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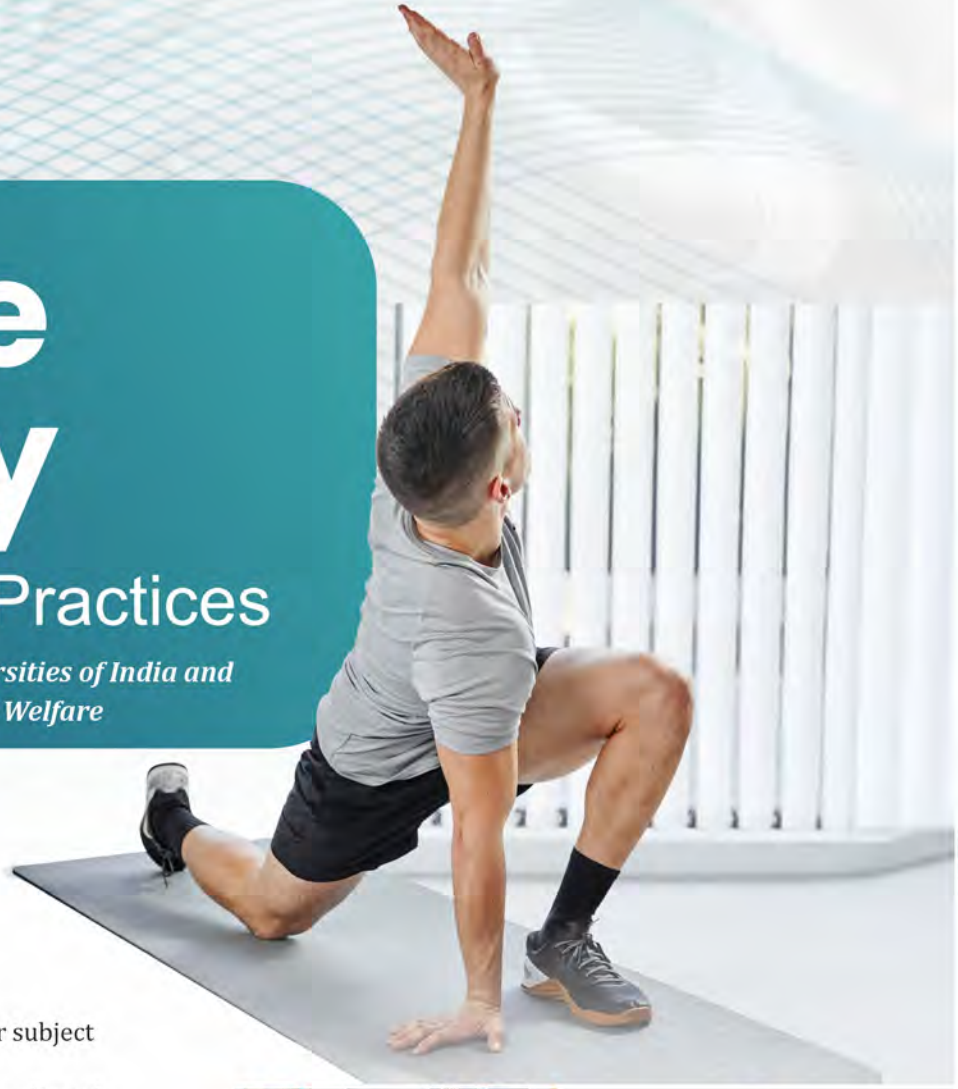
Fundamentals & Practices

As per Physiotherapy Curriculum of All Universities of India and NCAHP, Ministry of Health & Family Welfare



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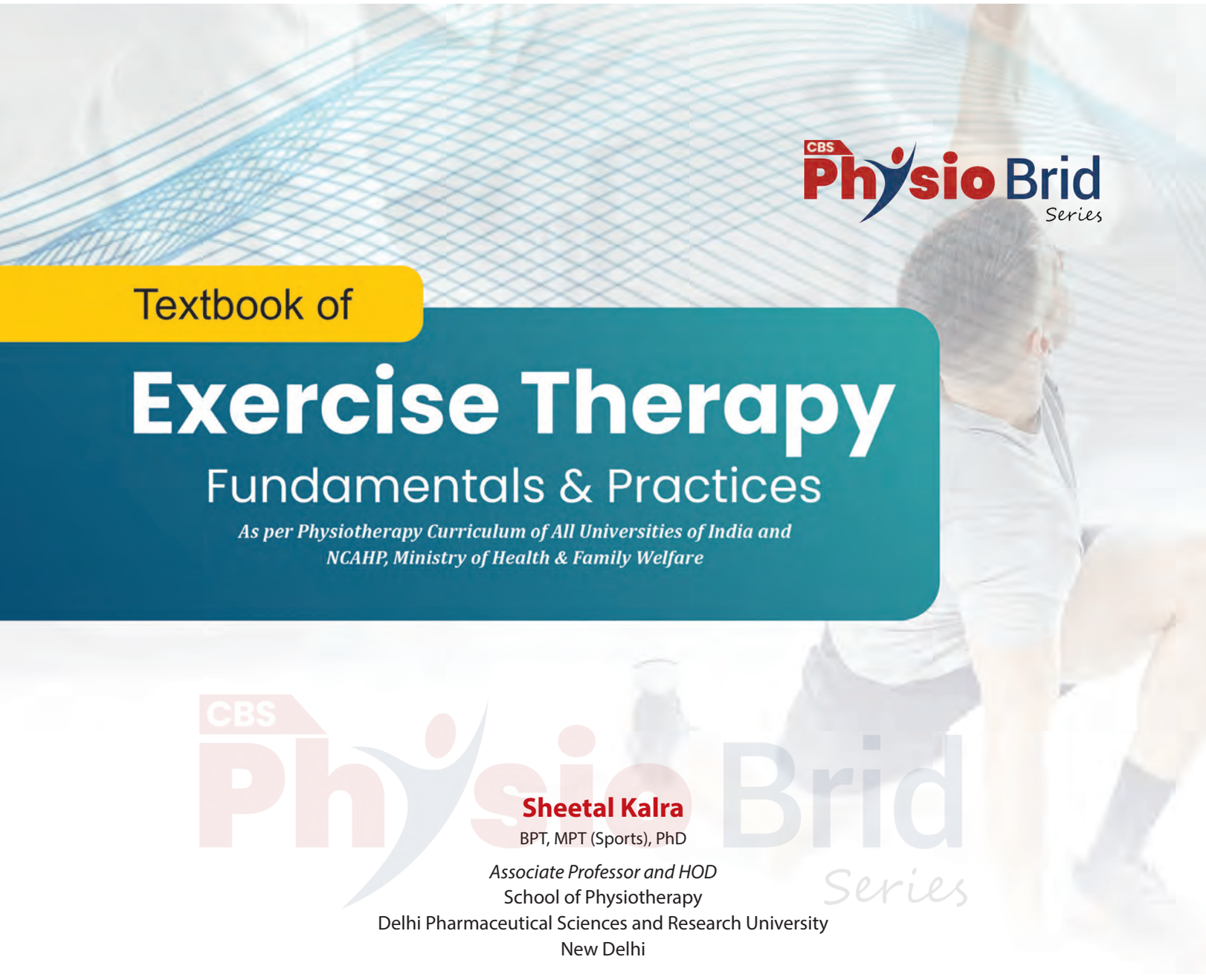

Textbook of

Exercise Therapy

Fundamentals & Practices

As per Physiotherapy Curriculum of All Universities of India and NCAHP, Ministry of Health & Family Welfare

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Dedicated to

the Almighty God and my beloved family

Foreword

Exercise therapy plays the role of foundation stone in the field of Physiotherapy bridging the gap between injury, rehabilitation, and optimal physical function. For many individuals, the journey to recovery goes beyond clinical treatments and involves a dedicated effort to restore the body through well-structured, evidence-based exercises. While the human body is inherently resilient, it often requires specialized support to recover from injuries or manage the complexities of chronic conditions. Exercise therapy is crucial in restoring balance and functional capacity. In the context of today's multidisciplinary rehabilitation approach, exercise therapy ensures a holistic and effective path to recovery.

With great excitement, I recommend *Textbook of Exercise Therapy—Fundamentals and Practices* that is a thorough resource tailored for physiotherapy students, educators, and practitioners. Exercise therapy is a dynamic and ever-evolving field, enriched by new techniques, insights, and evidence that continuously enhance the understanding of movement and recovery. This book bridges foundational concepts with advanced therapeutic methods, ensuring readers are equipped with the essential knowledge and practical skills needed to provide exceptional care in the field of physiotherapy.

The primary aim of this book is to offer a comprehensive information regarding fundamentals of exercise therapy. It provides readers with a deep understanding of the key principles behind human movement, muscle function, and therapeutic interventions. By covering all techniques of practice, *Textbook of Exercise Therapy—Fundamentals and Practices* ensures that physiotherapy professionals gain a well-rounded perspective of the core components of exercise therapy.

The book also includes essential practical skills—such as Manual Muscle Testing (MMT), goniometry, and neuromuscular assessments—empowering practitioners to enhance their clinical proficiency. The structure of the book has been carefully crafted to balance theoretical knowledge with real-world clinical application.

- The first section, *Essentials of Exercise Therapy*, provides a comprehensive introduction to the core principles that govern human movement.
- *Examination/Testing Techniques* takes a deeper dive into the diagnostic tools and assessment methods that are crucial for evaluating neuromuscular function and joint mobility.
- The *Application of Principles of Exercise Therapy* section focuses on the practical application of exercise therapy techniques, aimed at enhancing key aspects of physical health, including mobility, strength, and flexibility.
- The *Therapeutic Techniques* section explores advanced interventions, including proprioceptive neuromuscular facilitation (PNF) and hydrotherapy—evidence-based approaches with clinical relevance.
- The *Movement and Alignment* section discusses posture, gait, balance and yoga.

Textbook of Exercise Therapy—Fundamentals and Practices is designed to be a trusted, evidence-backed resource that supports the development of physiotherapists at all stages of their career. This book provides clear, practical guidance, modern techniques, and invaluable insights that will elevate the practice and ongoing professional growth of physiotherapy professionals and students.

As you engage with the content of this book, I encourage you to view exercise therapy not just as a set of techniques, but as a transformative tool for improving patient outcomes. By blending theoretical knowledge with hands-on application, this book will empower to enhance both the well-being and functionality of the patients, advancing the clinical skills and impact on the field of physiotherapy.

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Preface

When the publishers initially approached me with the idea of authoring *Textbook of Exercise Therapy—Fundamentals and Practices*, I was both honored and skeptical. The prospect of creating a comprehensive text on a subject so vital yet ever-evolving felt daunting. However, as the project slowly took shape, the journey turned into a rewarding collaborative endeavor.

This book is the culmination of inputs from experts in the field, including seasoned academicians and professionals from the physiotherapy fraternity. Together, we meticulously developed chapter outlines, aiming to balance foundational concepts with advanced topics. The result is a blend of theoretical and research-based evidence, enriched with practical insights, which I believe will be immensely useful for students, educators, and practitioners alike.

The book is organized into five sections. The first section, *Essentials of Exercise Therapy*, lays the groundwork with chapters on mechanics, muscle action, and the basics of therapeutic exercises. These chapters aim to provide readers with a strong foundation of the principles of exercise therapy.

The second section, *Examination/Testing Techniques*, delves into essential diagnostic tools such as manual muscle testing, goniometry, and assessment of neuromuscular efficiency. These chapters emphasize the practical application of assessment methods, equipping readers with the skills necessary for clinical practice.

In the third section, *Application of Principles of Exercise Therapy*, we explore passive and active movements, resisted exercises, stretching, and aerobic exercises. This section also focuses on functional re-education, coordination exercises, and the structuring of both group and individual exercise programs. The chapters here are designed to bridge the gap between theoretical knowledge and its real-world application.

The fourth section, *Therapeutic Techniques*, highlights advanced modalities like proprioceptive neuromuscular facilitation, manual therapy and peripheral joint mobilization, suspension therapy and hydrotherapy.

The fifth section, *Movement and Alignment*, includes topics such as posture, gait, and balance and yoga, providing a holistic perspective on rehabilitation and therapeutic interventions.

Sheetal Kalra

Acknowledgments

First of all, I would like to thank the Almighty God. The *Textbook of Exercise Therapy—Fundamentals and Practices* would not have been possible without His blessings.

I am thankful for the invaluable contributions of my colleagues and fellow physiotherapists, many of whom shared their specialized knowledge and experiences to enrich individual chapters. My sincere gratitude goes to the Institute, School of Physiotherapy, Delhi Pharmaceutical Sciences and Research University, New Delhi and the physiotherapy fraternity from adjacent colleges, whose collaboration and expertise were instrumental in shaping this work.

I extend my heartfelt thanks to the publishers for their patience and unwavering support throughout this endeavor. I hope that *Textbook of Exercise Therapy—Fundamentals and Practices* will serve as a reliable resource for its readers, inspiring both learning and application in the dynamic field of physiotherapy.

I extend my special thanks to Mr Satish Kumar Jain (Chairman) and Mr Varun Jain (Managing Director), M/s CBS Publishers and Distributors Pvt Ltd for their wholehearted support in publication of this book. I have no words to describe the role, efforts, inputs and initiatives undertaken by Mr Bhupesh Aarora (Sr. Vice President – Publishing & Marketing (Health Sciences Division)] for helping and motivating me.

My special thanks are due to Dr Divya Gupta, PT (Project Manager & Editorial [Scientific] Head – Physiotherapy) and Dr Apurva Chatterjee, PT (Content Strategist – Physiotherapy) for their valuable support, suggestions and advice that have helped me in refining the text and making it more comprehensive.

I sincerely thank the entire CBS team for bringing out the book with utmost care and attractive presentation. I would like to thank Ms Nitasha Arora (Assistant General Manager Publishing – Medical and Nursing), Ms Daljeet Kaur (Assistant Publishing Manager) and Dr Anju Dhir (Product Manager and Medical Development Editor) for their publishing support. I would also extend my thanks to Ms Surbhi Gupta (Sr. English Editor), Mr Ashutosh Pathak (Sr. Proofreader cum Team Coordinator) and all the production team members for devoting laborious hours in designing and typesetting the book.

Last but not least, I am thankful to my colleagues, peers, family and friends without whose support this book would not have been possible.

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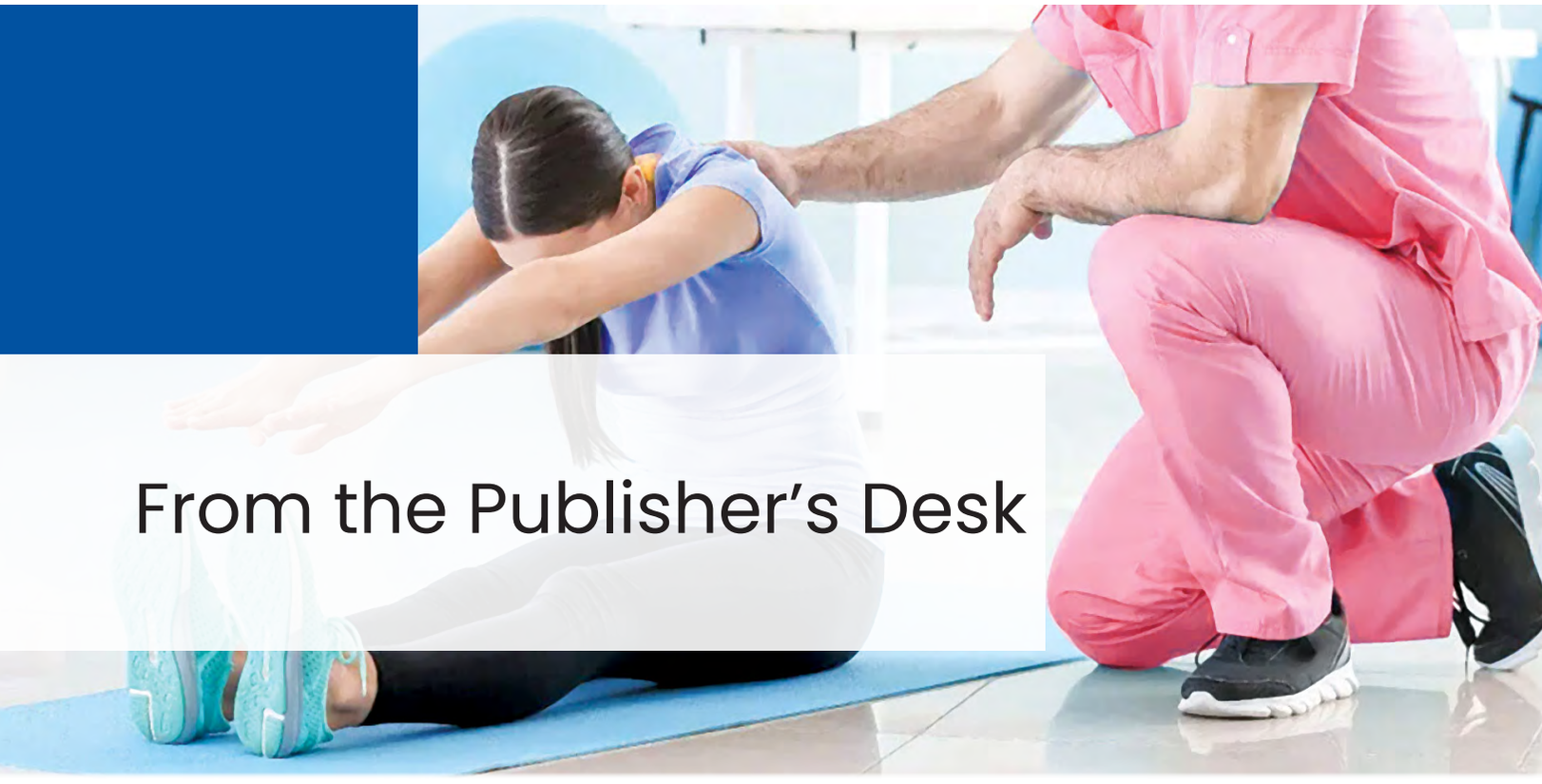

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Physiotherapy education has evolved significantly over the years, transitioning from traditional classroom-based learning to a more technology-integrated approach. Initially, students relied on lectures, reference books, and clinical training for knowledge acquisition. However, with the advancement of digital learning tools, physiotherapy education now incorporates innovative methods that enhance the learning experience and prepare students for clinical practice.

