

Neurological Rehabilitation

Edited by
DARCY ANN UMPHRED



VOLUME THREE

Neurological Rehabilitation

Edited by

Darcy Ann Umphred, Ph.D., R.P.T.

International Lecturer,
Consultant, Private Practitioner,
Rio Oso, California

Editorial contributions by

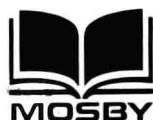
Martha J. Jewell, Ph.D., R.P.T.

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CONTRIBUTORS

C. Robert Almli, Ph.D.

Associate Professor, Washington University School of Medicine, Programs in Occupational Therapy and Neural Sciences, Department of Preventive Medicine, Anatomy and Neurobiology and Psychology, St. Louis, Missouri

Lois Barnhart, R.P.T.

Physical Therapy Supervisor, Emory University Center for Rehabilitation Medicine, Atlanta, Georgia

Bonnie Blossom, M.A., R.P.T.

President, Department of Rehabilitation Publications and Therapies, Inc., Atlanta, Georgia; Manager of Physical and Occupational Therapy Services, American Home Health Care of Georgia, Inc., Atlanta, Georgia

Mary Jane Bouska, O.T.R./L.

Private Practice, Philadelphia, Pennsylvania

Gordon Burton, Ph.D., O.T.R.

Assistant Professor, Department of Occupational Therapy, San Jose State University, San Jose, California

Sharon A. Cermak, Ed.D., O.T.R., F.A.O.T.A.

Associate Professor of Occupational Therapy, Department of Occupational Therapy, Boston University, Sargent College of Health Professions, Boston, Massachusetts; Faculty Member, Center for the Study of Sensory Integration Dysfunction, Pasadena, California

Debra Frankel, M.S., O.T.R.

Director of Support Services, Massachusetts Chapter, National Multiple Sclerosis Society, Waltham, Massachusetts

Susan R. Harris, Ph.D., R.P.T.

Child Development and Mental Retardation Center, University of Washington, Seattle, Washington

Anne Henderson, Ph.D., O.T.R.

Professor of Occupational Therapy, Department of Occupational Therapy, Boston University, Sargent College of Allied Health Professions, Boston, Massachusetts

Steven R. Huber, R.P.T., C.O.

Southern Maine Physical Therapy Services, Private Practitioner, Consultant, Westbrook, Maine

Fred Humphrey, B.A., M.A., Ph.D.

Professor and Chairman, Department of Recreation, University of Maryland, College Park, Maryland

Osa Jackson-Klykken, Ph.D., R.P.T.

Adjunct Assistant Professor, Department of Physical Therapy, University of Pittsburgh, Pittsburgh, Pennsylvania; Lecturer-Gerontological Nursing, Diakonissehuset Nursing School, Oslo, Norway

Martha J. Jewell, Ph.D., R.P.T.

Private Consultant; Senior Lecturer, Division of Physical Therapy, Stanford University, Palo Alto, California; Visiting faculty, Orthopedic Physical Therapy Residency Program, Kaiser Permanente Hospital, Hayward, California

Nancy Allen Kauffman, Ed.M., O.T.R./L.

Private Practice, Newtown Square, Pennsylvania

Margaret Kelly-Hayes, M.S., R.N.

Neurorehabilitation Clinical Nurse Specialist, Assistant Clinical Professor of Neurology (Neurological Nursing), Boston University School of Medicine, Boston, Massachusetts

Steven E. Marcus, O.D.

Private Practice, King of Prussia, Pennsylvania

Guy McCormack, M.S., O.T.R.

Associate Professor, Department of Occupational Therapy, San Jose State University, San Jose, California

Marsha Ellen Melnick, Ph.D., P.T.

Chairman and Associate Professor, Department of Physical Therapy Education, University of Kansas, College of Health Sciences and Hospital, Kansas City, Kansas

Linda Mirabelli, R.P.T. (B.S. in P.T.)

