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DESIGNING AND DEVELOPING ACTIVE ASSISTED EXERCISE PROTOCOLS FOR BEDRIDDEN PATIENTS: A PHYSIOTHERAPY REHABILITATION FRAMEWORK

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ABSTRACT

Background: Early rehabilitation following immobilization, surgery, or neurological impairment is often limited by pain, muscle weakness, and reduced neuromuscular control. During this phase, patients are unable to perform full active movements, increasing the risk of stiffness, contracture, and disuse atrophy. Active Assisted Exercise (AAE) serves as a transitional intervention between passive and active movement, allowing patient-initiated contraction with external assistance while protecting healing tissues. **Objective:** To design and develop a comprehensive, clinically applicable Active Assisted Exercise protocol in lying position covering major joints of the upper and lower extremities for bedridden patients. **Methods:** A structured physiotherapy rehabilitation framework was formulated based on therapeutic exercise principles, kinesiology, and functional movement requirements. Exercises were organized joint-wise, including shoulder, elbow, wrist, hand, hip, knee, and ankle movements. Each activity emphasized pain-free range, proper alignment, controlled assistance, and gradual progression toward independent motion. Assistance was provided through therapist support, gravity-eliminated positioning, or the unaffected limb. **Results:** The developed protocol enables safe mobilization with minimal mechanical stress, facilitates neuromuscular re-education, improves joint mobility, and prevents secondary complications such as contracture, edema, and muscle atrophy. The lying position reduced compensatory

movements and improved patient confidence. The program also demonstrated feasibility as a low-cost supervised home exercise regimen. **Conclusion:** The designed AAE lying protocol provides a simple, reproducible, and clinically practical rehabilitation framework that bridges passive therapy and active strengthening. It promotes early functional recovery and supports progression toward independent mobility and activities of daily living in patients with muscle strength grades 2–3 and limited voluntary movement.

KEYWORDS: Active Assisted Exercise, Bedridden Patients, Early Rehabilitation, Neuromuscular Re-Education, Physiotherapy Protocol, Mobility Restoration.

INTRODUCTION:

Restoration of movement is a primary goal of physiotherapy rehabilitation following injury, immobilization, surgery, or neurological impairment. Many patients in the early stages of recovery are unable to perform full voluntary movement due to muscle weakness, pain, reduced neuromuscular control, or fear of movement. During this phase, therapeutic interventions must promote mobility while simultaneously preventing tissue overload and secondary complications such as stiffness, contracture, and disuse atrophy.

Active Assisted Exercise (AAE) represents an essential transitional stage between passive and active movement. In this method, the patient actively initiates muscle contraction, while an external assistance — provided by a therapist, unaffected limb, gravity-eliminated positioning, or simple mechanical support — enables completion of the movement through the available range. Unlike passive exercise, AAE facilitates neuromuscular activation and motor relearning, yet avoids excessive stress on healing structures. Therefore, it is widely used in patients with muscle strength grades 2 to 3, post-immobilization conditions, post-operative states, and neurological disorders.

Positioning plays a critical role in determining exercise effectiveness. Lying positions reduce gravitational resistance, minimize compensatory movements, and improve patient confidence. This makes them particularly suitable during early rehabilitation when patients cannot overcome gravity or maintain postural stability in sitting or standing. Despite the frequent clinical use of AAE, standardized, structured protocols covering both upper and lower extremities in a systematic manner remain limited in clinical documentation.

Hence, there is a need to develop a simple, reproducible, and clinically applicable guideline that physiotherapists and patients can follow safely. A well-designed lying-position AAE

program can enhance joint mobility, promote muscle activation, facilitate functional recovery, and allow gradual progression toward independent active movement.

Therefore, the present work aims to design and compile a comprehensive protocol of active assisted exercises in lying position covering major joints of both upper and lower limbs, based on therapeutic exercise principles and functional rehabilitation requirements.