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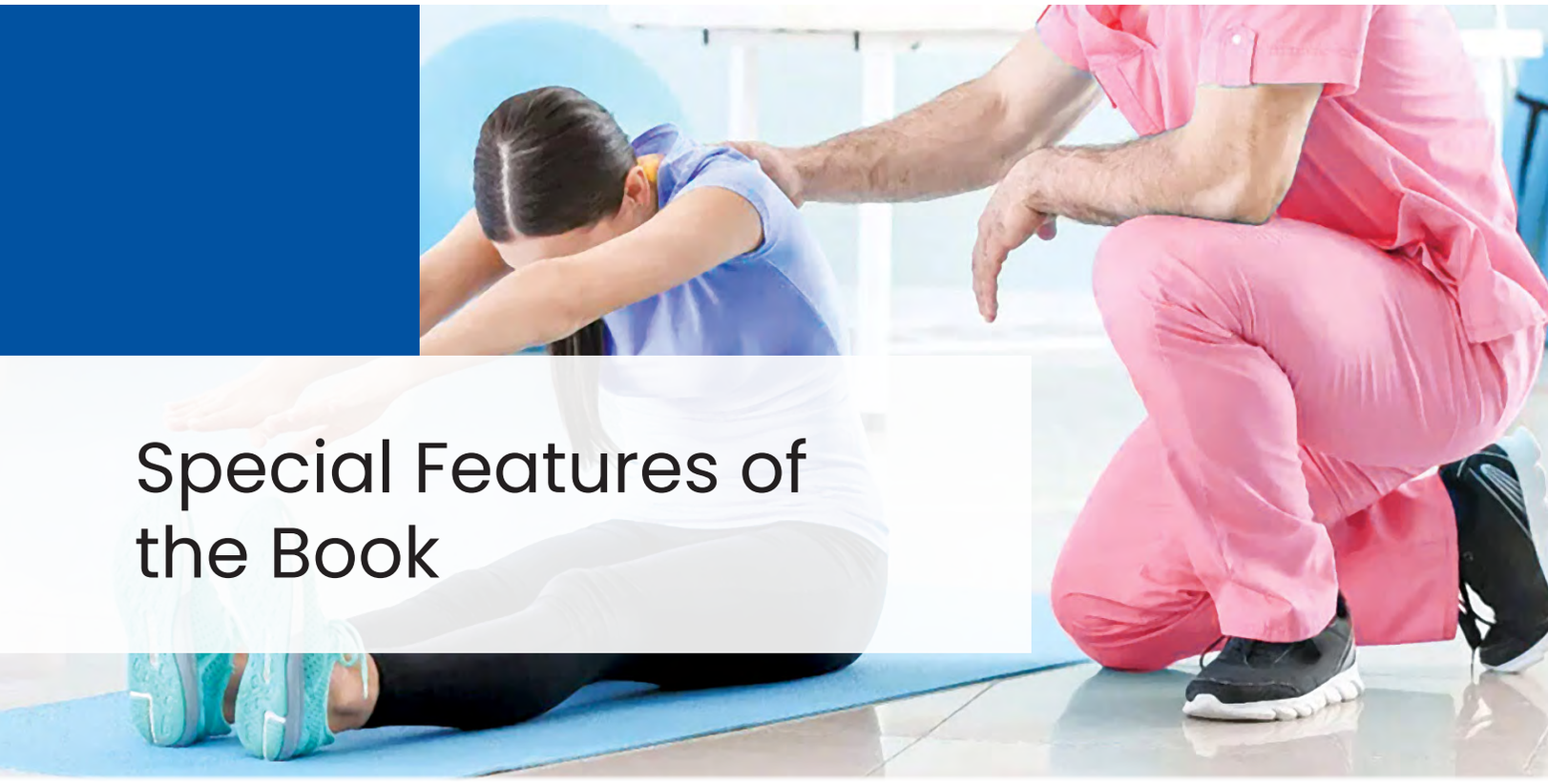


Special Features of the Book

Learning Objectives in the beginning of every Chapter help readers understand the purpose of the chapter.

LEARNING OBJECTIVES

After the completion of the chapter, the readers will be able to:

- Define force, speed, velocity, work, energy, power, acceleration, momentum, friction and inertia.
- Explain the components of forces and determine its magnitude by parallelogram of forces.
- Define gravity, center of gravity, line of gravity, and correlate its relevance with human body mechanics.

CHAPTER OUTLINE

- Introduction
- Kinematics
- Kinetics
- Force and its Composition
- Levers
- Anatomical Pulleys

Chapter Outline gives a glimpse of the content covered in the chapter.

Key Terms are added in each chapter to help understand difficult scientific terms in easy language.

KEY TERMS

Acceleration: The rate at which velocity changes in relation to time is known as acceleration in mechanics. Its SI unit is m/s^2.

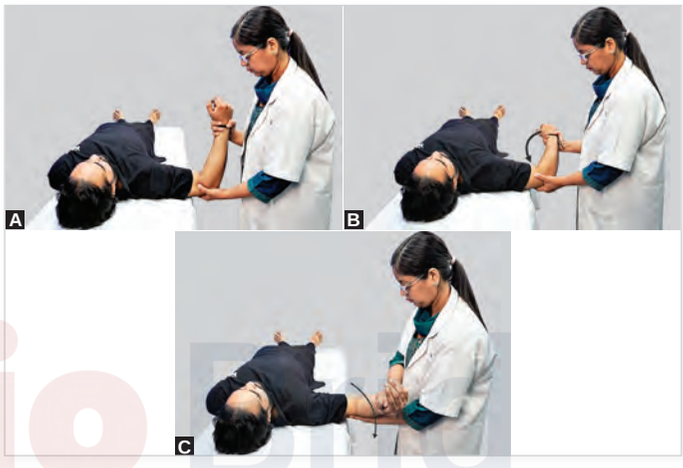
Base of Support (BoS): The term "base of support" refers to the space that is covered beneath an object or a person, i.e., the space between each point of contact the object or person makes with the supporting surface.

TABLE 22.2: Causes of Trendelenburg gait

Causes	Specific conditions
Failure of the fulcrum	Osteonecrosis of the hip
	Legg-Calvé-Perthes disease
	Developmental dysplasia of the hip
	Chronically dislocated hips secondary to trauma
	Chronically dislocated hips secondary to infections (e.g., tuberculosis of the hip)

Numerous **Tables** have been used in the chapters to facilitate learning in a quick way.

The book is well illustrated with practices/techniques of exercise therapy for better understanding of the theoretical concepts.



Figs 7.4A to C: Shoulder joint: **A.** Rotation starting position; **B.** Internal rotation; **C.** External rotation

Did You Know?

Suspension therapy also engages the proprioceptive system, which involves sensory receptors in the muscles and joints that provide feedback to the brain about body position and movement. This engagement helps improve proprioception, which can enhance coordination, balance, and overall body awareness, contributing to better movement patterns and injury prevention.

Did You Know? boxes give an overview of important facts and terms of the concerned topic.

Evolving conceptual details for application in clinical situations are depicted in **Clinical Correlation** boxes.

Clinical Correlation

Suspension therapy can also be adapted for postural correction and rehabilitation. By suspending the body in a controlled manner, therapists can manipulate the positioning of the body to promote proper alignment and muscle activation. This can be especially helpful for individuals with postural imbalances or conditions such as scoliosis, where targeted exercises and positioning can help alleviate pain and improve overall posture and spinal alignment.

SUMMARY

- Suspension therapy is a therapeutic exercise that involves suspending a person's body in the air while performing various movements and exercises.
  - This technique can be administered while sitting or lying down, and the suspension devices can be ropes or slings. It is often used by physical therapists, chiropractors, and other medical practitioners to increase joint mobility, flexibility, and strength.
  - The theory behind suspension therapy is that by suspending the person in midair, the force of gravity is diminished, which can help decompress joints and relieve strain on painful joints.

Important takeaway points of respective chapters have been highlighted under **Summary** boxes.

FURTHER READINGS

- El-Meniawy GH, Kamal HM, Elshemy SA. Role of treadmill training versus suspension therapy on balance in children with Down syndrome. Egyptian Journal of Medical Human Genetics. 2012;13(1):37-43.
- Gao, B., Rong, X., Liang, D. and Li, L. (2008) The Effect of Sling Exercise Therapy on Low Back Pain Caused by Exercises Training. Chinese Journal of Rehabilitation Medicine, 23, 1095-1097.

To give extra edge to the study, **Further Readings** have been included at the end of every chapter.

STUDENT ASSIGNMENT

LONG ANSWER QUESTIONS

1. Explain the techniques of suspension therapy for the upper limb and lower limb.
2. Explain indications, contraindications and benefits of suspension therapy.
3. Discuss in detail the principles of suspension therapy.

SHORT ANSWER QUESTIONS

1. Define suspension therapy.
2. Enlist the equipment and accessories used in suspension therapy.
3. Define the types of suspension.
4. What are the benefits of suspension therapy?

MULTIPLE CHOICE QUESTIONS

1. **Which is an indication of suspension therapy?**
   a. Relieve pain
   b. Improve mobility
   c. Enhance muscle strength
   d. All of the above
2. **Purpose of suspension therapy is:**
   a. To decrease ROM
   b. To decrease muscle power
   c. Remove body support
   d. All of the above
3. **Which type of suspension therapy is incorrect:**
   a. Vertical
   b. Horizontal
   c. Axial
   d. Pendular
4. **Regarding axial suspension which statement is incorrect?**
   a. It is the most common type.
   b. Joint is taken as a point of suspension.
   c. Gravity is not eliminated.
   d. Limb is supported by the slings above the joint.
5. **Which statement is incorrect regarding pendular suspension therapy?**
   a. Point of suspension should be shifted away from the joint axis.
   b. Movement usually takes place against gravity.
   c. Muscles will be getting resistance while moving if the axis is shifted opposite to that movement.
   d. Point of suspension should be fixed with the joint.
6. **Following are the supporting ropes except:**
   a. Single rope
   b. Double rope
   c. Pulley rope
   d. Triple rope

At the end of chapters, **Student Assignment** section is given which contains frequently asked questions in exams and multiple choice questions to help students attain mastery over the subject.

Syllabus

EXERCISE THERAPY

THEORY

Basics of Exercise Therapy

1. **Mechanics**

   Define the following terms and describe the principles involved with suitable examples.

   - **Force:** Composition of force, parallelogram of forces.
   - **Equilibrium:** Stable, unstable, neutral.
   - **Gravity:** Center of gravity, line of gravity.
   - **Levers:** 1st, 2nd and 3rd order. Their examples in the human body and their practical application in physiotherapy, forces applied to the body levers.
   - **Pulleys:** Fixed, movable.
   - **Springs:** Series, parallel.
   - Tension.
   - **Elasticity:** Hooks law.
   - **Axis:** Sagittal, frontal, and horizontal.
   - **Planes:** Sagittal, frontal, and horizontal.
   - **Definitions:** Speed, velocity, work, energy, power, acceleration, momentum, friction and inertia.

2. **Introduction to Exercise Therapy**
   - The aims of exercise therapy, the techniques of exercise therapy, approach to patient's problems, assessment of patient's condition—measurements of vital parameters.
   - Starting positions—fundamental positions—muscle work, effect and uses.
   - Derived positions, planning of treatment.

3. **Muscle Action**
   - **Muscle work:** Isotonic (concentric, eccentric), isometric (static).
   - **Group actions:** Agonists (prime movers), antagonists, synergists, fixators.
   - Angle of muscle pull, mechanical efficiency of the muscles.
   - Active and Passive insufficiency.

4. **Passive Movements**
   - Causes of immobility, Classification of passive movements, and specific definitions related to passive movements, principles of giving passive movements, indications, contraindications, effects and uses, techniques of giving passive movements.

5. **Active Movements**
   - Definition of strength, power and work, endurance, muscle actions.
   - **Physiology of muscle performance:** Structure of skeletal muscle, chemical and mechanical events during contraction and relaxation, muscle fiber types, motor unit, force gradation.
   - Causes of decreased muscle performance.
   - **Physiologic adaptation to training:** Strength and power, endurance.
   - Types of active movements.
   - **Free exercise:** Classification, principles, techniques, indications, contraindications, effects and uses.

- **Active assisted exercise:** Principles, techniques, indications, contraindications, effects and uses.
- **Assisted-resisted exercise:** Principles, techniques, indications, contraindications, effects and uses.
- **Resisted exercise:** Definition, principles, indications, contraindications, precautions and techniques, effects and uses.
- **Types of resisted exercises:** Manual and mechanical resistance exercise, isometric exercise.
- **Dynamic exercise:** Concentric and eccentric, constant versus variable resistance, isokinetic exercise, open-chain and closed-chain exercise.
- Specific exercise regimens.
- **Isotonic:** de Lormes, Oxford, Macqueen, circuit weight training.
- **Isometric:** Brief resisted isometric exercise (BRIME), multiple angle isometrics, isokinetic regimens.
- **Progressive resisted exercises:** Describe the following exercises, their advantages and disadvantages and demonstrate the techniques of the following types of PREs: Fractional system, Macqueen's set system, Mcqueen's power system.
- **Demonstrate practically each system using:** Delorme boot, dumbells, sand bags in pulleys, powder board and suspension therapy.

6. **Functional Re-education/Mat Activities**
   - **Lying to sitting:** Activities on the mat/bed, movement and stability at floor level; sitting activities and gait; lower limb and upper limb activities.
   - Demonstrate common mat activities.
   - Rolling, prone on elbows, prone on hands, Hook lying, bridging, quadruped position, long sitting, short sitting, kneeling, half kneeling, standing, walking.
   - Describe the term re-education of muscles and the techniques, spatial summation and temporal summation.
   - Demonstrate the various re-education techniques and facilitating methods for various groups of muscles.
   - Demonstrate the progressive exercises in strengthening by using various applications from (according to their muscle power) Grade-I to Grade-IV.

7. **Aerobic Exercise**
   Definition and key terms; physiological response to aerobic exercise, examination and evaluation of aerobic capacity—exercise testing, determinants of an exercise program, the exercise program, normal and abnormal response to acute aerobic exercise, physiological changes that occur with training, application of principles of an aerobic conditioning program for patients—types and phases of aerobic training.

8. **Stretching**
   - Definition of terms related to stretching; tissue response toward immobilization and elongation, determinants of stretching exercise, effects of stretching, inhibition and relaxation procedures, precautions and contraindications of stretching, techniques of stretching.
   - Special emphasis on stretching of pectoral major, biceps brachii, triceps brachii, and long flexors of fingers, rectus femoris, iliotibial band, gastrocnemius-soleus, hamstrings, hip abductors, iliopsoas, sternocleidomastoid.

9. **Balance**
   - Definition.
   - **Physiology of balance:** Contributions of sensory systems, processing sensory information, generating motor output.
   - Components of balance (sensory, musculoskeletal, biomechanical).
   - Causes of impaired balance, examination and evaluation of impaired balance, activities for treating impaired balance with mode posture, movement, precautions and contraindications, types.
   - Balance retraining.

10. **Coordination Exercise**
    - Anatomy and physiology of cerebellum with its pathways.
    - Definitions: Coordination, incoordination.
    - Explain the mechanism of neuromuscular coordination.
    - Describe the incoordination due to lower motor neuron lesions (flaccidity) upper motor neuron lesions (spasticity) cerebellar lesions, loss of kinesthetic sense (tabes dorsalis, syringomyelia, leprosy), imbalance due to muscular disease.
    - Causes for incoordination.
    - Tests for coordination: Equilibrium test, nonequilibrium test, principles of coordination exercise.
    - **Frenkel's exercise:** Uses of Frenkel's exercise, technique of Frenkel's exercise, progression, home exercise.

Examination/Testing Techniques

11. **Manual Muscle Testing**
    - **Introduction to MMT, principles and aims, various methods, indications and limitations, techniques of MMT for group and individual muscles:** Techniques of MMT for upper limb/techniques of MMT for lower limb/techniques of MMT for spine.

- Describe the types of muscle grading, key to muscle grading, demonstrate the skill to grade the individual and group muscles of upper and lower limb, neck and trunk muscles.

