilitation range of motion

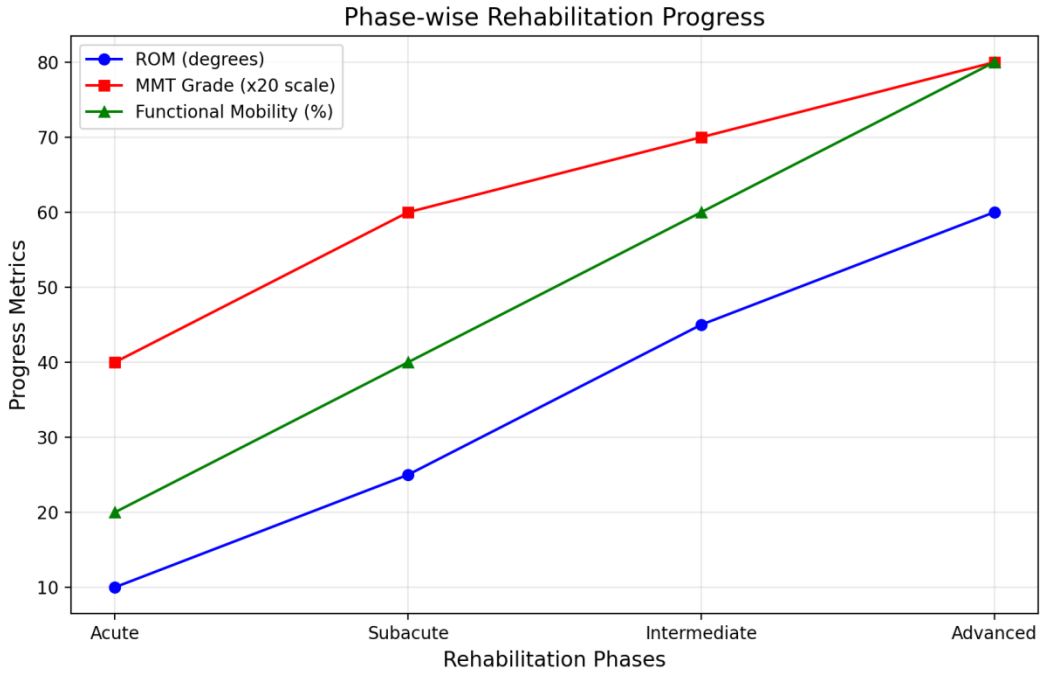
Data Analysis

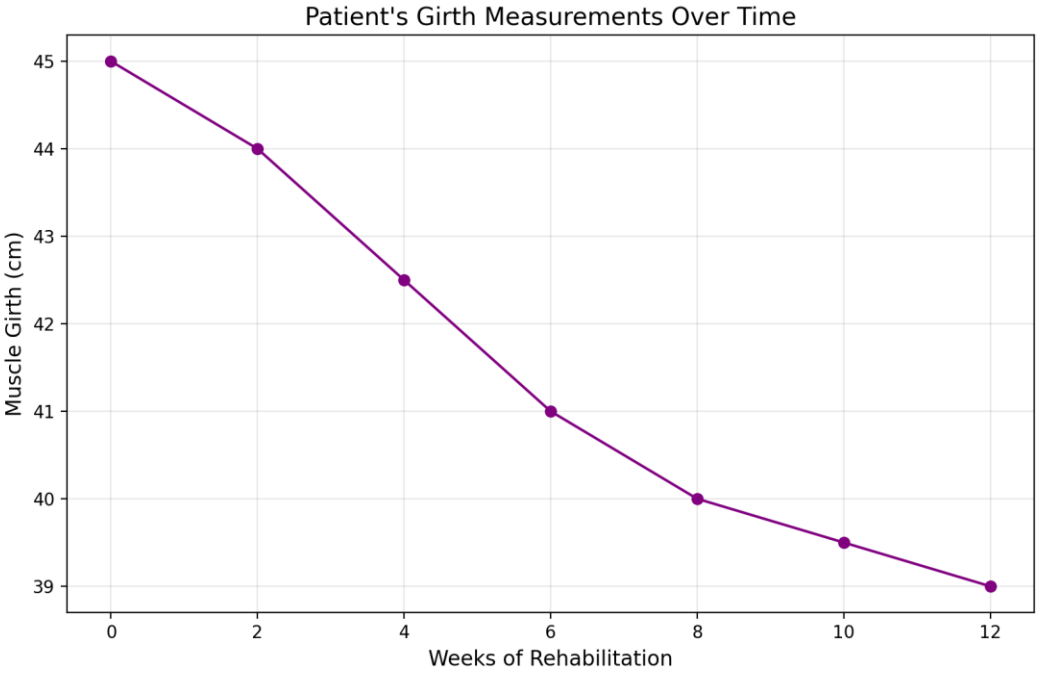


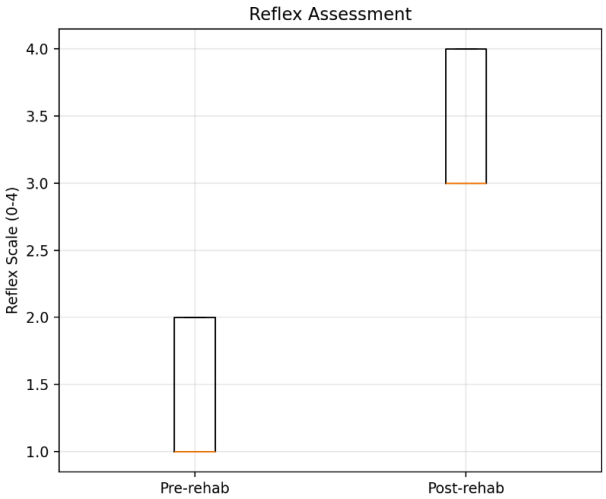

Muscle Strength Improvement (MMT Grading) Over Time
MMT Grade
MMT Grade (1 to 5 scale)
5
4
3
2
1
0
4
8
12
Weeks of Rehabilitation

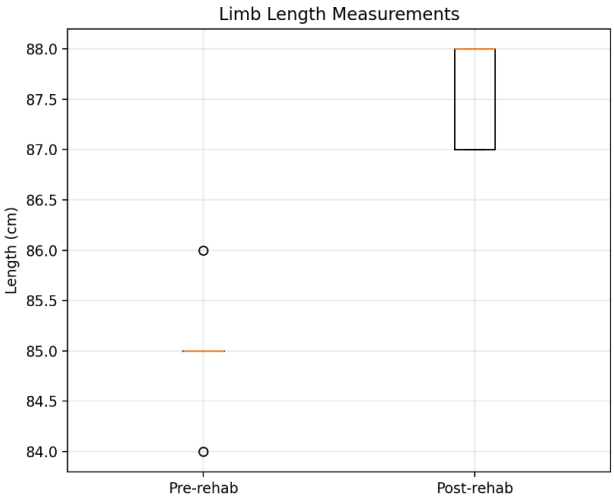

Functional Mobility Improvement Over Time
tair Climbing
Walking
Standing
Sitting
0
20
40
60
80
100
Performance Improvement (%)


Pre- and Post-Rehabilitation Comparisons
Pre-Rehabilitation
Post-Rehabilitation
Measurement Values
0
10
20
30
40
50
60
70
80
Range of Motion (ROM)
Muscle Strength (MMT)
Functional Mobility


Phase-wise Rehabilitation Progress
ROM (degrees)
MMT Grade (x20 scale)
Functional Mobility (%)
Progress Metrics
10
20
30
40
50
60
70
80
Acute
Subacute
Intermediate
Advanced
Rehabilitation Phases


Patient's Girth Measurements Over Time
Muscle Girth (cm)
Weeks of Rehabilitation
45
44
43
42
41
40
39
0
2
4
6
8
10
12


Reflex Assessment
Reflex Scale (0-4)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Pre-rehab
Post-rehab


Limb Length Measurements
Length (cm)
88.0
87.5
87.0
86.5
86.0
85.5
85.0
84.5
84.0
Pre-rehab
Post-rehab

Results

1. Improved Range of Motion (ROM):significant increase in knee flexion ROM, from 5°to 60°,after 12 weeks of rehabilitation.
2. Enhanced Muscle Strength: Quadriceps muscle strength improved from 2/5 to 4/5 on the Manual Muscle Testing (MMT) scale.
3. Functional Mobility: The patient showed improved functional mobility, including increased ability to walk, run, and climb stairs.

Discussion