DEFINITION

Assisted exercise is a type of exercise in which the movement is performed partly by the patient and partly with the help of an external force such as therapist,equipment or gravity reduced position-**CAROLYN KISNER AND COLBY`**

EXERCISE PROTOCOL

LYING

Upper exterimity

Joint:shoulder joint

Movement:flexion

Range of motion:0 – 180*

Muscle work: Anterior deltoid and coracobrachialis

Position of patient:supine lying

Procedure:

*Affected side –instruct the patient to lift their extremity as much they can

*unaffected side –1.Hold the affected arm at elbow or wrist joint with unaffected hand [depends upon the patients comfortable]

2. lift the weak arm to overhead ,close to the ear and return to the normal position

Upper exterimity

Joint:shoulder joint

Movement:extension

Range of motion:45* – 60*

Muscle work:latissmus dorsi and posterior deltoid

Position of patient:prone lying

Procedure:

*Affected side – instruct the patient to lift their affected hand on upwards as much they can

* Unaffected side-1.assist the affected arm with the unaffected hand by grasping the forearm just below the elbow

2. slightly lift the arm to pain free range and return to the normal position

Upper exterimity

Joint:shoulder joint

Movement:abduction

Range of motion:0-180^

Muscle work:middle fibre of deltoid,supra spinatus

Position of patient:supine lying

Procedure:

*Affected side – instruct the patient to lift their affected hand on away from the body as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by grasping the elbow

2.slightly lift the arm away from the body at pain free range and return to the normal position

Upper exterimity

Joint:shoulder joint

Movement:adducion

Range of motion:180^or 170^ - 0^

Muscle work:latismus dorsi,teres major,pectoralis major

Position of patient:supine lying

Procedure:

*Affected side – instruct the patient to pull their affected hand on inward to the body as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by grasping the elbow

2.slightly pull the affected arm inward to the body at pain free range and return to the normal position

Upper exterimity

Joint:shoulder joint

Movement:external rotation

Range of motion: 0^-90^

Muscle work:latismus dorsi,teres major,pectoralis major,subscapularis

Position of patient:supine lying

Procedure:

*Affected side – instruct the patient to flex their elbow 90^and arm should be abducted 90^ and make them to tilt the arm backward as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by grasping the wrist

2.slightly push the affected arm backward at pain free range and return to the normal position

Upper exterimity

Joint:shoulder joint

Movement:internal rotation

Range of motion: 0^-70^ to 90^

Muscle work:latismus dorsi,teres major,pectoralis major,subscapularis

Position of patient:supine lying

Procedure:

*Affected side – instruct the patient to flex their elbow 90^and arm should be abducted 90^ and make them to tilt the arm forward as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by grasping the wrist

2.slightly pull the affected arm forward at pain free range and return to the normal position

Upper exterimity

Joint:elbow joint

Movement:flexion

Range of motion: 0^-140^ to 150^

Muscle work:biceps brachii,brachioradialis,brachialis

Position of patient:supine lying

Procedure:

*Affected side – instruct the patient to flex their elbow as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by hold the wrist

2.slightly lift the affected arm with unaffected hand and flex about pain free range and return to the normal position

Upper exterimity

Joint:elbow joint

Movement:extension

Range of motion: 140^ to 150^- 0^

Muscle work:triceps brachii anconeus

Position of patient:supine lying

Procedure:

*Affected side – instruct the patient to extend their elbow as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by hold the wrist

2.slightly push the affected arm downward with unaffected hand and extend about pain free range and return to the normal position.

Upper exterimity

Joint:radioulnar joint

Movement:supination

Range of motion:0*-80*or 90*

Muscle work:biceps brachii,supinator

Position of patient:supine lying

Procedure:

*Affected side –guide the patient to hold elbow at 90^ and turn the forearm as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by holding the dorsal side of hand

2.slightly turn the affected arm where the palm faces patient to supination in pain free range and return to the normal position

Upper exterimity

Joint:radioulnar joint

Movement:pronation

Range of motion: 0*-80*or 90*

Muscle work:pronator teres,pronator quadratus

Position of patient:supine lying

Procedure:

*Affected side –guide the patient to hold elbow at 90^ and turn the forearm as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by holding the dorsal side of hand

2.slightly turn the affected arm where the palm faces opposite to the patient to pronation in pain free range and return to the normal position.

Upper exterimity

Joint:wrist joint

Movement:flexion

Range of motion: 0^-60^ to 80^

Muscle work:flexor carpi radialis,flexor carpi ulnaris,palrmaris longus

Position of patient:supine lying

Procedure:

*Affected side –guide the patient to flex elbow at 90^ and instruct them to bend the wrist toward the palm[forward]as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by holding the carpal and metacarpal bones

2.by holding the hand in wrist should pulled downwards [palm facing forward] in pain free range and return to the normal position

Upper exterimity

Joint:wrist joint

Movement:extension

Range of motion: 0^-70^ to 90^

Muscle work:extensor carpi radialis longus, extensor carpi radialis brevis, extensor carpi ulnaris

Position of patient:supine lying

Procedure:

*Affected side –guide the patient to flex elbow at 90^ and instruct them to bend the wrist to the back of hand as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by holding the carpal and metacarpal bones

2.by holding the hand in wrist should pushed downwards [palm facing roof] in pain free range and return to the normal position.