12. Goniometry

- **Measurement of joint range:** ROM-definition, normal ROM for all peripheral joints and spine, goniometer-parts, types, principles, uses, limitations of goniometry, techniques for measurement of ROM for all peripheral joints
- Describe the normal range of various joints. Describe goniometer, range of measuring systems for trunk and head, techniques of goniometer.
- Demonstrate measuring of individual joint range using goniometer.
- Demonstrate measurement of limb girth (using measuring tape for arm, forearm, thigh, calf.

13. Tests for Neuromuscular Efficiency

- Electrical tests.
- **Anthropometric measurements:** Muscle girth—biceps, triceps, forearm, quadriceps, calf.
- Static power test.
- Dynamic power test.
- Endurance test.
- Speed test
  - Tests for coordination.
  - Tests for sensation.
  - Pulmonary function tests.
  - **Measurement of limb length:** True limb length, apparent limb length, segmental limb length.
  - Measurement of the angle of pelvic inclination.
- Describe—pelvic tilts, alterations from normal-anterior tilt (forward), posterior tilt (backward) lateral tilt. Muscles responsible for alterations and pelvic rotation. Identification of normal pelvic tilts, pelvic rotation and altered tilts and their correction.

Therapeutic Techniques

14. Proprioceptive Neuromuscular Facilitation

- Definitions and goals.
- **Basic neurophysiologic principles of PNF:** Muscular activity, diagonals patterns of movement: upper limb, lower limb.
- **Procedure:** Components of PNF.
- Techniques of facilitation.
- **Mobility:** Contract relax, hold relax, rhythmic initiation.
- **Strengthening:** Slow reversals, repeated contractions, timing for emphasis, rhythmic stabilization stability: alternating isometric, rhythmic stabilization.
- **Skill:** Timing for emphasis, resisted progression endurance: slow reversals, agonist reversal.
- Patterns of movement in detail.

15. Suspension Therapy

- Definition, principles, equipment and accessories, Indications and contraindications, benefits of suspension therapy. Types of suspension therapy—axial, vertical, pendula, eccentric fixation (anterior, posterior, medial and lateral). Explain the indications and technique for each type of suspension. Demonstrate axial and eccentric fixation for mobilizing, strengthening and re-education of various muscles and joints.
- Techniques of suspension therapy for upper limb, techniques of suspension therapy for lower limb.

16. Manual Therapy and Peripheral Joint Mobilization

- **Basics in manual therapy and applications with clinical reasoning:**
  - Examination of joint integrity
  - Contractile tissues
  - Noncontractile tissues
  - Mobility—assessment of accessory movement and end feel.
  - Assessment of articular and extra-articular soft tissue status.
  - Myofascial assessment.
  - Acute and chronic muscle hold.
  - Tightness.
  - Pain-original and referred.
  - Basic principles, indications and contraindications of mobilization skills for joints and soft tissues.
  - Maitland
  - Mulligan
  - McKenzie
  - Muscle energy technique
  - Myofascial stretching
  - Cyriax
  - Neuro dynamic testing
- Schools of manual therapy, principles, grades, indications and contraindications, effects and uses—Maitland, Kaltenborn, Mulligan
- Biomechanical basis for mobilization, effects of joint mobilization, indications and contraindications, grades of mobilization, principles of mobilization, techniques of mobilization for upper limb, lower limb, precautions.

17. Massage

- History and classification of massage technique principles, indications and contraindications technique of massage manipulations.

- Physiological and therapeutic uses of specific manipulations, history of massage.
- Mechanical points to be considered while giving massage; techniques, indications and contraindications.
- Physiological effects of massage on various systems of body. Effects on: Excretory system, Circulatory system, Muscular system, Nervous system and Metabolic system.
- Define and describe the various manipulation techniques, effects, uses and contraindications used in massage.
  - **Stroking manipulation:** Effleurage, stroking.
  - **Pressure manipulations:** Kneading, squeezing, stationary, circular ironing (reinforced kneading), finger kneading, petrissage (picking up, wringing, rolling), frictions.
  - **Percussion manipulation:** Tapotement, hacking, clapping, beating and pounding.
  - **Shaking manipulations:** Vibration, shaking.
- **Demonstrate the following techniques on patients/models:**
  - **Massage for upper limb:**
    - Scapular region
    - Shoulder joint
    - Upper arm
    - Elbow joint
    - Forearm
    - Wrist joint
    - Hand.
  - **Massage for lower limb:**
    - Thigh
    - Knee joint
    - Leg
    - Foot (including ankle joints and toes)
  - **Massage for back:**
    - Neck and upper back
    - Middle and lower back
    - Gluteal region, arm and leg.
  - **Massage for the face**

18. Hydrostatics and Hydrodynamics

- History
- Properties of water, specific gravity, hydrostatic pressure
- Archimedes principle, buoyancy-law of floatation
- Effect of buoyancy on movements performed in water
- Equilibrium of a floating body, Bernoulli's theorem
- Physiological effects of exercise in water

19. Hydrotherapy

- Definitions, goals and indications, precautions and contraindications, properties of water, use of special equipment, techniques, effects and uses, merits and demerits.
- Describe the dress of patients and the therapist and necessary hydrotherapy equipment.
- **Types of hydrotherapy:** Sterile pool contrast bath, whirlpool bath, Hubbard tank.
- **Construction of hydrotherapy tank:** Design of construction, safety features, cleaning the pool, water heating systems, hygiene of patient and pool.

Posture, Gait, Miscellaneous

20. Posture

- Definition, active and inactive postures, postural mechanism, patterns of posture, principles of re-education, corrective methods and techniques, patient education.
- **Describe posture:** Posture (static and dynamic), definition of good posture, muscles responsible for good posture. Postural mechanisms, definition of abnormal posture (kyphosis, scoliosis, lordosis, kyphoscoliosis, kypholordosis), assessment of posture (inspection, scoliosis, lordosis, kyphoscoliosis, kypholordosis), assessment of posture (inspection, measurement—length of legs, width of pelvis, plumb line—ROM of trunk in flexion, extension, side flexion and rotation).
- Describe and demonstrate postural correction by strengthening of muscles, mobilization of trunk, relaxation. Active correction of the deformities, passive correction (traction), postural awareness, abdominals and back extensors.
- Outline principles in bracing of the trunk and surgical correction.
- **Demonstrate practically:** Identification of abnormal posture, and postural corrective measures.

21. Gait

- Define gait and center of gravity of the human body.
- Describe muscles responsible for normal gait, six determinants of gait (pelvic rotation, pelvic tilt, hip flexion, lateral displacement of pelvis, knee flexion, in stance phase, normal foot pattern during walking).
- **Describe the gait cycle:** Stance (heel strike, foot flat, mid stance, and foot off), Swing (acceleration, mid swing and deacceleration).
- **Describe the following pathological gaits:** Gluteus medius gait, gluteus maximus gait, hip flexor weakness gait, quardriceps weakness gait, foot drop gait, hemiplegic gait, ataxic waddling gait, equinus gait, calcaneus gait, equinovarus gait.
- Demonstrate skill in identifying pathological gait and proper gait training.

22. Gait Training and Walking Aids

- Definition, different methods of gait training, gait training in parallel bars.
- **Walking aids:** Types: Crutches, canes, frames; principles and training with walking aids.
- Describe components of a crutch, types of classification of crutches, characters of good crutch, preparing a patient for crutch walking, crutch walking muscles, measurement of crutches (axillary piece, hand piece), crutch stance, crutch palsy, types of crutch walking (4 point, 3 point, 3 point (nonweight bearing and partial weight bearing), modified 3 point (paraplegic and shuffling gait, swing to and swing through).
- Demonstrate crutch measurement (sitting, standing and lying positions) and various types of crutch walking (even ground, stairs and ramps).

23. Individual and Group Exercises

Advantages and disadvantages, organization of group exercises, recreational activities and sports.

24. Complications of Bed Rest

- Describe the complications of patients on prolonged bed rest.
- Buerger exercises.
- Demonstrate maintenance exercises for patients on prolonged bed rest.

25. Relaxation

- **Definitions:** Muscle tone, postural tone, voluntary movement, degrees of relaxation, pathological tension in muscle, stress mechanics, types of stresses, effects of stress on the body mechanism, description of fatigue and spasm, general causes, signs and symptoms of fatigue, indications of relaxation, rationale of relaxation techniques.
- Methods and techniques of relaxation—principles and uses for general, local, Jacobson's, Mitchel's, additional methods.

26. Introduction to Yoga

- Physiology and therapeutic principles of yoga.
- Yoga Sana for physical culture, relaxation and medication.
- Application of yoga Sana in physical fitness, flexibility.
- Therapeutic application of yoga. Yoga a holistic approach.

PRACTICAL

The students of exercise therapy are to be trained in practical laboratory work for all the topics discussed in theory. The student must be able to evaluate and apply judiciously the different methods of exercise therapy techniques on the patients. They must be able to:

- Demonstrate the technique of measuring using goniometry.
- Demonstrate muscle strength using the principles and technique of MMT.
- Demonstrate the techniques for muscle strengthening based on MMT grading.
- Demonstrate the PNF techniques.
- Demonstrate exercises for training coordination—Frenkel exercise.
- Demonstrate the techniques of massage manipulations.
- Demonstrate techniques for functional re-education.
- Assess and train for using walking aids, crutch gaits, gait training using various walking aids.
- Demonstrate mobilization of individual joint regions.
- Demonstrate to use the technique of suspension therapy for mobilizing and strengthening joints and muscles.
- Demonstrate the techniques for muscle stretching.
- Assess and evaluate posture and gait.
- Demonstrate to apply the technique of passive movements.
- Demonstrate various techniques of active movements.
- Demonstrate techniques of strengthening muscles using resisted exercises.
- Demonstrate techniques for measuring limb length and body circumference.
- Various types breathing exercises, chest mobilization exercises, postural drainage.

Contents

SECTION II EXAMINATION/TESTING TECHNIQUES

SECTION III APPLICATION OF PRINCIPLES OF EXERCISE THERAPY

Section III

Application of Principles of Exercise Therapy

SECTION OUTLINE

7

Passive Movements

Sheetal Kalra

LEARNING OBJECTIVES

After the completion of the chapter, the readers will be able to:

- Define passive movements.
- Explain causes of immobility.
- Classify passive movements.
- Explain the principles of passive movements.
- Mention the indications and contraindications of passive movements.
- Explain the effects and uses of passive movements.
- Understand and demonstrate technique of passive movements at various joints.

CHAPTER OUTLINE

- Introduction
- Range of Motion
- Causes of Immobility
- Classification
- Principles and Procedure
- Indications
- Effects and Uses
- Contraindications
- Techniques of Relaxed Passive Movements for Individual Joints

KEY TERMS

Contracture: A condition that causes muscles, tendons or other tissue to shorten and stiffen; frequently, resulting in joint deformity and restricted movement.

Effusion: Abnormal accumulation of fluid in cavities or between body tissues.

Myositis ossificans: A condition that occurs when bone tissue forms within soft tissues or muscles, typically as a reaction to muscle injury or severe bruising.

Osteokinematics: The study of bone motion around a joint, including the movements of the bony levers in the body.

Overstretching: Stretching a muscle, tendon or ligament beyond its normal limit, potentially causing injury.

Scar: A mark left on the skin or body tissue where a cut, burn or wound has not completely healed and connective tissue has formed.

Sepsis: An extreme response of the body's immune system to an infection or injury causes sepsis. It is a life-threatening medical emergency.

Stasis: A duration, condition or state of balance, inactivity or stagnation.

INTRODUCTION

Passive movement (PM) is an intervention in which an outside force, usually by a therapist or a mechanical device, repeatedly moves a person's joints through their range of motion (ROM). These are performed during periods of muscular inactivity or when range of motion is restricted due to various reasons. Physiology and medicine have long recognized the benefits of passive exercise and movement. Early clinical uses of passive exercise/movement stimulated the vasculature and elicited changes in blood flow to prevent complications caused by stasis and vascular disease.

The basic objective of PMs is to influence the extensibility of soft tissues surrounding joints in order to preserve or improve joint mobility.

They are also used to lessen side effects brought on by cartilage deterioration. People who are unable to move certain joints on their own due to paralysis, severe pain, or limited consciousness typically receive PMs for a short period of time. Passive movements can take 20–30 minutes to administer. In some patients with neurological disabilities, these are administered every day throughout a person's life.

RANGE OF MOTION

The definition of ROM varies among published sources; Kapandji and colleagues described ROM as "the extent of osteokinematic motion available for movement activities, functional or otherwise, with or without assistance".

In its most basic form, movement—which is required to carry out functional tasks—can be understood as the result of muscles or outside forces moving bones in different ways or ranges of motion. The central nervous system is responsible for the complex regulation of muscle activity that drives or regulates motion when a person moves. At the joints, bones move relative to one another. The amount of mobility that can take place between any two bones depends on the structure of the joints as well as the flexibility of the soft tissues that cover the joints. The segments must periodically move across their ranges, to maintain appropriate ROM. It is acknowledged that there are so many variables, like systemic, joint, neurological, or muscle illnesses; traumatic or surgical; or physical inactivity or immobilization for any reason, that can lead to decreased ROM. Therapeutically, ROM activities are administered to maintain joint and soft tissue mobility to minimize loss of tissue flexibility and contracture formation.

The ROM can be reduced by inactivity or immobilization for any reason. Therapeutic ROM exercises are used to keep soft tissues and joints mobile in order to prevent contracture formation and tissue stiffening.

Types of ROM Exercises

- **Passive ROM:** Physiology and medicine have a long and rich history with passive exercise/movement, which is simply defined as the movement of the body or a limb (such as the leg or arm) without deliberate effort or muscle activity. The external force could be from gravity, a machine or by someone else.
- **Active ROM:** The movement of a segment inside the unrestricted ROM is known as active range of motion (AROM), and it is caused by the active contraction of the muscles that span that joint.
- **Active assisted ROM:** Because the prime mover muscles require assistance, active-assistive range of motion (A-AROM) is a kind of AROM in which assistance is given manually or mechanically by an outside source while the muscle also contracts to complete the movement.

CAUSES OF IMMOBILITY

The inability to move or difficulty in moving can be caused by a number of factors. Listed below are a few typical reasons:

- **Musculoskeletal injuries:** Immobility may result from sprains, fractures, or strains. Casts or braces may be necessary for immobilization in cases of severe injuries.
- **Neurological conditions:** Immobility can be a consequence of neurological disorders such as multiple sclerosis, Parkinson's disease, spinal cord injuries, stroke, or other nervous system disorders.
- **Joint issues:** Disorders such as arthritis or inflammation of the joints can impair mobility and cause pain.
- **Chronic pain:** Resulting from neurological problems or musculoskeletal conditions, chronic pain can make a person immobile and make it difficult for them to move around comfortably and go about their everyday lives.
- **Surgery:** Following some surgeries, patients may become immobile for a while as they heal.
- **Obesity:** Carrying too much weight around can strain muscles and joints, making movement difficult.
- **Circulatory issues:** Disorders that impair blood flow, like peripheral artery disease or deep vein thrombosis, can make a person immobile.
- **Breathing problems:** Illnesses such as severe chronic obstructive pulmonary disease (COPD) or specific respiratory infections can cause weakness and fatigue making it difficult to move.
- **Infections:** Severe infections can cause immobility, particularly if they affect the joints or bones.
- **Age-related problems:** As people age, their muscles, bones, and joints might change, which can lead to decreased mobility in older persons.

- **Trauma:** Severe trauma, like that from a fall or an automobile accident, can cause injuries that restrict movement.
- **Psychological factors:** Disorders such as anxiety or depression can cause a person to lose desire and energy, which in turn might cause them to engage in less physical exercise.

Clinical Correlation

Integrating mental health support into treatment plans is crucial to address underlying mood disorders and motivational barriers, promote adherence to rehabilitation programs, and improve overall well-being and quality of life.

CLASSIFICATION

Relaxed Passive Movements

These are the movements which are carried out in the range of motion that is available, with precision, rhythm, and fluidity. The movements are carried out within the same direction and plane as active movements. The joint is moved through its current range of motion and just as far as it causes pain.

Accessory Movements

Any normal joint has accessory movements, but in abnormal circumstances they could be restricted or nonexistent. They consist of gliding or rotating movements that can be separated by the physiotherapist but cannot be done independently as voluntary movements.

Passive Manual Mobilization Techniques

Mobilization of Joints

These are often small, repeated, rhythmical, oscillatory, localized accessory, or functional motions carried out by the physiotherapist in a variety of amplitudes. The motions can be controlled by the patient and are within the available range of motion.

Manipulation of Joints

These are precisely localized, single, swift, and decisive movements that are finished at high speeds before the patient can stop them. These movements enhance range of motion in a stiff joint by breaking or stretching the restricting structures such as adhesions. A sudden forceful movement is given at the limit of the motion. Accessory movements can be restored at the joints which otherwise cannot be localized actively.

Precautions:

- Patient must be encouraged to relax and should be provided with care.
- Manipulation should be performed only by trained doctors and therapists.
- Anesthesia is used during these maneuvers by a surgeon or doctor to eliminate pain and protective spasm so as to increase range of motion.

Controlled Sustained Stretching of Passive Structures

Movement can be achieved by lengthening the muscle by inhibiting the tendon protective reflex or by stretching adhesions in these tissues. The collagen fibers which are strong, inextensible and inelastic will elongate when subjected to prolonged stress. The resistance of tight structures can be overcome by this method.