In this study, we clinically demonstrated that different physiotherapy methods provide positive improvement in knee flexion joint movement, health status to patients diagnosed with knee contracture. Values were improved post-treatment compared to pre-treatment, as well as, in the long-term, through the third month after treatment. Although there are many causes of knee contracture, one of the most common causes is immobilization. A joint may be immobilized due to factors including fractures requiring a brace, inflammatory diseases such as rheumatoid arthritis, paralysis, spasticity or muscle diseases Previous studies have demonstrated that, immobilization causes deterioration in the structure of collagen fibrils, shortening of the ligaments and joint capsule, and fibrosis, leading to contracture. Also, degeneration of articular cartilage, which is mostly irreversible, occurs as a result of immobilization. Patients developing knee contracture due to immobilization were included in this study. Most of the patients developed contracture as a result of a fracture caused by trauma. The causes of trauma included primarily traffic accidents, followed by occupational accidents, falls and sports injury. In order to objectively assess treatment responses, patients with similar etiopathogeneses were included in the study. In a previous study, the knees of healthy mice and rabbits were immobilized and two weeks after immobilization, the development of knee contracture was detected. Furthermore, in the serial observations of 2-12 weeks after immobilization, a progressive increase in the severity of contracture over time was observed. Therefore, for immobile patients, it is very important to start physical activity and ROM exercises single movement of the joint each day may prevent contracture development. The earliest any patient included in our study received treatment was 2 years after trauma. thus, significant degeneration arose in these patients. Joint cartilage, collagen fibers and periarticular structures. Although most of the patients in group 1