Upper exterimity

Joint:wrist joint

Movement:ulnar deviation

Range of motion:30* - 45*

Muscle work:flexor digitorum profundus,extensor digitorum

Position of patient:supine lying

Procedure:

*Affected side –guide the patient to flex elbow at 90^ and instruct them to bend the wrist toward little finger as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by holding the carpal and metacarpal bones

2.by holding the hand in wrist should tilt on medial side at pain free range and return to the normal position

Upper exterimity

Joint:wrist joint

Movement:radial deviation

Range of motion:0^-20^to25^

Muscle work: extensor carpi radialis longus, extensor carpi radialis brevis, flexor carpi radialis

Position of patient:supine lying

Procedure:

*Affected side –guide the patient to flex elbow at 90^ and instruct them to bend the wrist toward thumb side as much they can

* Unaffected side-1. assist the affected arm with the unaffected hand by holding the carpal and metacarpal bones

2.by holding the hand in wrist should tilt on lateral side at pain free range and return to the normal position.

Upper exterimity

Joint:metacarpo phalangeal joint

Movement:flexion

Range of motion:0^-90^

Muscle work:lumbricals,interossei

Position of patient:supine lying

Procedure:

*Affected side –guide the patient to flex elbow at 90^ and instruct them to flex the fingers toward palm as much they can

* Unaffected side-1. Guide the patient to affected arm with the unaffected hand by holding the phalanges [2nd to 5th]

2.flex the phalanges toward the palm at pain free range and return to the normal position.

Upper exterimity

Joint:metacarpo phalangeal joint

Movement:extension

Range of motion:0^-45^

Muscle work:extensor digitorum,extensor indicis,extensor digiti minimi

Position of patient:supine lying

Procedure:

*Affected side –guide the patient to flex elbow at 90^ and instruct them to extend the fingers outward the palm as much they can

* Unaffected side-1. Guide the patient to affected arm with the unaffected hand by holding the phalanges [2nd to 5th]

2.extend the phalanges behind the palm at pain free range and return to the normal position.

lower exterimity

Joint:hip joint

Movement:flexion

Range of motion: 0*-90*

Muscle work:iliopsoas

Position of patient:supine lying

Peocedure:

*Affected side – instruct the patient to lift their legs upward as much they can

* Unaffected side-1. Over the ankle[between the two malleolus] of unaffected leg placed on the back of ankle in affected leg

2. lift the affected leg with support of unaffected leg in upward at pain free range and return to the normal position.

lower exterimity

Joint:hip joint

Movement:extension

Range of motion: 0*-20*

Muscle work:gluteus maximus

Position of patient: prone lying

Peocedure:

*Affected side – instruct the patient to lift their legs upward as much they can

* Unaffected side-1. Over the ankle[between the two malleolus] of unaffected leg placed on the back of ankle in affected leg

2. lift the affected leg with support of unaffected leg in upward at pain free range and return to the normal position.

lower exterimity

Joint:hip joint

Movement:abduction

Range of motion:0* to 40*-45*

Muscle work:gluteus medius ,gluteus minimus

Position of patient: supine lying

Peocedure:

*Affected side – instruct the patient to lift their legs outward to the body as much they can

* Unaffected side-1.flex the knee 90* place their foot on medial condyle of the affected side leg

2. push the affected leg outward to the body with the support of unaffected leg at pain free range and return to the normal position

lower exterimity

Joint:hip joint

Movement:adduction

Range of motion: 20*-30*

Muscle work:adductor medius, adductor brevis, adductor magnus

Position of patient: supine lying

Peocedure:

*Affected side – instruct the patient to lift their legs inward to the body as much they can

* Unaffected side-1.flex their hip and knee,place their foot on lateral condyle of the affected side(crossed leg position)

2. pull the affected leg inward to the body with the support of unaffected leg at pain free range and return to the normal position.

lower exterimity

Joint:hip joint

Movement:medial rotation

Range of motion: 0*-30* to 40*

Muscle work:anterior gluteus medius,gluteus minimus

Position of patient: supine lying

Peocedure:

Affected side – instruct the patient to flex their hip and knee at 90 as much they can

* hand placement -1.place one hand at proximal joint(knee joint) to stabilize it and place another hand on distal joint (ankle joint)