Continuous Passive Motion

A device that promotes continuous passive motion keeps a joint moving (Figs 7.1A and B). Constant motion reduces stiffness and pain. It can be carried out mechanically or manually. Continuous passive motion (CPM) is usually the name for device assisted passive motion carried out by a

Figs 7.1A and B: **A.** Lower limb continuous passive motion machine; **B.** Wrist and hand continuous passive motion machine

mechanical device that gently and continuously moves a joint through a controlled range of motion. It has good healing effects on diseased or injured joint structures and soft tissues in animal and clinical tests. Mechanical devices are now available for almost every joint in the body.

Continuous passive motion must be used with an appropriate range of motion without causing distress. Based on the patient's comfort level and the required number of repetitions in a certain amount of time, the speed of movement through the range of motion should be determined. It should be one cycle every 45 seconds.

Clinical Correlation

The CPM therapy is particularly beneficial in the early stages following surgery or injury, helping to minimize joint hemarthrosis, periarticular edema, and aiding in the removal of blood from the joint and surrounding tissues.

Indications

- Treating early scar contracture after hand burns (Zhao et al.).
- Flexion contractures (Lindenhovious et al.).
- Continuous passive range of motion may provide an improved benefit for some unfavorable symptom reduction in the hemiplegic arm following a stroke (Lynch et al.).
- Early recovery after periosteal transplantation (Alfredson et al.).
- Intra-articular anterior cruciate reconstructions (Rosen et al.).
- Intra-articular fractures of the knee, elbow, and ankle, etc. (Hill et al.).
- Following a total knee and hip arthroplasty (Harvey et al.).
- Post cartilage repair (Howard et al.).
- After repair of rotator cuff (Lastayo et al.).

Clinical Correlation

Passive movements in hemiplegic stroke patients activate patterns crucial for motor function recovery, particularly by activating the affected hemisphere.

Precautions

- **Correct alignment:** In order to avoid putting more strain on joints or soft tissues, make sure the patient's limb is properly positioned inside the CPM device.
- **Patient positioning:** To prevent undue strain on the joints and surrounding tissues, maintain the patient's optimal positioning during CPM therapy.
- **Contraindications:** Recognize which medical conditions, such as particular fractures or surgical operations, make CPM contraindicated. Make sure that CPM is only applied when medical professionals suggest it is suitable.
- **Monitoring comfort levels:** Throughout CPM sessions, periodically gauge the patient's level of comfort. As appropriate, modify the range of motion or stop the CPM if there is severe pain or discomfort.
- **Individualized settings:** Adjust the CPM settings to the patient's unique requirements, accounting for their pain threshold, range of motion, and kind of surgery or injury.
- **Limit range of motion:** To avoid overstretching or stressing the joint, gradually increase the range of motion within the boundaries set by the healthcare professional.
- **Patient education:** Inform the patient about the goals and procedures of CPM, stressing the need of adhering to prescription guidelines and reporting any uncomfortable or odd sensations.
- **Regular supervision:** In order to ensure appropriate usage and make any required adjustments, healthcare practitioners should initially keep a careful eye on CPM sessions. As soon as the patient gets comfortable using the gadget, less supervision is required.
- **Skin integrity:** Check for irritation, redness, or pressure sores on a regular basis on the skin surrounding the joint. It could be required to reposition or pad in order to preserve skin integrity.
- **Joint stability:** Make sure the joint doesn't move excessively or is unstable during CPM sessions. If it does, it should be swiftly adjusted.

Contraindications

- **Uncontrolled pain:** It might not be appropriate if the patient has uncontrollably high pain levels during CPM sessions. It is best to treat pain properly before thinking about CPM.
- **Fracture with displacement:** CPM is usually not recommended in fracture instances involving considerable bone fragment displacement.
- **Unstable fractures:** When a fracture is unstable or when the stability of the fracture site may be jeopardized by the use of CPM, CPM usage is not recommended.
- **Compromised soft tissue:** If the soft tissues surrounding the joint are damaged or compromised in any way, such as by severe contusions, open wounds, or infections, CPM may not be appropriate.
- **Joint infections:** There may be contraindications due to active joint infections or the possibility of infection spreading to the joint through CPM.
- **Deep vein thrombosis (DVT):** Because of the possibility of displacing blood clots, the use of CPM may not be appropriate in cases of suspected or confirmed DVT.
- **Peripheral vascular disease (PVD):** Because CPM can worsen circulation problems, it might not be appropriate for people with peripheral vascular disease.
- **Compromised vascular supply:** When the blood supply to the afflicted joint or limb is impaired, CPM may not be appropriate.

- **Neurological impairments:** The use of CPM may be contraindicated in certain cases of neurological disorders or impairments, particularly if the patient is unable to participate actively or communicate properly.
- **Lack of cooperation:** Individuals unable to comprehend or assist with the CPM procedure, including CPM as part of the treatment must be avoided.

Effects and Uses

The CPM and passive exercises are successful therapies to stimulate movement in various orthopedic, neurological and sports injuries like hemiplegic stroke, post fracture stiffness, burns, sprains, strains, etc.

- CPM exercises have a local circulatory effect by raising blood flow to the skeletal muscles.
- Edema, spasticity, rigidity, and motor function have all been found to be considerably improved by CPM therapies (Brenner et al., 2018).
- Moving a joint through CPM leads to a different sensory input, which could reduce pain.
- CPM lessens the perception of pain in addition to reducing pain, avoiding the negative effects of immobilization, and enabling the "healing power of motion" to occur (Mccarthy et al., 1992).
- Animal studies have found use of CPM promotes development of hyaline cartilage in rabbits with full thickness defects of articular cartilage, accelerates the clearance of blood, decreases erythrocyte trapping in the synovium in induced effusion and hemarthrosis, enhances ROM and transport of metabolites out of joint.
- To minimize joint hemarthrosis and periarticular edema and aid in the removal of blood from the joint and surrounding tissues, CPM treatment is most helpful in the early stages following an accident or surgery.
- CPM causes a sinusoidal oscillation in intra-articular pressure, facilitating in the effective clearance of hemarthrosis. The displacement from the maximal volume position reduces the elevated intra-articular pressure brought on by joint effusion.
- CPM is effective in increasing blood clearance from the joint and periarticular tissues, hence limiting further accumulation of edema. This is confirmed by radiolabeled erythrocyte tracking.
- CPM is most helpful during the first several days and hours following surgery (the first and second stages of stiffness). In the third and fourth stages, it becomes less helpful (Driscoll et al.).
- Applying CPM promotes the metabolism of chondrocyte Proteoglycan 4 (PRG4). One way that CPM may help cartilage and joint health during postoperative rehabilitation is by stimulating PRG4 synthesis (Nugent et al.).

PRINCIPLES AND PROCEDURE

Planning for Examination, Assessment and Treatment

1. Examine and evaluate patient's general condition, level of impairment and function before administering passive movements.
2. Determine the motion that can be safely applied to the patients.
3. Documentation, re-evaluation and modification of intervention may be required based on patient's response.

Patient Preparation

1. Describes the strategy and technique used to achieve the goals to the patient.
2. Remove all constrictive garments, splints, and dressings from the area. Cover the patient as needed.
3. Place the patient in a relaxed position that allows moving the segment through its range of motion while maintaining good body alignment and stability.

Technique of Relaxed Passive Movements

1. **Relaxation:** It can be achieved by a brief explanation to the patient of what is going to happen. A suitable starting position is selected for comfort and support of patient before starting passive movements. It is important to gain patient's confidence in maintaining relaxation till the passive movement is completed.
2. **Fixation:** The bone proximal to the joint where movement is to be performed should be fixed. This helps in localizing movement to the joint being moved and avoiding compensatory movements.
3. **Support:** To gain patient's confidence and relaxation throughout the range of motion the part being moved should be comfortably supported. Firm but comfortable grip of physiotherapist is required to provide support. Alternatively slings or axial suspension can also be used for supporting heavy limbs.
4. **Stance:** A firm and comfortable stance of physiotherapist is required to ensure movement is performed properly. Both feet should be apart and in line with the direction of movement.
5. **Traction:** Traction should be given along the long axis of the joint to facilitate movement. The fixation of the bone proximal to the joint provides an opposing force to the sustained pull on the distal bone.
6. **Movement:** The physiotherapist performs the movement similar to that of natural movement taking care that range is as full as possible without provoking pain in adjacent areas. To ensure full range slight overpressure can be applied in the end of the range.

7. **Speed and duration:** The speed must be gradual and rhythmic with appropriate repetitions of the action since it is crucial that relaxation be maintained throughout the movement.
8. **Repetition:** Perform passive movement at least 5–10 times smoothly and rhythmically. However the number of repetitions will depend upon condition of the patient.

INDICATIONS

- Passive motion is advantageous in the area where there is acute, inflamed tissue and when aggressive motion would be harmful to the healing process. (After an injury or operation, inflammation often lasts 2–6 days.)
- Patients with paralysis like hemiplegia, paraplegia.
- Postoperative cases like TKR, THR, etc.
- Reconstructive surgeries like ligament repair, injuries around joints, dislocation, fractures, etc.
- Comatose or bed ridden patients.
- Critically ill patients like patients in intensive care. To prevent deterioration, improve condition, and shorten intensive care unit (ICU) and inpatient stays, early mobilization and rehabilitation are advised (Boulain et al., 2002).
- Treatment and prevention of contractures (Prabhu et al.).

EFFECTS AND USES

- Preserve joint and soft tissue flexibility.
- Passive motions stop adhesions from forming around and inside the soft tissues of joints. This could be achieved by blocking collagen's production of cross-bridges (Prabhu et al., 2013).
- Help with neuromuscular reeducation
- Improve synovial circulation
- Prevent shortening and contracture while maintaining the natural characteristics of the muscle (extensibility, elasticity, etc.). Prevent myofascial adhesions.
- Help by activating the kinesthetic receptors, which preserve and maintain memory of the movement patterns (Paillard et al., 1968).
- The venous and lymphatic return is improved by the mechanical pressure created by the stretching of the thin walled veins that pass over the moving joints (improving circulation).
- To train for relaxation because the soothing effects of the rhythmic, continuous passive movements can help relax more and fall asleep while also enhancing sense of position and movement (Paillard et al., 1968).
- Increases in metabolic and hemodynamic demands, such as increased venous return and stroke volume, as well as a potential impact on the inflammatory response are all potential consequences of PMs.
- In a small study with healthy people, passive leg activity was found to increase minute ventilation, and it may also enhance oxygen consumption (Clini et al., 2005).
- Improve collagen re-organization after injury, maintain joint range of motion, and minimize contracture formation (Prabhu et al., 2013).
- Repeated, externally imposed, sequential flexion-extension movements of the elbow decreased the elbow flexor stretch reflex in spastic hypertonia patients (Schmit et al., 2020).
- In the paretic lower limb muscles of chronic stroke patients, passive leg movements have the power to stimulate muscular activity and improve oxygen metabolism. This kind of exercise may be a helpful and effective way to stop the lower limb paretic muscles of chronic stroke patients from degenerating metabolically (Jigjid et al., 2008).
- Deeply sedated patients who get passive exercise have improved muscle fiber function and reduced muscle atrophy, suggesting a possible positive impact for immobile ICU patients (Llano et al., 2012).
- In critical patients on mechanical ventilation in ICUs, early rehabilitation with a passive cycle ergometer can preserve the morphology of the lower limb and respiratory muscles (diaphragm) and hence prevent neuromuscular complications (dos Santos et al., 2015).
- Before clinical recovery, passive movements in hemiplegic stroke patients evoke activation patterns that may be crucial for the recovery of motor function. Particularly, it appears that persistent and early activation of the afflicted hemisphere, as shown with a transcranial doppler, prefigures the improvement of a motor deficiency (Matteis et al., 2003).
- Passive Range of Motion (PROM) is utilized to assess mobility restrictions, joint stability, muscle flexibility, and other soft tissue elasticity when a therapist examines inert structures.
- To show the desired motion when a therapist is teaching an active exercise workout program, PROM is employed.
- PROM is frequently used before passive stretching treatments when a therapist is getting a patient ready for stretching.

Clinical Correlation

Early rehabilitation with passive cycle ergometer in critically ill patients on mechanical ventilation preserves lower limb and respiratory muscle morphology, preventing neuromuscular complications.

CONTRAINDICATIONS

- Immediately after surgery or acute injury like muscle/ligament tear.
- Conditions like myositis ossificans.
- Unhealed or recent fractures.

Did You Know?

Common effects and uses of passive movement

Besides the major effects and uses of passive movements, some more common effects and uses are as follows:

- Prevents the formation of adhesions and contractures, which lead to joint stiffness.
- Stimulates the healing of tendons and ligaments.
- Promotes the healing of incisions over moving joints.
- Increases synovial fluid lubrication of the joint, which speeds up the rate of intra-articular cartilage healing and regeneration.
- Prevents the debilitating effects of immobilization.
- Provide a quicker return of ROM.

TECHNIQUES OF RELAXED PASSIVE MOVEMENTS FOR INDIVIDUAL JOINTS

Techniques of performing relaxed passive movements by the physiotherapist at individual joints for specific movements are described as follows.

Shoulder Joint

Flexion and Extension

- **Patient position:** The patient should be comfortably positioned in supine lying for flexion, and supine or prone lying for extension.
- **Hand placement:** The therapist typically stands or sits beside the patient on the side on which passive movement is to be performed. Hold the patient's arm beneath the elbow with the upper hand. With the other hand, reach over and grip the patient's wrist and palm.
- **Procedure:**
  1. Elevate the arm through its available range of flexion (Fig. 7.2A) and bring it back down through extension (Fig. 7.2B).
  2. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint.
  3. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.

Figs 7.2A to D: Shoulder joint: **A.** Flexion; **B.** Extension; **C.** Hyperextension in supine; **D.** Hyperextension in prone

4. Return the limb to the starting position in a controlled manner.
5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Hyperextension

Extension beyond zero can be achieved when the patient's shoulder is at the bed's edge in the supine position (Fig. 7.2C) or if the patient is in a side-lying, prone (Fig. 7.2D), or seated posture.

Abduction and Adduction

- **Patient position:** For shoulder abduction and adduction, the patient should be comfortably seated or lying down.
- **Hand placement:** Utilize the same hand placement as in flexion.
- **Procedure:**
  1. Move the patient's arm sideways (Fig. 7.3A). The elbow can be flexed.
  2. To achieve full abduction range, external rotation of the humerus and upward rotation of the scapula are essential.
  3. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.
  4. Return the limb to the starting position in a controlled manner (Fig. 7.3B).
  5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Horizontal Abduction and Adduction

- **Patient's position:** For shoulder horizontal abduction and adduction, the patient should be comfortably seated or lying down. For complete horizontal abduction, the patient's shoulder should be at the table's edge. Commence with the arm flexed or abducted at 90° (Fig. 7.3C).
- **Hand placement:** Hand placement mirrors that of flexion.
- **Procedure:**
  1. Move the patient's arm outward and then across the body for horizontal adduction (Fig. 7.3C).
  2. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint.