and group 2 involved in to rehabilitation very late, the range of motion increase, health status and significantly improved after treatment. This situation indicates us that the physical therapy and rehabilitation programmed which consists both stretching exercises and physical therapy modalities, if applied in the early period may be more effective. Joint cartilage, collagen fibers and periarticular structures. Although most of the patients in group 1 and group 2 involved in to rehabilitation very late, the range of motion increase, health status and significantly improved after treatment, This situation indicates us that the physical therapy and rehabilitation programmed which consists both stretching exercises and physical therapy modalities, if applied in the early period may be more effective. Therefore, to prevent contracture in immobile patients, it is highly important that patients be made aware of and begin an appropriate physiotherapy and rehabilitationprogramas soon as possible. If preventive treatment methods are not applied properly, contracture may develop. In such cases, patients should be treated with an appropriate physiotherapy and rehabilitation program. Physiotherapy and rehabilitation with superficial and deep heaters (hot packs, US, WP, hydrotherapy, etc.),

ROM exercises, progressive resistive exercises, iontophoresis treatment, serial plastering are commonly used in knee contracture treatment. If success cannot be achieved using conservative treatments, surgical methods may be used as well. Stretching exercises (SE) are a basic physiotherapy treatment for contracture. ROM increases with stretching and pain and adhesion decrease. If stretching is not performed, collagen fibers shorten progressively. The simplest and most common type of stretching used for increasing muscle flexibility is static stretching. In a previous study which assessed the effects of SE on humans, long-term stretching with low resistance was found to be more effective. Heat application, another alternative for contracture treatment, increases the extension capacity of collagen. Heat may be applied superficially or deeply. Through heat application, stretching of scar tissue and adhesion is facilitated. We determined the patient treatments for our study based on this information. To determine the effectiveness of both deep and superficial heat separately, we created different treatment groups for each. Paraffin wax and whirlpool can be used as superficial heating agents before stretching exercises. In our study we preferred whirl pool therapy for superficial heating before stretching exercises. The most important reason of this is the easy use of whirl pool for the lower extremity joints like knee according to the paraffin wax. The purpose of each treatment program was to decrease pain complaints and to improve patients' depression level and health status. Currently, only a limited number of studies on knee contracture exist. Therefore, although our study contains a small number of patients, it provides important information on the subject of knee contracture. In the present study, knee contracture was most frequently observed in the form of flexion contracture as well as extension contracture with severe knee stiffness. The most common cause of immobilization, leading to knee contracture, was a traffic accident and the trauma most often affected the femoral shaft. Among contracture patients, pain complaints may arise in daily life and during rehabilitation programs, negatively affecting the treatment programs.

As previous studies were largely performed on rats, pain was not assessed. In our study, in the long-term compared to pre-treatment. This situation may be associated with range of motion enhancing of patients in before treatment. Since there was no significant difference between the groups, it was observed that the ROM increase could be achieved through SE alone. Due to the decrease in joint range of motion, knee contracture patients have trouble performing daily activities and may become dependent on others; often negatively affected. In the present study, all of the treatment groups demonstrated significant improvement in their goniometer ROM and MMT grade in the long-term compared to pre treatment. Accordingly, as knee joint range of motion patient improves as well.

The knee joint bears the weight of the body, enables an individual to stand straight, provides the ability to balance and walk and plays a first-degree role in active life. Therefore, since knee contracture leads to function loss, it significantly affects the gait pattern, sitting, factors as well. Inourstudy, significant improvement in health status, ROM achieved 5° to 60° physical function and pain, was observed in all treatment groups in the long-term compared to pre - treatment.

Thus, according to our results, the same functional improvement may be accomplished through SE and mobilization alone without heat application. In the literature, a small number of studies exist that address knee contracture rehabilitation and most of them were performed on animals. In one such study, electric stimulation and placebo were compared in knee contracture. [12]

Conclusion

This case study demonstrates the effectiveness of a targeted rehabilitation program in improving knee flexion ROM, muscle strength, and functional mobility in a 3-year-old patient. The results suggest that early intervention and intensive rehabilitation can lead to significant improvements in knee function and overall mobility.

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