2.pull the distal joint outward to the body at pain free range and return to the normal position

lower exterimity

Joint:hip joint

Movement:lateral rotation

Range of motion: 40*-60*

Muscle work:gluteus maximus,piriformis

Position of patient: supine lying

Peocedure:

Affected side – instruct the patient to flex their hip and knee at 90 as much they can

* hand placement -1.place one hand at proximal joint(knee joint) to stabilize it and place another hand on distal joint (ankle joint)

2.pull the distal joint inward to the body at pain free range and return to the normal position

lower exterimity

Joint:knee joint

Movement:flexion

Range of motion:0^-130^to140^

Muscle work:hamstring

Position of patient:prone lying

Procedure:

*Affected side – instruct the patient to flex their leg upward as much they can

* Unaffected side-1. Support the unaffected by placing under the affected leg[over the ankle]

2.guide them to lift their affected leg with help of unaffected leg at pain free range and return to the normal position.

lower exterimity

Joint:knee joint

Movement:extension

Range of motion: 130^to140^-0^

Muscle work:quadriceps femoris group

Position of patient:prone lying

Procedure:

*Affected side – instruct the patient to extend their leg downward as much they can

* Unaffected side-1. Support the unaffected by placing above the affected leg[back of the ankle]

2.guide them to push their affected leg with help of unaffected leg at pain free range and return to the normal position

lower exterimity

Joint:ankle joint

Movement:dorsiflexion

Range of motion:0*-20*

Muscle work:tibialis anterior,extensor hallicius longus,digitorum longus

Position of patient:supine lying

Procedure:

*Affected side – instruct the patient to bring their toes toward the body as much they can

* Unaffected side-1. Support the affected leg on below by placing the toes of unaffected leg 2.slightly bring the affected toe closer to leg at pain free range and return to the normal position.

lower exterimity

Joint:ankle joint

Movement:plantarflexion

Range of motion:0^-45^to55^

Muscle work:gastrocnemius,soleus

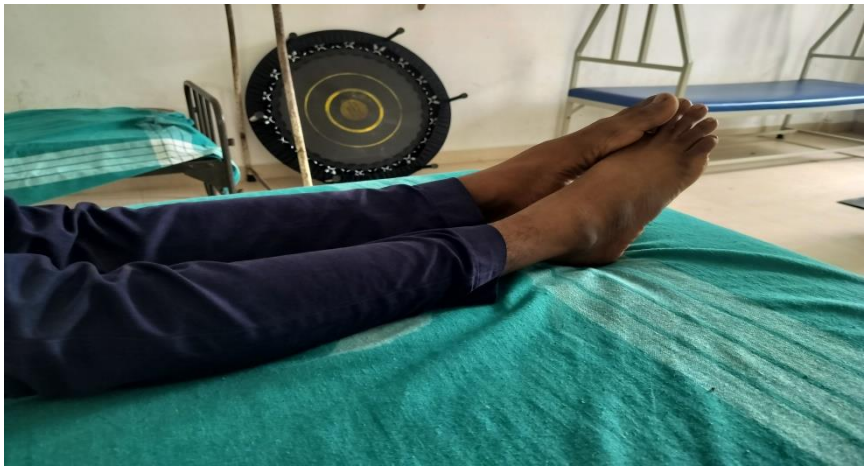
Position of patient:supine lying

Procedure:

*Affected side – instruct the patient to push their toes outward the body as much they can

* Unaffected side-1. Support the affected leg on below by placing above the toes of unaffected leg

2.slightly push the affected toe at pain free range and return to the normal position.