Figs 7.3A to D: Shoulder joint: **A.** Abduction; **B.** Adduction (with external rotation); **C.** Horizontal abduction; **D.** Horizontal adduction

3. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.
4. Return the limb to the starting position in a controlled manner for horizontal abduction (Fig. 7.3D).
5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Internal (Medial) and External (Lateral) Rotation

- **Patient's position:** For shoulder medial or lateral rotation, the patient should be comfortably seated or lying down. Ideally, the arm is abducted to 90°, the elbow is flexed at 90°, and the forearm is held neutrally (Fig. 7.4A). Internal rotation may also be achieved with the arm at the thorax's side, but it's limited in this position.
- **Hand placement:** The therapist typically stands or sits beside the patient. Grasp the hand and wrist with one hand. Secure the elbow with the other hand.
- **Procedure:**
  1. Rotate the humerus by moving the forearm inward for medial rotation (Fig. 7.4B) and outward for lateral rotation (Fig. 7.4C) in a spoke-like fashion.
  2. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint.
  3. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.
  4. Return the limb to the starting position in a controlled manner.
  5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Scapulothoracic Joint

Elevation and Depression

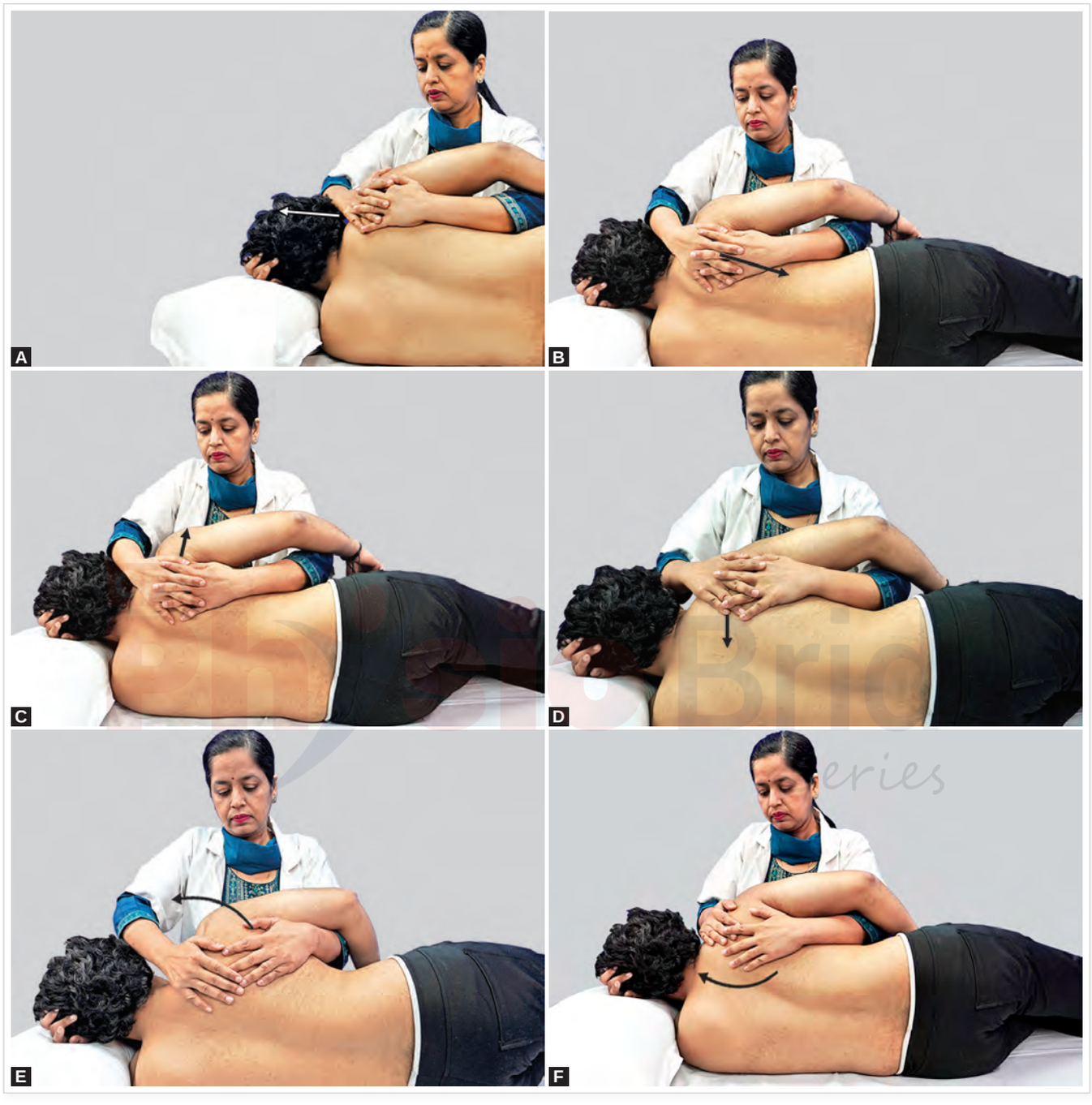
- **Patient's position:** Position the patient either prone lying or side lying with patient facing the therapist.
- **Hand placement:** The therapist typically stands or sits beside the patient when performing scapula elevation and depression allowing for better control and guidance of the movements. Cup one hand over the acromion process and the other around the inferior angle of the scapula. Alternatively, hands can be clasped across the scapula.
- **Procedure:**
  1. For elevation and depression of scapula the therapist moves the hand upward and downward respectively (Figs 7.5A and B).
  2. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint.
  3. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.
  4. Return the limb to the starting position in a controlled manner.

Figs 7.4A to C: Shoulder joint: **A.** Rotation starting position; **B.** Internal rotation; **C.** External rotation

5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Protraction and Retraction

- **Patient position:** Position the patient either prone lying or side lying with patient facing the therapist.
- **Hand placement:** The therapist typically stands or sits beside the patient when performing hand placements for scapular upward and downward rotation, allowing



Figs 7.5A to F: Scapulothoracic joint: **A.** Elevation; **B.** Depression; **C.** Protraction; **D.** Retraction; **E.** Upward rotation; **F.** Downward rotation

for better control and guidance of the movements. The therapist positions hands at the medial border of the scapula.

- **Procedure:**
  1. To initiate scapular protraction, place hands on the medial borders of the scapulae and guide them away from the spine (Fig. 7.5C).
  2. For retraction, position hands on the lateral borders and guide the scapulae toward the spine (Fig. 7.5D).
  3. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint.
  4. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.
  5. Return the limb to the starting position in a controlled manner.
  6. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Upward and Downward Rotation

- **Patient's position:** Position the patient either prone lying or side lying with patient facing the therapist.
- **Hand placement:** The therapist typically stands or sits beside the patient when performing hand placements for scapular upward and downward rotation, allowing for better control and guidance of the movements. The therapist positions hands at inferior angle of scapula and at acromion process (Fig. 7.5E).
- **Procedure:**
  1. To rotate, direct scapular motions at the inferior angle of the scapula while pressing the acromion in the opposite direction, creating a force pair turning effect.
  2. Inferior angle of scapula moves laterally for upward rotation (Fig. 7.5E) and medially for downward rotation (Fig. 7.5F).

Elbow and Forearm

Flexion and Extension

- **Patient position:** Patient should be comfortably seated or lying down with the arm supported. Ensure a relaxed position with a slightly flexed elbow for optimal movement.
- **Hand placement:** Therapist stands or sits facing the patient. While supporting the patient's forearm, grasp the hand.
- **Procedure:**
  1. Lift and lower the forearm gently through its available range for elbow flexion (Fig. 7.6A).
  2. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint.
  3. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.
  4. Return the limb to the starting position in a controlled manner for elbow extension (Fig. 7.6B).
  5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Pronation and Supination

- **Patient position:** The patient should be comfortably seated or lying down. The elbow can be flexed or extended based on the desired range of motion.
- **Hand placement:** Therapist stands or sits facing the patient. Secure the patient's wrist, placing the thumb on the dorsal aspect and fingers on the volar side (Figs 7.6C and D). The elbow is stabilized with the other hand. Alternatively, handshake grasp may also be used (Figs 7.6E to G)

Figs 7.6A to G: Elbow joint and forearm: **A.** Elbow flexion; **B.** Elbow extension; **C.** Pronation (with elbow flexed); **D.** Supination (with elbow flexed); **E.** Starting position for pronation and supination (with elbow extended); **F.** Pronation (with elbow extended); **G.** Supination (with elbow extended)

- **Procedure:**
  1. Rotate the volar aspect of forearm away from therapist for supination and toward the therapist for pronation.
  2. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint.
  3. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.
  4. Return the limb to the starting position in a controlled manner.
  5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Wrist Joint

Radial and Ulnar Deviation

- **Patient position:** The patient should be comfortably seated or lying down with the hand accessible and well-supported.
- **Hand placement:** Therapist stands or sits facing the patient. Grasp the patient's hand while providing support to the forearm.
- **Procedure:**
  1. Therapist applies gentle pressure to deviate the hand radially (Fig. 7.7A) and ulnarly (Fig. 7.7B).
  2. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint.
  3. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.
  4. Return the limb to the starting position in a controlled manner.
  5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Flexion and Extension

- **Patient position:** The patient should be comfortably seated or lying down with the hand accessible and well-supported. Ensure the elbow is in a relaxed position and forearm supinated, allowing for the desired wrist motion.
- **Hand placement:** The therapist stands or sits facing the patient. Grasp the patient's hand while providing support to the forearm.

Figs 7.7A to D: Wrist joint: **A.** Radial deviation; **B.** Ulnar deviation; **C.** Flexion; **D.** Extension

- **Procedure:**
  1. Move the wrist and hand upwards for flexion (Fig. 7.7C) and downwards for extension (Fig. 7.7D) movements of the wrist.
  2. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint.
  3. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.
  4. Return the limb to the starting position in a controlled manner.
  5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Carpometacarpal (CMC) and Intermetacarpal Joints

Cupping and Flattening the Arch of the Hand

- **Patient position:** The patient should be comfortably seated or lying down with the hand accessible and well-supported.
- **Hand placement:** The therapist sits or stand facing the patient's hand, positioning the fingers of both the hands into the patient's palm, with thenar eminences on the posterior aspect.
- **Procedure:**
  1. Roll the metacarpals palmar-ward to enhance the arch (Fig. 7.8A), and dorsal-ward to flatten it (Fig. 7.8B).
  2. Execute the movements smoothly and rhythmically, respecting the natural range of motion of each joint.
  3. Hold the end position briefly, allowing the muscles and joints to adapt to the stretch.
  4. Return the limb to the starting position in a controlled manner.
  5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Flexion, Extension, Abduction and Adduction at CMC Joint

- **Patient position:** The patient should be comfortably seated or lying down with the forearm supported on a table or armrest, hand relaxed.
- **Hand placement:** The therapist sits or stand facing the patient's hand. One hand stabilizes the base of the first metacarpal (at the wrist), and the other hand holds the thumb.

Figs 7.8A and B: Carpometacarpal and intermetacarpal joints: **A.** Hand cupping; **B.** Hand flattening

- **Procedure:**
  1. To perform passive CMC joint movements, guide the thumb toward the palm for flexion (Fig. 7.9A), away from the palm for extension (Fig. 7.9B), outward from the palm for abduction (Fig. 7.9C), and back toward the palm for adduction (Fig. 7.9D), ensuring smooth and comfortable motion throughout.
  2. Execute the movements smoothly and rhythmically.
  3. Hold the end position briefly and then return the limb to its starting position in a controlled manner.
  4. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Metacarpophalangeal (MCP) and Interphalangeal (IP) Joints

Flexion and Extension

- **Patient position:** The patient should be comfortably seated or lying down with the hand accessible and well-supported.
- **Hand placement:** The therapist stands or sits in front of the patient. Place one hand on the dorsum (back) of the patient's hand, just proximal to the MCP joint, with fingers

Figs 7.9A to D: Passive movements at continuous passive motion joint: **A.** Flexion; **B.** Extension at continuous passive motion joint; **C.** Abduction; **D.** Adduction

Figs 7.10A to D: Metacarpophalangeal and interphalangeal joints: **A.** Finger flexion; **B.** Finger extension; **C.** Metacarpophalangeal abduction; **D.** Metacarpophalangeal adduction

resting on the metacarpal bones. Use the other hand to support the proximal phalanges (finger bones) at the MCP joint.

- **Procedure:**
  1. For MCP joint flexion, gently guide the fingers toward the palm using controlled motion (Fig. 7.10A). Simultaneously, for MCP joint extension, guide the fingers back to their extended position (Fig. 7.10B).
  2. To perform IP joint flexion, carefully bend the fingers at the proximal or distal interphalangeal joint.
  3. For IP joint extension, guide the fingers to straighten at the interphalangeal joints.
  4. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Abduction and Adduction

- **Patient position:** Ensure the patient is comfortably seated or lying down, with the hand accessible and well-supported.
- **Hand placement:** The therapist stands or sits in front of the patient. Begin by securely holding the patient's hand, maintaining a stable grip.
- **Procedure:**
  1. For MCP joint abduction, gently guide the fingers away from the midline (Fig. 7.10C).
  2. Simultaneously, for MCP joint adduction, guide the fingers back toward the midline (Fig. 7.10D).
  3. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Hip Joint

Flexion and Extension

- **Patient position:** The patient should be positioned comfortably on a treatment table or bed, lying in a supine (on their back) position.

Fig. 7.11: Hip flexion with knee in extension

Fig. 7.12: Hip extension in side lying

- **Hand placement:** The therapist should stand on the side of the limb being treated. Place one hand under the patient's knee, the other hand should be positioned under the patient's heel, the hands should be in a position to allow controlled and smooth movement through the desired range of motion.
- **Procedure:**
  1. With one hand supporting the ankle and the other supporting the knee, gently lift the lower limb off the bed or treatment table keeping the knee extended for hip flexion. Gently move the limb down and back or hip extension (Fig. 7.11). Alternatively, slowly and smoothly flex both the hip and knee joints simultaneously, moving the lower limb toward the patient's chest for hip flexion and down and back for hip extension.
  2. Move the limb through a comfortable range of motion, taking care not to force the joint beyond its natural limits.
  3. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Hyperextension

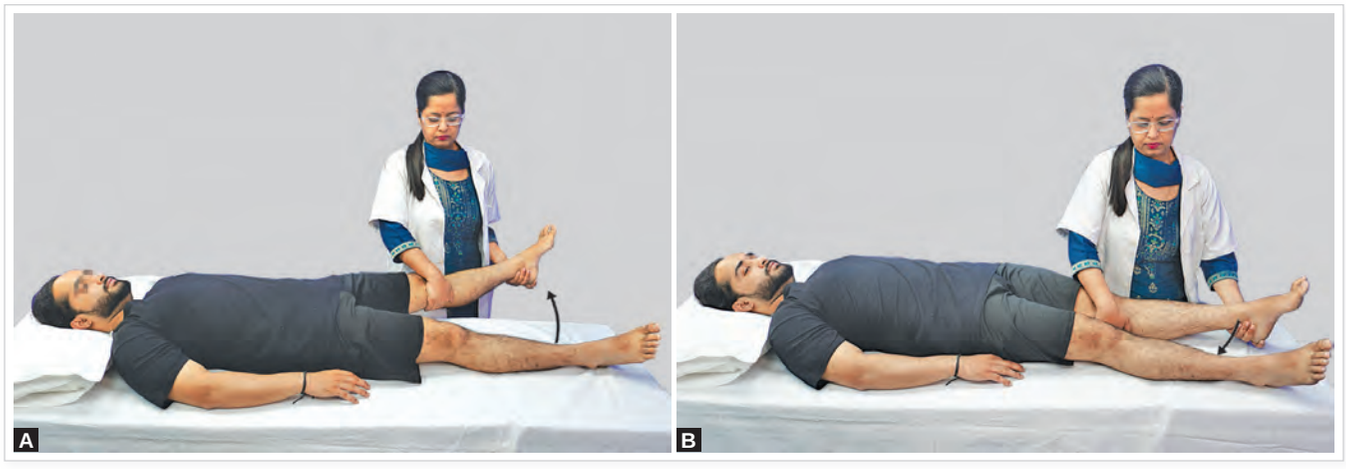
- **Patient position:** The patient lies on the side on a treatment table, with the hip and knee of the lower leg slightly flexed for comfort. The upper leg is kept straight, and a small pillow may be placed between the knees for support.
- **Hand placement:** The therapist stands at the side of the treatment table, at the back of the patient. Place one hand over the patient's hip for support, near the joint. The other hand is positioned under the patient's thigh. Do not fully flex the knee to avoid the two-joint rectus femoris to restrict the movement. Hands should be arranged to allow controlled and smooth movement during the passive hip extension.
- **Procedure:**
  1. Gradually extend the hip joint, moving the leg backward (Fig. 7.12).
  2. Maintain a controlled movement, avoiding any abrupt or forceful actions.
  3. Move the leg through a comfortable range of motion, considering the individual's flexibility and any existing limitations.
  4. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Abduction and Adduction

- **Patient position:** The patient lies on a treatment table in a supine position (on their back). Ensure the patient is comfortable, with head and trunk adequately supported. The legs are extended.
- **Hand placement:** The therapist stands on the side of the limb being treated. For hip abduction and adduction place one hand under the patient's knee or thigh. The other hand supports the ankle or heel.
- **Procedure:**
  1. With one hand supporting the knee and the other supporting the ankle or heel, gently lift the lower limb off the bed.
  2. Gradually move the leg away from the midline, performing hip abduction (Fig. 7.13A) and toward the midline, performing hip adduction (Fig. 7.13B).
  3. Move the limb through a comfortable range of motion, avoiding any forceful actions.
  4. Hold the end position briefly to allow the muscles and joints to adapt to the stretch.
  5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Internal and External Rotation

- **Patient position:** The patient lies on a treatment table in a supine position (on their back). Ensure the patient



Figs 7.13A and B: Hip joint: **A.** Abduction; **B.** Adduction

is comfortable, with the head and trunk adequately supported. The legs are extended.

- **Hand placement:** The therapist stands on the side of the limb being treated. For hip external and internal rotation place one hand on distal part of thigh and other hand supporting lower part of leg.
- **Procedure:**
  1. With one hand supporting the knee and the other supporting the outer ankle or heel, gently rotate the lower limb inward for medial rotation (Fig. 7.14A) and outward for lateral rotation (Fig. 7.14B).

Figs 7.14A to D: Hip joint: **A.** Internal rotation; **B.** External rotation; **C.** Alternative position for hip internal rotation; **D.** Alternative position for hip external rotation

2. Move the limb through a comfortable range of motion, avoiding any forceful actions.
3. Hold the end position briefly to allow the muscles and joints to adapt to the stretch.
4. Return the leg to the starting position in a controlled manner.
5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Alternate Method

1. In the procedure for rotation with the hip and knee flexed, the patient's hip and knee are flexed to approximately 90°.
2. The top hand is positioned under the patient's knee, offering initial support and stabilization to the knee joint and the other hand grasps the ankle or the heel. If there is instability in the knee, the bottom hand cradles the thigh and provides additional support to the proximal calf and knee.
3. The femur is then rotated by moving the leg in a pendulum-like motion (Figs 7.14C and D).
4. While this hand placement offers support to the knee, caution should be exercised, particularly in cases of knee instability.

Knee Joint

Flexion and Extension

- **Patient position:** The patient should be positioned comfortably on a treatment table or bed, lying in a prone position.
- **Hand placement:** The therapist should stand on the side of the limb being treated. Place one hand under the patient's knee or at the distal thigh, the other hand grasps the patient's ankle, the hands should be in a position to allow controlled and smooth movement through the desired range of motion.
- **Procedure:**
  1. With one hand supporting the thigh and the other supporting the lower leg, gently lift the lower limb off the bed or treatment table by bending the patient's knee joint (Fig. 7.15A).
  2. Slowly and smoothly flex both the hip and knee joints simultaneously, moving the lower limb toward the patient's chest.
  3. Move the knee and leg through a comfortable range of motion, avoiding forceful actions.
  4. Hold the end position briefly to allow the muscles and joints to adapt to the stretch.
  5. Move the leg back to the starting position in a controlled manner for knee extension (Fig. 7.15B).
  6. Alternatively, the patient can be in a supine lying position (Fig. 7.15C).
  7. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Ankle Joint and Foot

Dorsiflexion and Plantar Flexion

- **Patient position:** The patient should be positioned comfortably on a treatment table or bed, lying in a supine position. Ensure that the patient can communicate any discomfort during the procedure.
- **Hand placement:** The therapist stands toward the test side of the patient. For ankle dorsiflexion and plantarflexion place one hand on the heel so that the therapist's forearm supports the plantar surface of the foot (Figs 7.16A and B). The other hand is used to stabilize the lower leg around the malleoli. Alternatively, the hands can be clasped across the dorsum of the foot (Figs 7.16C and D).
- **Procedure:**
  1. Gently lift the foot toward the shin and downward for ankle dorsi and plantar flexion respectively.

Figs 7.15A to C: Knee joint: **A.** Flexion; **B.** Extension; **C.** Flexion and extension (Alternate position)

Figs 7.16A to D: Ankle joint and foot: **A.** Dorsiflexion; **B.** Plantarflexion; **C.** Dorsiflexion (Alternate grasp); **D.** Plantarflexion (Alternate grasp)

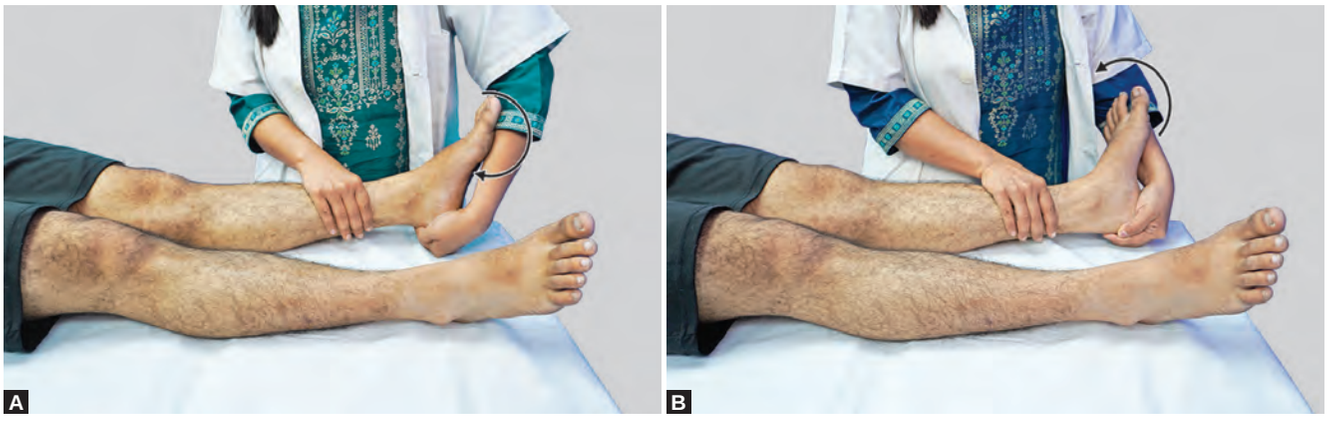
2. Move the foot through a comfortable range of motion, avoiding forceful actions.
3. Hold the end position briefly to allow the muscles and joints to adapt to the stretch.
4. Move the foot back to the starting position in a controlled manner.
5. Repeat the movement within a comfortable range, following the prescribed number of repetitions or therapist's guidance.

Inversion and Eversion

- **Patient position:** The patient is typically seated on a treatment table or lying in a supine position. Ensure the patient is comfortable, and their lower leg and foot are adequately supported.
- **Hand placement:** The therapist stands beside the patient. For subtalar joint inversion and eversion place thumb of one hand on the inside of the heel and fingers on the outer side, supporting the lateral aspect of the foot. The other hand is used to stabilize the lower leg if needed.
- **Procedure:**
  1. With one hand supporting the heel and the lateral aspect of the foot, gently tilt the heel inward for inversion (Fig. 7.17A) and outward for eversion (Fig. 7.17B).
  2. Move the foot through a comfortable range of motion, avoiding forceful actions.
  3. Hold the end position briefly to allow the subtalar joint to adapt to the stretch.
  4. Return the foot to the starting position in a controlled manner.
  5. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Metatarsophalangeal (MTP) and Interphalangeal (IP) Joints Flexion and Extension

- **Patient position:** The patient should be comfortably seated or lying down with the leg extended and supported, foot relaxed.
- **Hand placement:** The therapist sits or stands toward the affected side. One hand stabilizes the metatarsal or proximal phalanx, while the other hand holds the toe (Figs 7.18A to D).
- **Procedure:**
  1. To perform passive MTP joint movements, guide the toe toward the sole for flexion and away from the sole for extension.
  2. For IP joint movements, guide the toe toward the sole for flexion and away from the sole for extension.



Figs 7.17A and B: Ankle joint and foot: **A.** Subtalar inversion; **B.** Subtalar eversion

Figs 7.18A to D: Metatarsophalangeal and interphalangeal joints: **A.** Flexion; **B.** Extension; **C.** Flexion (Great toe); **D.** Extension (Great toe)

3. Execute the movements smoothly and rhythmically, holding the end position briefly before returning the toe to its starting position in a controlled manner.
4. Repeat the movement within a comfortable range, following the prescribed number of repetitions.

Cervical Spine

Flexion and Extension

- **Patient position:** The patient lies on their back in a supine position on a treatment table with the head out of the edge of the table.
- **Hand placement:** The therapist stands at the head of the table. Place both hands on the patient's occiput (the back of the head), with the fingers supporting the base of the skull.
- **Procedure:**
  1. Gently guide the patient's head forward, flexing the cervical spine (Fig. 7.19A).
  2. Move the chin toward the chest in a controlled manner.
  3. Move the head through a comfortable range, avoiding any sudden or forceful actions.
  4. Ensure the patient feels a gentle stretch without discomfort.
  5. Hold the flexed position briefly to allow the cervical spine to adapt to the stretch.
  6. Gradually bring the patient's head back to the starting position in a controlled manner.
  7. Ensure smooth and controlled movement throughout.
  8. Repeat the movement within a comfortable range, considering the patient's tolerance and any specific guidelines provided by the therapist.
  9. For cervical spine extension move the head backward (Fig. 7.19B).
  10. Patient position and hand placement remains same.

Lateral Flexion and Rotation

- **Patient position:** The patient lies on their back in a supine position on a treatment table.

Figs 7.19A to D: Cervical spine: **A.** Flexion; **B.** Extension; **C.** Lateral flexion (left side); **D.** Rotation (left side)

- **Hand placement:** The therapist stands at the head of the table. Place both hands on the patient's occiput (the back of the head), with the fingers supporting the base of the skull and the thumbs resting on the upper neck or around the jaw.
- **Procedure:**
  1. Gently move the patient's head and neck side to side for laterally flexing the cervical spine (Fig. 7.19C).
  2. Move in a controlled manner through a comfortable range, avoiding any sudden or forceful actions.
  3. Ensure the patient feels a gentle stretch without discomfort.
  4. Hold the laterally flexed position briefly to allow the cervical spine to adapt to the stretch.
  5. Gradually bring the patient's head back to the starting position in a controlled manner.
  6. Ensure smooth and controlled movement throughout.
  7. Repeat the movement within a comfortable range, considering the patient's tolerance and any specific guidelines provided by the therapist.
  8. For cervical spine rotation, rotate the head from side to side (Fig. 7.19D).

Lumbar Spine

Flexion

- **Patient position:** The patient lies on their back in a supine position on a treatment table with legs extended.
- **Hand placement:** The therapist stands at the side of the table. The therapist grasps the legs and knees.
- **Procedure:**
  1. Gently guide the patient's lower back into flexion by moving both the knees toward the chest causing full hip flexion and posterior rotation of pelvis (Fig. 7.20A).
  2. Move the lumbar spine through a comfortable range, avoiding any abrupt or forceful actions.
  3. Ensure the movement is smooth and controlled, focusing on the flexibility of the lumbar region.
  4. Hold the flexed position briefly to allow the lumbar spine to adapt to the stretch.
  5. Gradually bring the patient's lower back to the neutral position in a controlled manner.
  6. Ensure smooth and controlled movement throughout.
  7. Repeat the movement within a comfortable range, considering the patient's tolerance.

Extension

- **Patient position:** The patient lies on their abdomen in a prone position on a treatment table.
- **Hand placement:** The therapist stands at the side of the table. Place one hand at the patient's lumbar spine, providing gentle support, typically around the lower back. The other hand is placed under the thighs.
- **Procedure:**
  1. Gently guide the patient's lower back into extension, by lifting the thighs upward causing the pelvis to rotate anteriorly, encouraging a slight arch in the lumbar spine (Fig. 7.20B).
  2. Move the lumbar spine through a comfortable range, avoiding any abrupt or forceful actions.
  3. Ensure the movement is smooth and controlled, focusing on the extension of the lumbar region.
  4. Hold the extended position briefly to allow the lumbar spine to adapt to the stretch.
  5. Gradually bring the patient's lower back to the neutral position in a controlled manner.
  6. Repeat the movement within a comfortable range, considering the patient's tolerance.

Rotation

- **Patient position:** The patient lies in a hook lying position.
- **Hand placement:** The therapist stands at the side of the table. Place one hand on the patient's knees to stabilize and guide the movement. The other hand is positioned on the opposite shoulder or chest, depending on the direction of rotation.
- **Procedure:**
  1. Gently guide the patient's lower body into rotation by pushing both the knees in one direction until the opposite side is lifted up, off the couch (Fig. 7.20C).
  2. Ensure the movement is controlled and smooth by stabilizing the opposite side.
  3. Rotate the lumbar spine through a comfortable range, avoiding any abrupt or forceful actions.
  4. Encourage the patient to relax and let the therapist guide the movement.
  5. Hold the rotated position briefly to allow the lumbar spine to adapt to the stretch.
  6. Gradually bring the patient's lower body back to the neutral position in a controlled manner.
  7. Repeat the movement within a comfortable range, considering the patient's tolerance.

Figs 7.20A to C: Lumbar spine: **A.** Flexion; **B.** Extension; **C.** Rotation (left side)

SUMMARY

- Range of motion (ROM) is the amount of osteokinematic motion accessible for movement activities, which is governed by factors such as joint shape and soft tissue elasticity.
- Immobility can be caused by musculoskeletal injuries, neurological conditions, joint issues, chronic pain, surgery, obesity, circulatory or respiratory problems, infections, age-related changes, trauma, or psychological factors, all of which necessitate therapeutic range of motion exercises to prevent contracture formation and maintain mobility.
- Passive motions (PMs) are when external forces, such as therapists or mechanical devices, move a person's joints to maintain or enhance joint mobility.
- PMs, which include mobilization, manipulation, and controlled stretching, aim to impact soft tissue extensibility and are especially effective for people who have limited motion owing to conditions such as paralysis, pain etc.
- Continuous passive motion (CPM) devices, which are a subset of PMs, provide therapeutic benefits by encouraging joint movement, reducing stiffness, improving circulation, and preventing problems like adhesions, but they must be carefully monitored and contraindicated.
- Principles and procedures for applying passive movements involve thorough planning, patient assessment, and documentation.
- Patient preparation includes explaining techniques, removing constrictive garments, and positioning for optimal movement.
- The technique for relaxed passive movements emphasizes patient relaxation, joint fixation, proper support, stance, traction, and controlled movement with gradual speed and appropriate repetitions.
- Indications for passive movements include acute inflammation, paralysis, postoperative cases, reconstructive surgeries, comatose or bedridden patients, and critical care situations.
- The effects of passive movements encompass preserving joint flexibility, preventing adhesions, aiding neuromuscular reeducation, improving synovial motion, and various physiological benefits.
- However, contraindications include immediate postsurgery or acute injury, conditions like myositis ossificans, unhealed fractures, and life-threatening situations.
- Overall, passive movements play a crucial role in rehabilitation and healthcare across diverse medical conditions.

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STUDENT ASSIGNMENT

LONG ANSWER QUESTIONS

1. Explain and classify passive movements.
2. Explain the indications, contraindications, effects and uses of passive movements.
3. Discuss technique of relaxed passive movement with suitable example.

SHORT ANSWER QUESTIONS

1. Write short note on continuous passive motion.
2. Write about effects and uses of relaxed passive motion.
3. Classify range of motion exercises.

MULTIPLE CHOICE QUESTIONS

1. _____are small, repeated, rhythmical, oscillatory, localized accessory, or functional motions carried out by the physiotherapist in a variety of amplitudes while the patient is in control.

a. Manipulation b. Mobilization
c. Stretching d. All of these

2. Passive motion cannot be given in:

a. Postoperative cases like TKR, THR etc
b. Reconstructive surgeries like ligament repair
c. Comatosed or bed ridden patients
d. Immediately after surgery

3. _____are precisely localized, single, swift, and decisive movements that are finished at high speeds before the patient can stop them.

a. Manipulation b. Mobilization
c. Stretching d. None of these

4. What does CPM stand for in the context of rehabilitation?

a. Continuous passive motion
b. Controlled physical manipulation
c. Comfortable passive movement
d. Continuous progressive mobilization

5. In the context of passive movements, what is the primary objective of fixation during the technique?

a. Enhancing patient comfort
b. Localizing movement to the joint
c. Preventing muscle contractions
d. Facilitating rapid movements

6. What is the recommended speed for performing passive movements to ensure patient relaxation?

a. Slow and abrupt b. Fast and erratic
c. Gradual and rhythmic d. Sudden and forceful

7. Indications for passive movements include:

a. Chronic inflammation
b. Stable fractures
c. Conscious and active patients
d. Critical care situations

8. Which physiological effect is NOT associated with passive movements?

a. Improved circulation
b. Prevention of myofascial adhesions
c. Reduced joint flexibility
d. Activation of kinesthetic receptors

9. What is a contraindication for applying passive movements?

a. Chronic inflammation
b. Unhealed fractures
c. Critical care situations
d. Controlled muscle contractions

10. In the context of continuous passive motion, what is the purpose of adjusting the settings based on the patient's unique requirements?

a. To maintain joint stability
b. To increase discomfort
c. To maximize overstretching
d. To prevent appropriate usage

11. When is passive motion considered most helpful in postsurgery or postinjury situations?

a. During the acute inflammation phase
b. After 2–6 days of inflammation
c. In the presence of stable fractures
d. In conscious and active patients

12. What is the main objective of passive movements in critically ill patients in intensive care?

a. To induce pain for alertness
b. To prolong ICU stays
c. To prevent neuromuscular complications
d. To exacerbate inflammation

13. Which term refers to the technique that involves externally moving a patient's joints without their deliberate muscle activity?

a. Controlled physical manipulation
b. Passive exercise
c. Controlled progressive mobilization
d. Active assisted range of motion

ANSWER KEY

1. b	**2.** d	**3.** a	**4.** a	**5.** b	**6.** c	**7.** d	**8.** c	**9.** b	**10.** a
11. a	**12.** c	**13.** b							

25

Introduction to Yoga

Sheetal Kalra

LEARNING OBJECTIVES

After the completion of the chapter, the readers will be able to:

- Understand concept and types of yoga.
- Explain physiology and therapeutic effects of yoga.
- Understand effects and physiological basis of Yogasanas, Pranayamas, and Transcendental Meditation.
- Explain application of yoga in fitness and flexibility.
- Describe common poses with name, position, specific effects and uses.
- Interpret yoga as holistic approach.

CHAPTER OUTLINE

- Introduction
- What is Yoga?
- Types of Yoga
- Psychophysiological Mechanisms of Action
- Principles of Therapeutic Approach of Yoga
- Therapeutic Effects
- Benefits of Yoga
- Yoga: A Holistic Approach

KEY TERMS

Pranayama: Pranayama is a fundamental part of yoga, a physical and mental health practice. “Yama” signifies control and “prana” is the Sanskrit word for life energy. Breathing exercises and patterns are part of pranayama practice.

Transcendental meditation (TM): Transcendental meditation is a method for preventing distracting thoughts and encouraging a calm state of awareness.

Yogasanas: Postures are called asanas. The body can adopt countless different positions. Of them, some positions are known as “yoga asanas” or yogasanas. A greater dimension or a higher understanding of life is what is meant to be reached through “yoga”. Consequently, a “yogasana” is a position that raises one’s potential.

INTRODUCTION

The word "yoga" derives from the Sanskrit root "yuj", which also means 'to join' or 'to unite'. Regular yoga practice cultivates qualities of friendliness, compassion, and more self-control while encouraging strength, endurance, and flexibility. It also improves a sense of peace and well-being. Sustained practice also produces significant results, such as shifts in perspective on life, increased self-awareness, and more vitality to live life to the fullest and with genuine happiness.

A condition of balance and oneness between the mind and body can be attained because yoga practice results in a physiological state that is the reverse of the flight-or-fight stress reaction.