lower exterimity

Joint:subtalar joint

Movement:inversion

Range of motion: 0^-30^ to 35^

Muscle work:tibialis anterior and tibialis posterior

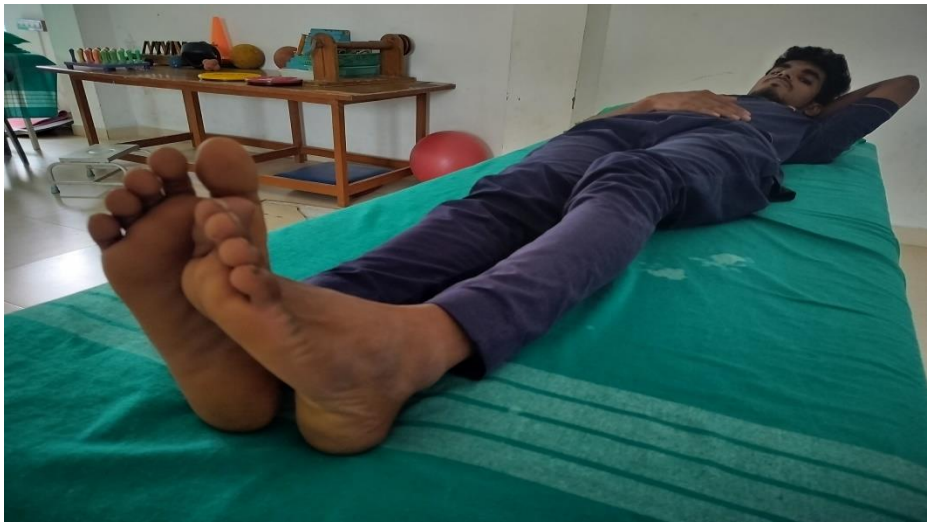
Position of patient:supine lying

Procedure:

*Affected side – instruct the patient to bend-inward their toes as much they can

* Unaffected side-1. The 1st metatarsal [bigtoe] is placed below the 1st metatarsal of affected toe

2. lift the toe inward to body at pain free range and return to the normal position



lower exterimity

Joint:subtalar joint

Movement:eversion

Range of motion: 0^-15^ to 20^

Muscle work:fibularis longus ,fibularis brevis

Position of patient:supine lying

Procedure:

*Affected side – instruct the patient to bend-inward their toes as much they can

* Unaffected side-1. The 1st metatarsal [bigtoe] is placed below the 1st metatarsal of affected toe

2. lift the toe inward to body at pain free range and return to the normal position.

CLINICAL UTILITY

The developed Active Assisted Exercise (AAE) protocol in lying position provides a practical and clinically applicable rehabilitation framework for patients who are unable to perform full active movements during the early stages of recovery. By minimizing gravitational load and allowing patient-initiated movement with minimal assistance, the program enables safe mobilization without overstressing healing tissues. This makes the protocol suitable for conditions such as post-immobilization stiffness, post-operative states, neurological weakness, pain-limited movement, and muscle strength grades 2–3.

The structured progression from assisted movement toward independent activity facilitates neuromuscular re-education, improves joint mobility, and prevents complications including contracture, stiffness, edema, and disuse atrophy. Because the exercises are performed in lying, compensatory movements are reduced and correct movement patterns can be reinforced early in rehabilitation. This helps restore motor control and prepares patients for functional positions such as sitting, standing, and gait training.

An additional advantage of this protocol is its simplicity and low cost. Most exercises utilize the unaffected limb as the assisting force, allowing patients to practice safely outside therapy sessions as a supervised home exercise program. This improves patient participation, adherence, and continuity of care while reducing therapist dependency.

Overall, the AAE lying protocol serves as an effective bridge between passive therapy and active strengthening, promoting safe functional recovery and facilitating return to activities of daily living.

DISCUSSION

- Active assisted exercise (AAE) serves as an intermediate stage between passive and active movement, helping patients regain voluntary control safely. The designed protocol uses lying positions to reduce gravitational load, making exercises suitable for individuals with muscle weakness, pain, post-immobilization stiffness, or neurological impairment.
- The program focuses on patient-initiated movement with minimal assistance to prevent dependency and promote neuromuscular re-education. Proper stabilization and controlled motion reduce compensatory patterns and support correct muscle activation. Gradual reduction of assistance allows progression from passive to active and eventually resisted exercise.
- By including both upper and lower limb movements, the protocol improves joint mobility and supports functional activities of daily living. Overall, the AAE program is a simple, low-

cost, and clinically applicable method that safely bridges early rehabilitation toward independent functional recovery.

CONCLUSION

- The present work successfully designed and compiled a comprehensive protocol of **active assisted exercises (AAE) in lying positions** covering major joints of both upper and lower extremities. The structured procedures emphasize patient-initiated movement with minimal external support, ensuring that exercise remains active rather than passive. By following principles such as pain-free range, proper alignment, gradual assistance, and controlled movement, the program promotes safe restoration of joint mobility and neuromuscular control.
- These exercises are especially useful for patients with muscle weakness (MMT grade 2–3), post-immobilization stiffness, post-surgical conditions, and neurological impairments where full active motion is not yet achievable. The protocol also supports functional recovery by facilitating muscle re-education and preventing complications like stiffness, contracture, and disuse atrophy.
- Overall, the developed AAE guideline provides a simple, low-cost, and clinically applicable rehabilitation framework that can be easily implemented by physiotherapists and taught to patients for supervised home programs. With appropriate progression toward active and resisted exercises, this program can effectively bridge the transition from passive movement to independent functional mobility.

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