WHAT IS YOGA?

Yoga is a type of mind-body exercise that combines physical exercises with a conscious interior emphasizing on awareness of the self, the breath, and energy (Fig. 25.1).

In the famous work known as the Yoga Sutras, which is usually regarded as the canonical work on yoga, Patanjali first provided a description of the philosophy and practice of yoga. Ashtanga, which literally translates to "eight limbs", (Fig. 25.2) is the eight-fold route Patanjali describes in the Yoga Sutras for achieving consciousness and enlightenment. The eight limbs are composed of moral guidelines for leading a fulfilling life; they act as a guide for moral behavior and self-discipline, and they emphasize physical well-being while also recognizing one's spiritual nature. Any one of the eight limbs may be practiced independently, but according to yoga philosophy, physical poses and breathing techniques help to prepare the body and mind for meditation and spiritual growth. There are numerous distinct yogic disciplines that have been created based on Patanjali's eight limbs. Each uses a different method for both disease prevention and treatment.

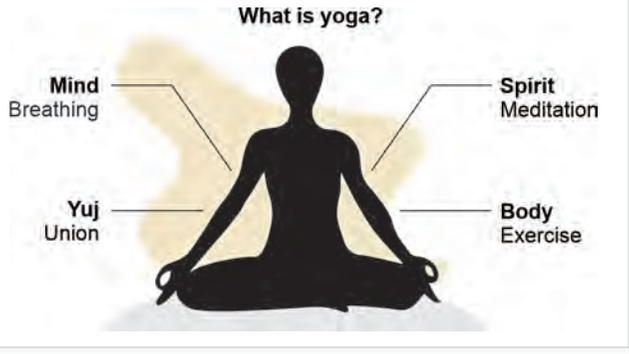


Fig. 25.1: Yoga

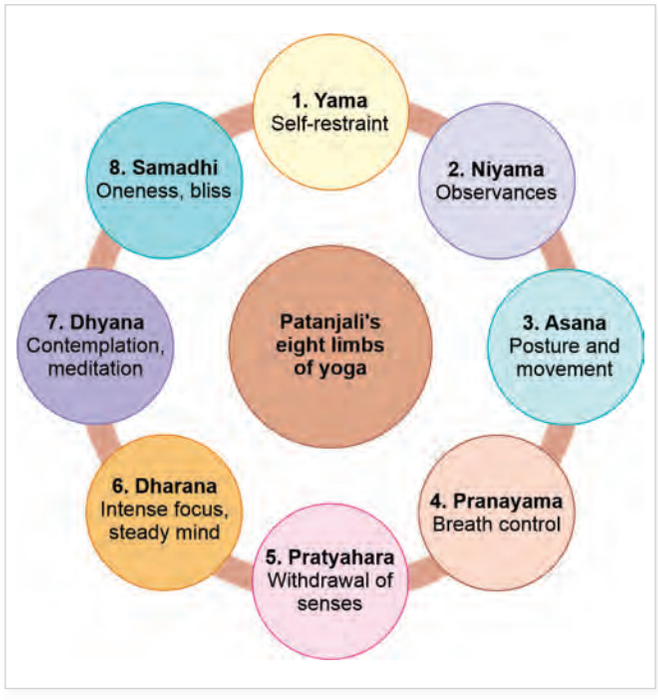


Fig. 25.2: Eight limbs of yoga

Did You Know?

Recognizing the interconnectedness of the mind, body, and spirit, healthcare providers can integrate yogic principles and practices into holistic treatment plans to address the multifaceted needs of patients.

TYPES OF YOGA

Ashtanga Yoga

- This type of yoga practice uses ancient yoga teachings. However, it became popular during the 1970s.
- Ashtanga applies the same poses and sequences that rapidly link every movement to breath.

Bikram Yoga

People practice Bikram yoga, also known as hot yoga, in artificially heated rooms at a temperature of nearly 105°F and 40% humidity. It consists of 26 poses and a sequence of two breathing exercises.

Hatha Yoga

The purposeful prolonging of inhalation, breath retention, and exhalation is the main focus of Hatha yoga breathing methods. Blockages in the body's energy channels are removed, and the energy system of the body becomes more balanced, by combining the physical body, breath, and focus while doing the postures and motions.

Did You Know?

Hatha yoga, often associated with gentle and slow-paced movements, actually encompasses various styles ranging from the more meditative and therapeutic to the vigorous and physically challenging. It is a versatile system that caters to different needs and preferences, making it accessible to practitioners of all levels and abilities.

Iyengar Yoga

This style of yoga emphasizes using a variety of props, including chairs, bolsters, blankets, blocks, and straps, to assist practitioners achieve the proper alignment in each posture.

Kripalu Yoga

- Kripalu yoga educates practitioners to understand, accept, and draw lessons from their bodies. By going inward, a Kripalu yoga student discovers his own level of practice.
- It is a gentler form of Hatha yoga.
- Breathing exercises and gentle stretches commonly start the classes. Individual poses are then practiced, culminating in a final relaxation.

Kundalini Yoga

- Kundalini yoga is a type of meditation that is intended to help release stored energy.
- Chanting usually opens a Kundalini yoga class, while singing closes it. It includes asana, pranayama, and meditation aimed at achieving a particular result.

Power Yoga

This vigorous and athletic style of yoga was created by practitioners in the late 1980s, drawing inspiration from the Ashtanga method.

Sivananda Yoga

- The core of this method is a five-point concept which emphasizes that a healthy yogic lifestyle may be achieved by appropriate breathing, relaxation, food, exercise, and positive thought.
- Practitioners of Sivananda Yoga perform 12 fundamental asanas, Sun salutations coming first and Savasana last.

Did You Know?

Sivananda yoga was founded by Swami Sivananda, who was not only a yogi but also a physician. He synchronized traditional yoga teachings with modern medical knowledge to create a holistic approach to health and well-being, emphasizing not just physical postures but also proper breathing, relaxation, diet, and positive thinking.

Viniyoga

Viniyoga emphasizes the art and science of sequencing form over function, breath and adaptation, repetition and holding.

Yin Yoga

Holding passive positions for extended periods of time is the main focus of yin yoga. Deep tissues, ligaments, joints, bones, and fascia are all targeted by this type of yoga.

Prenatal Yoga

Prenatal yoga practitioners design poses specifically with expectant mothers in mind. This type of yoga can promote health throughout pregnancy and assist individuals in getting back into shape after giving birth.

Restorative Yoga

This style of yoga is calming. During a restorative yoga class, an individual performs four or five basic poses, utilizing props like blankets and bolsters to help them sink into deep relaxation and hold the poses without having to work at all.

PSYCHOPHYSIOLOGICAL MECHANISMS OF ACTION

Yoga is likely to affect the neural system, cardiovascular system, psycho-neuro-endocrine axis, neurotransmitter levels, molecular and gene expression, among other things.

At Mental Level

- According to published research, yoga practice stimulates the vagal nerve, increasing parasympathetic function of the autonomic nervous system and brain Gamma-Aminobutyric acid (GABA) activity. Studies showing long-term yoga practitioners' gene expression profiles compared to controls demonstrate that yoga has a favorable impact on immune cell gene expression profiles.
- Regular yoga practice has also been proven to alter the brain, increasing the left prefrontal cortex's level of activation. Numerous studies have demonstrated that yoga-based techniques can lead to creating new brain pathways.

- Yoga activities have an impact on resonance circuits that thicken the pre-frontal medial cortex and insula, especially on the right side, which aids in the processing of empathy, apprehension, reasoning, and intuition. These activities frequently lower stress, which improves mood and lessens emotional suffering.
- The autonomic processes, neurophysiologic mechanisms, neurochemical mechanisms, cognitive mechanisms, and spiritual factors have all been the focus of scientific studies on yoga.
- The effects of yoga in conditions including depression, schizophrenia, attention-deficit/hyperactivity disorder (ADHD), and other psychological illnesses seem to be best explained by neurochemical pathways. According to studies, yoga has a biological basis for treating depression since it lowers cortisol levels and increases brain-derived neurotrophic factor (BDNF) serum levels (Telles et al., 2020).

At Physical Level

- Pancreatic cells are rejuvenated or regenerated as a result of abdominal stretching during yoga exercise, which could boost the enzymatic process that increases the use and metabolism of glucose in peripheral tissues, the liver, and adipose tissues.
- Muscle development, relaxation, and better blood flow to the muscles may boost insulin receptor expression in the muscles, resulting in higher glucose uptake by the muscles and lowering of blood sugar.
- The rise in hepatic lipase and lipoprotein lipase at the cellular level, which alter lipoprotein metabolism and consequently increase uptake of triglycerides by adipose tissues, may be the cause of the improvement in lipid levels after yoga.
- The cumulative effect of doing the postures can improve insulin sensitivity and the β-cells' sensitivity to the glucose signal in the pancreas, which in turn can improve glucose sensitivity.
- The ability of the pancreas to make insulin can be restored by the postures' direct stimulation of the organ. Yoga poses that stimulate the pancreatic meridian and workouts that increase blood circulation in the pancreas region may help some diabetes patients regenerate pancreatic β-cells.
- Pranayama exercises strain the lung tissue, which results in inhibitory signals from the activity of hyperpolarizing currents and slowly adapting receptors. These inhibitory signals from the vagi-involved cardiorespiratory region are thought to coordinate neuronal components in the brain, changing the autonomic nervous system and producing a state marked by decreased metabolism and a predominance of the parasympathetic nervous system.
- Higher melatonin levels could be one mechanism through which the claimed health promoting effects of meditation occur.

Did You Know?

Effects of Transcendental Meditation

Researchers identified considerably more gray matter in the meditators' right orbitofrontal cortex, right thalamus, and left inferior temporal gyrus in a study to determine the morphological correlates of long-term meditation.

An increase in alpha activity was observed in both the major depressive patient group and the healthy individuals in a comparative investigation of the effects of Sahaja Yoga meditation on Electroencephalogram (EEG) in both groups after two months of Sahaja yoga meditation practice.

Long-term practitioners of meditation have structural variations in brainstem regions related to cardiorespiratory regulation, according to a Danish study that found experienced meditators had higher gray matter density in lower brain stem regions than age-matched nonmeditators.

Another study carried out in Germany with eight Buddhist nuns and monks trained in meditation showed that regular meditation practice increased the speed at which attention may be distributed, increasing the depth of information processing and decreasing reaction latency.

Long-term Sahaja Yoga meditation practitioners reported higher quality of life (QoL) and functional health than the general population, according to a cross-sectional survey with 347 respondents (Balaji et al., 2012).

Research indicates that regular practice of TM is associated with changes in gene expression related to immune regulation, as well as increased antibody production.

PRINCIPLES OF THERAPEUTIC APPROACH OF YOGA

The therapeutic approach of yoga is based on four fundamental principles:

1. The first principle is that the human body is a holistic system made up of multiple interconnected dimensions that are inextricably linked to one another, and that the health or illness of any one dimension has an impact on all the others.
2. The second principle is that each person is different, and that each person has different needs. As a result, each person should be treated as an individual, and practices should be adjusted as necessary.
3. The third principle of yoga empowers the practitioners to be their own healer. Yoga involves the learner in the healing process; by actively participating in their quest for health, the healing occurs within rather than from an external source, and a greater sense of autonomy is developed.
4. The fourth principle is that healing depends greatly on a person's mental makeup and condition. Recovery proceeds more rapidly when the person is in a positive mental state; conversely, if the person is in a negative mental state, healing can take longer.

THERAPEUTIC EFFECTS

As per research studies, following are some of the therapeutic effects of yoga.

Mental Health

- Regular practice is effective in reducing symptoms of depression, anxiety, fatigue, stress, post-traumatic stress disorder.
- **Reduction in anxiety:** Participation in yoga leads to significant reduction in perceived levels of anxiety in women who suffer from anxiety disorders (Javnbakht et al., 2009).
- **Antidepressant effects:** Yoga alone produced substantial antidepressant effects correlated with the elevation of serum BDNF levels. The findings argue for a neuroplastic mechanism of antidepressant action for Yoga (Naveen et al., 2013).
- **Reduces stress:** Yoga is valuable in helping to achieve relaxation and diminish stress, it also helps cancer patients perform daily and routine activities, and increases the quality of life in cancer patients (Ulger et al., 2010).

Physical Fitness

- Positive effects are seen on body composition, muscle strength, endurance, flexibility and balance.
- **Improve health and fitness:** Yogic practices enhance muscular strength and body flexibility, promote and improve respiratory and cardiovascular function, expedite recovery from and treatment of addiction, reduce stress, anxiety, depression, and chronic pain, improve sleep patterns, and enhance overall well-being and quality of life (Rayal et al., 2021).
- **Yoga and cardiopulmonary conditions:** Regular practice of yoga improves cardiopulmonary parameters.
  - **Reduction in blood pressure:** Yoga has been found to decrease blood pressure as well as the levels of oxidative stress in patients with hypertension (Dhameja et al., 2013).
  - **Improvements in pulmonary functions:** A study reported significant increase in FVC, FEV-l and peak expiratory flow rate (PEFR) at the end of 12 weeks of yogic practice in young healthy females (Yadav et al., 2001).
- **Patients with neurological disorders:** Yoga might be considered an effective adjuvant for the patients with various neurological disorder (poststroke aphasia, epilepsy, Alzheimer's, dementia, myelopathy, Guillain-Barré syndrome, diabetic neuropathy, amyotrophic lateral sclerosis (ALS)) (Mooventhan et al., 2017).
- **Yoga and musculoskeletal conditions:**
  - Yoga improves musculoskeletal function and pain perception.
  - Regular yoga practice decreases frequency, intensity and degree of interference due to musculoskeletal discomfort, increases hand grip strength, coordination and flexibility (Telles et al., 2009).
- **Therapeutic effects for children (Galantino et al., 2008):**
  - Children with ADHD-show improved sensory motor skills, health and performance.
  - Reduction in asthmatic attacks.
- **Special conditions:**
  - **Improved QoL** and physiological functions in stages 1–2 of Parkinson's disease (Sharma et al., 2015).
  - **Reduction in symptoms of dysmenorrhea:** Yoga intervention was found to be associated with reductions in severity of dysmenorrhea and may be effective in lowering serum homocysteine levels after an intervention period of 8 weeks (Chien et al., 2013).
  - **Irritable bowel syndrome:** Yoga improves symptoms in patients with IBS (Schumann et al., 2016).
  - **Non-insulin-dependent diabetes mellitus (NIDDM):** Better glycemic control and pulmonary functions can be obtained in NIDDM cases with yoga asanas and pranayama. The exact mechanism as to how these postures and controlled breathing, interact with somato-neuro-endocrine mechanism affecting metabolic and pulmonary functions remains to be worked out (Sharma et al., 2002).

Clinical Correlation

Yoga can complement traditional rehabilitation programs by improving flexibility, strength, and balance. Understanding styles like Viniyoga, which prioritize adaptation and gradual progression, can be particularly useful in designing rehabilitation plans for patients recovering from injuries or surgeries.

BENEFITS OF YOGA

- **Physical advantages:**
  - A predisposition toward parasympathetic nervous system dominance rather than the typical stress-induced sympathetic nervous system dominance; stable autonomic nervous system homeostasis.
  - Blood pressure falls.
  - Pulse rate reduces.
  - Respiratory rate decreases.
  - Galvanic skin response (GSR) rises, EEG alpha waves rise (theta, delta, and beta waves also rise throughout the meditation process), electromyography (EMG) activity falls, cardiovascular efficiency rises, respiratory efficiency rises (breathing amplitude and smoothness rises, vital capacity rises, breath-holding time rises), gastrointestinal function normalizes, endocrine function normalizes, excretory function normalizes.
  - Musculoskeletal flexibility and joint range of motion increase; posture is improved; strength and resilience rise; endurance soars; energy levels soar; weight returns to normal; sleep is enhanced; immunity soars; and pain levels decline.

- **Mental health benefits:**
  - A rise in somatic and kinesthetic awareness; an uptick in mood and subjective well-being
  - An increase in social adjustment, a decrease in anxiety and despair, a rise in self-acceptance and self-actualization, and a decline in hostility.
- **Psychomotor functions:** Grip strength, dexterity, fine motor skills, eye-hand coordination, reaction time, steadiness, depth perception, balance, and integrated body part functioning are just a few of the psychomotor improvements. The cognitive functions like depth perception, symbol coding, attention, concentration, memory, and learning effectiveness increase.
- **Effects on biochemistry:** The metabolic profile improves, showing a stress-relieving and antioxidant effect that is crucial for preventing degenerative illnesses, reduced levels of glucose, sodium, and total cholesterol, reduced triglycerides, increased high-density lipoprotein (HDL) cholesterol, decreased low-density lipoprotein (LDL) cholesterol, and decreased very low-density lipoprotein (VLDL) cholesterol are all positive effects. Cholinesterase levels rise, catecholamine levels fall, and ATPase levels rise, Lymphocyte count increases, hemoglobin levels rise, total white blood cell count falls, thyroxin levels rise, vitamin C levels rise, total serum protein levels rise, oxytocin levels rise, prolactin levels rise, and oxygen levels in the brain rise.

Yoga for Fitness

Fitness can be defined as an individual's capability to perform any activity with full vigor and alertness without fatigue. Yoga can be practiced by people of all ages to improve fitness, and the asanas can even be modified to accommodate those with particular needs or limitations. The positions increase muscle strength, coordination, flexibility, and agility. The National Institutes of Health claim that when people consciously try to lessen their stress levels through mental stillness, their bodies frequently start to heal. In this sense, yoga may be viewed as a method of self-healing as well as a way to get physically and mentally fit.

Asanas, which are aimed to promote strength, flexibility, balance, and the coordination of the mind, body, and breath through controlled breathing exercises (pranayama), as well as meditation, are common components of many types of yoga. The development of a strong, flexible body that is pain-free, the development of a balanced neurological system that allows all physiological systems to work effectively with a clear and quiet mind, and the development and integration of the body, mind, and breath are the general goals of yoga practice.

Research-Based Evidences

- 8 weeks of Hatha yoga practice improved health related fitness of subjects—study by Tran et al., in 2001. Isokinetic muscular strength, isometric muscular endurance, ankle, shoulder, trunk flexibility, absolute and relative maximal oxygen uptake increased.
- A 90-minutes short duration session of Bikram Yoga increased deadlift strength, lower back/hamstring flexibility, shoulder flexibility, and decreased body fat compared with control group—study by Tracy et al., in 2013.
- Regular yoga practice results in enhanced flexibility very rapidly as this process involves gentle stretching of muscles and connective tissues around bones and joints—study by Woodyard in 2011. Yoga also has profound effect on balance, muscular strength, endurance and coordination because of its highly structural activity and involvement.

Yoga for Flexibility

Flexibility is an important components of fitness which can be defined as the capability of a joint to move through its full ROM. Good flexibility is essential for optimal movement, range of motion and prevention of injury. Both competitive and recreational athletes stretch their muscles to increase flexibility. In order to complete daily duties, maintain proper posture, and relax the muscles, one needs a sufficient range of motion. This can also improve performance and lower the risk of injury.

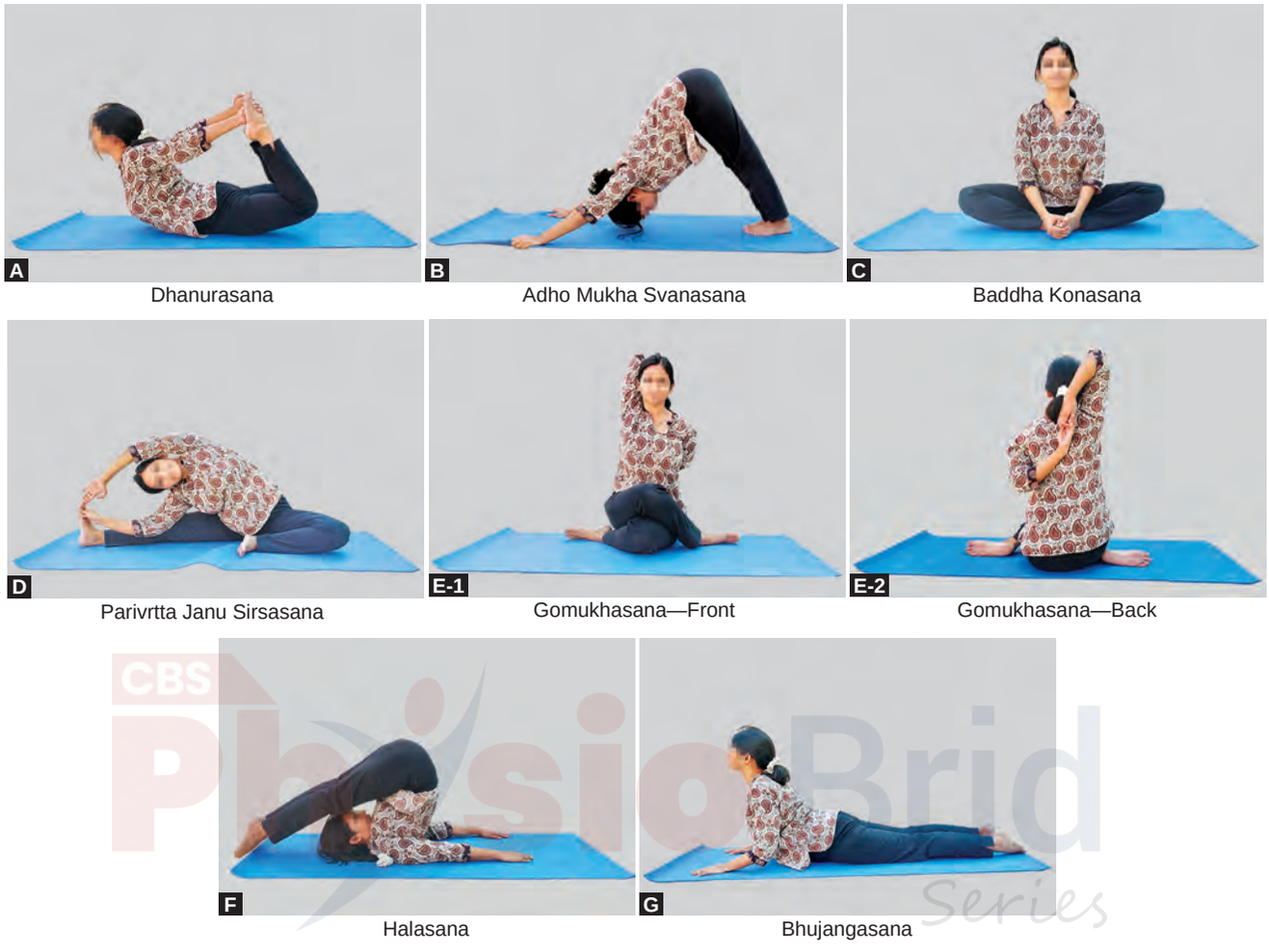
One of the first and most noticeable advantages of yoga is increased flexibility. Yoga leads to gradual relaxation of the muscles and connective tissues surrounding the bones and joints that occurs with repeated practice.

Yoga positions for flexibility can improve health in a variety of ways. Stretching helps to enhance range of motion, increase mobility, and lower risk of injury. Any fitness program should include flexible exercises. Tension and stress can be relieved by stretching. It enhances both mental and physical health generally.

Yoga stretching is thought to assist discharge of lactic acid from the muscle cells into the bloodstream so that it does not interfere with muscular contraction, which may help the body become more flexible and increase the range of motion of the joints. Some yogasanas for flexibility are shown in Figures 25.3A to G.

Research-Based Evidences

- A study showed regular yoga training may improve the balance and flexibility of shooting athletes even within short period of time (6 weeks) and can also improve the athletic performances that demand high flexibility and balance—study by Iftekhar et al., in 2017.
- Yoga exercises increased spinal mobility and flexibility of the hamstring muscles regardless of age as was demonstrated in a study by Grabara et al., in 2015.
- Study by Tekur et al., showed seven (7) days of a residential intensive yoga-based lifestyle program reduced pain-related



Figs 25.3A to G: Yoga asanas for flexibility

disability and improved spinal flexibility in patients with chronic low back pain better than a physical exercise regimen.

YOGA: A HOLISTIC APPROACH

Yoga is a holistic science that embodies the interdependence of life; it is a physical, mental, and spiritual practice that has its roots in ancient India and links emotional stability and mental equilibrium to physical well-being. Yoga has been shown to help control chronic conditions like obesity, cancer, metabolic syndrome, cardiovascular, respiratory, and endocrine disorders as well as boost immunity. Yoga poses or asanas, such as Dhyana for meditation and Pranayama for breathing control enhance innate immunity, reduce inflammation, and delay the onset of chronic diseases. Yoga also improves joint flexibility and microcirculation, which reduces the symptoms of chronic arthritis. Neurotransmitters, neuropeptides, hormones, and cytokines that mediate interactions between the immune system and the central nervous system are regulated by yoga and meditation. The psychological and physical impacts of ongoing stress are lessened by these methods. It has been demonstrated that the direct release of serotonin, oxytocin, and melatonin during yoga practice helps people more effectively handle anxiety and panic, particularly during pandemics.

Physical activity, relaxation, breathing exercises, meditation, a healthy diet, and purifying detoxification methods are used to achieve this comprehensive approach. Health, calmness, tranquilly, positive thinking, mental stability, energy, and inner power are all improved through these techniques.

Clinical Correlation

Research suggests that yoga practice may help alleviate symptoms of various physical and mental health conditions, including stress, anxiety, depression, chronic pain, hypertension, and insomnia. Moreover, incorporating yoga into clinical interventions has shown promising results in improving overall quality of life and promoting holistic wellness.

SUMMARY

- Yoga, derived from the Sanskrit root "yuj", is a mind-body exercise that promotes friendliness, compassion, self-control, strength, endurance, flexibility, and a sense of peace.
- It can lead to significant results such as shifts in perspective, increased self-awareness, and more vitality.
- The Yoga Sutras, Patanjali's canonical work on yoga, describes the eight limbs of yoga philosophy.
- The therapeutic approach of yoga is based on four fundamental concepts: The human body is a holistic system with multiple interconnected dimensions; each person has different needs and should be treated as an individual; yoga empowers the practitioner to be his/her own healer; and healing depends greatly on a person's mental makeup and condition.
- Ashtanga yoga uses ancient teachings, while Bikram yoga involves 26 poses and two breathing exercises.
- Hatha yoga focuses on prolonging inhalation, breath retention, and exhalation to balance the body's energy system. Iyengar yoga focuses on finding correct alignment in each pose using props.
- Kripalu yoga teaches practitioners to know, accept, and learn from the body, while Kundalini yoga aims to release pent-up energy.
- Power yoga, developed in the late 1980s, is an active and athletic type of yoga based on the traditional Ashtanga system.
- Yoga has numerous benefits for mental health, including reducing symptoms of depression, anxiety, fatigue, stress, and post-traumatic stress disorder. It also has antidepressant effects, reduced stress, and improved physical fitness.
- Yoga can also help patients with cardiovascular conditions like hypertension and musculoskeletal conditions, such as ADHD.
- Therapeutic effects for children include improved sensory motor performance as well as reduced asthmatic attacks.
- Yoga has been shown to improve QoL and physiological functions in Parkinson's disease patients, reduce symptoms of dysmenorrhea, and improve symptoms in IBS patients. It can also improve glycemic control and pulmonary functions in NIDDM cases.
- Physical advantages of yoga include a predisposition toward parasympathetic nervous system dominance and stable autonomic nervous system homeostasis. Blood pressure falls, pulse rate reduces, respiratory rate decreases, and GSR increases ; normalization of EEG alpha waves, EMG activity, cardiovascular efficiency, respiratory efficiency, gastrointestinal function, endocrine function, excretory function, and pain levels.
- Psychomotor functions improve, with improvements in grip strength, dexterity, fine motor skills, eye-hand coordination, reaction time, steadiness, depth perception, balance, and integrated body part functioning. Cognitive functions also improve.
- Yoga has potential psycho-physiological mechanisms, such as stimulating the vagal nerve, increasing parasympathetic function of the autonomic nervous system and brain GABA activity.
- Studies have shown that yoga has a positive impact on immune cell gene expression profiles and alters the brain by increasing the left prefrontal cortex activation level.
- Yoga activities also aid in processing empathy, apprehension, reasoning, and intuition, lowering stress and improving mood.
- Yoga has numerous health benefits, including rejuvenating pancreatic cells through abdominal stretching, boosting insulin receptor expression, and improving insulin sensitivity.
- Transcendental meditation has been found to have health-promoting effects, with long-term practitioners reporting higher QoL and functional health than the general population.
- Yoga can be practiced for fitness and flexibility, with asanas aimed at promoting strength, flexibility, balance, and coordination of the mind, body, and breath through controlled breathing exercises (pranayama).
- Yoga is also beneficial for flexibility, as it leads to gradual relaxation of muscles and connective tissues surrounding bones and joints. Stretching helps enhance range of motion, increase mobility, and lower the risk of injury.
- Yoga poses and asanas, such as dhyana for meditation and pranayama for breathing control, enhance innate immunity, reduce inflammation, and delay the onset of chronic diseases.
- Yoga has been shown to help control chronic conditions like obesity, cancer, metabolic syndrome, cardiovascular, respiratory, and endocrine disorders, and boost immunity.
- Yoga and meditation regulate neurotransmitters, neuropeptides, hormones, and cytokines that mediate interactions between the immune system and the central nervous system, reducing the psychological and physical impacts of ongoing stress.

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STUDENT ASSIGNMENT

LONG ANSWER QUESTIONS

1. Explain the therapeutic effects of yoga.
2. Describe the psychophysiological mechanisms of action of yoga.
3. Explain how yoga improves flexibility.
4. What are types of yoga and its benefits? Elaborate

SHORT ANSWER QUESTIONS

1. Define yoga and principles.
2. Write note on yoga as a holistic approach.
3. What is the role of yoga in fitness enhancement?

MULTIPLE CHOICE QUESTIONS

1. Yoga is derived from a Sanskrit word. What does that word mean?
   a. Diffusion
   b. Breaking into pieces
   c. Surya Namaskar
   d. Union

2. What would not be helpful when meditating?
   a. Concentrate on breathing
   b. Picture a peaceful place
   c. Thinking of problems
   d. Concentrate on a color

3. Pranayama is cutting down the speed of:
   a. Mind
   b. Inhalation-Exhalation
   c. Anger
   d. Jealousy

4. Which one comes under Antaranga Yoga?
   a. Dharana
   b. Pratyahara
   c. Niyama
   d. Asana

5. The yoga that emphasizes use of prop is:
   a. Ashtanga yoga
   b. Hatha yoga
   c. Iyengar yoga
   d. Kundalini yoga

ANSWER KEY

1. d **2.** c **3.** b **4.** c **5.** d

Textbook of

Exercise Therapy

Fundamentals & Practices

Salient Features

- This book provides a detailed understanding of the fundamentals of exercise therapy, including human movement, muscle function, and therapeutic techniques.
- It follows a dual approach, covering both the theoretical principles and practical applications to ensure a well-rounded learning experience.
- The book is structured into five sections – (1) Essentials of Exercise Therapy, (2) Examination/Testing Techniques, (3) Application of Principles of Exercise Therapy, (4) Therapeutic Techniques, and (5) Movement and Alignment.
- It explains key concepts in a simple and systematic manner, making it easier for readers to grasp both basic and advanced therapeutic methods.
- The content is designed to help physiotherapy professionals develop essential knowledge and hands-on skills for effective patient care.
- By integrating core principles with real-world applications, this book serves as a valuable resource for both students and practitioners in the field of physiotherapy.

Learning Objectives in the beginning of every Chapter help readers understand the purpose of the chapter.

LEARNING OBJECTIVES

After the completion of the chapter, the readers will be able to:

- Define force, speed, velocity, work, energy, power, acceleration, momentum, friction and inertia.
- Explain the components of forces and determine its magnitude

Chapter Outline gives a glimpse of the content covered in the chapter.

CHAPTER OUTLINE

- Introduction
- Kinematics
- Kinetics

Key Terms are added in each chapter to help understand difficult scientific terms in easy language.

KEY TERMS

Acceleration: The rate at which velocity changes in relation to time is known as acceleration in mechanics. Its SI unit is m/s^2.

Base of Support (BoS): The term "base of support" refers to the space

Did You Know? boxes give an overview of important facts and terms of the concerned topic.

Did You Know?

Suspension therapy also engages the proprioceptive system, which involves sensory receptors in the muscles and joints that provide feedback to the brain about body position and movement. This engagement helps improve proprioception,

The book is well illustrated with practices/techniques of exercise therapy for better understanding of the theoretical concepts.

Numerous **Tables** have been used in the chapters to facilitate learning in a quick way.

TABLE 22.2: Causes of Trendelenburg gait

Causes	Specific conditions
Failure of the fulcrum	Osteonecrosis of the hip
	Legg-Calvé-Perthes disease
	Developmental dysplasia of the hip
	Chronically dislocated hips secondary to trauma

Evolving conceptual details for application in clinical situations are depicted in **Clinical Correlation** boxes.

Clinical Correlation

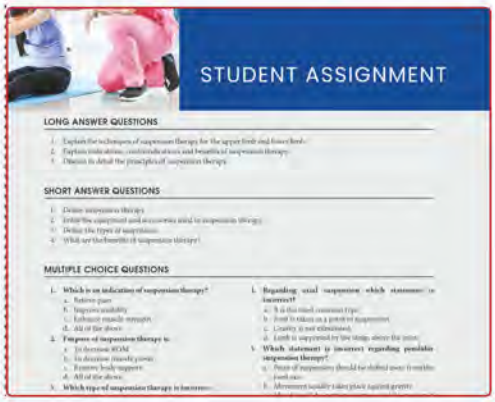
Suspension therapy can also be adapted for postural correction and rehabilitation. By suspending the body in a controlled manner, therapists can manipulate the positioning of the body to promote proper alignment and muscle activation. This can be especially helpful for individuals with postural imbalances

Important takeaway points of respective chapters have been highlighted under **Summary** Boxes.

SUMMARY

- Suspension therapy is a therapeutic exercise that involves suspending a person's body in the air while performing various movements and exercises.
  - This technique can be administered while sitting or lying down, and the suspension devices can be ropes or slings. It is often used by physical therapists, chiropractors, and other medical practitioners to increase joint mobility, flexibility, and strength.

At the end of chapters, **Student Assignment** section is given which contains frequently asked questions in exams and multiple choice questions to help students attain mastery over the subject.



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