Director of Physical Therapy, Department of Physical Therapy, Humana Hospital Sun Bay, St. Petersburg, Florida

Christine A. Nelson, Ph.D., O.T.R.

Clinical Director, Centro de Aprendizaje de Cuernavaca, Cuernavaca, Morelos, Mexico

Marilyn Pires, M.S., R.N.

Rehabilitation Clinical Nurse Specialist, University Hospital; Clinical Instructor, Boston University School of Medicine, Adjunct Clinical Assistant Professor, Boston University School of Nursing, Boston, Massachusetts

Rebecca Elaine Dunnuck Porter, M.S., R.P.T.

Director and Associate Professor, Physical Therapy Program, Division of Allied Health Sciences, Indiana University School of Medicine, Indianapolis, Indiana

Katharine B. Robertson, B.A., R.P.T.

Private Practice, Physical Therapist and Electroneuromyographer, Walnut Creek, California

Susan D. Ryerson, B.A., M.A., R.P.T.

Clinical Consultant and Lecturer, Private Practice, Washington, D.C.

Frederick J. Schneider, M.Ed., P.T.

Associate, Department of Rehabilitation Medicine, Northwestern University Medical School, Chicago, Illinois; Director, Physical Therapy Education, Rehabilitation Institute of Chicago, Chicago, Illinois

Jane W. Schneider, M.S., P.T.

Assistant Professor, Programs in Physical Therapy, Northwestern University Medical School, Chicago, Illinois; Physical Therapy Clinical Staff, Senior Physical Therapist, Department of Physical Therapy, Children's Memorial Hospital, Chicago, Illinois

Nina Newlin Simmons, M.S., C.C.C.-SP

Department Head, Department of Speech Pathology, Touro Infirmary, New Orleans, Louisiana

Susan Snyder Smith, M.S., P.T.

Assistant Professor, Department of Physical Therapy, University of Texas Health Science Center at Dallas, Dallas, Texas

Jane K. Sweeney, M.S., R.P.T.

Lieutenant Colonel, Army Medical Specialist Corps, Director, High Risk Infant Project, Department of Pediatrics, Madigan Army Medical Center, Tacoma, Washington

Wendy L. Tada, M.A., R.P.T.

Physical Therapy Department Head, Clinical Training Unit, Child Development and Mental Retardation Center, University of Washington, Seattle, Washington

Darcy Ann Umphred, Ph.D., R.P.T.

Clinician, Consultant, International Lecturer, Rio Oso, California

Nancy L. Urbscheit, Ph.D.

Director, Program in Physical Therapy, Division of Allied Health, University of Louisville, Louisville, Kentucky

To
Gordon, Jeb, Benjamin, and Janet,
whose love, patience, and understanding
constantly give me strength

PREFACE

During the past decade, physical therapists have increasingly developed high-level problem-solving skills and expanded their understanding of the client as a total human being. As a result, more effective therapeutic management of client problems is being realized.

Until now there has existed no comprehensive source of information that synthesizes this practical treatment philosophy. This book was designed to provide the practitioner and advanced physical therapy student with a variety of problem-solving strategies that can be used to tailor treatment approaches to individual client needs and cognitive style.

The treatment of persons with neurological disabilities requires an integrated approach involving theories and treatment procedures used by occupational and recreational therapists, speech pathologists, and nurses. Contributors were selected for their expertise and integrated knowledge of subject area. The result is, we hope, a blend of state of the art information about the therapeutic management of the neurologically disabled person.

This book is organized to provide the student with a comprehensive discussion of all aspects of neurological rehabilitation and to facilitate quick reference in a clinical situation. Part One, "Theoretical Foundations for Clinical Practice," comprises an overview of basic neuroanatomy, neurological development, and psychosocial aspects of neurological disability. Part Two, "Management of Clinical Problems," offers a clear description of each neurological disability encountered by the physical therapist in general clinical practice and appropriate treatment strategies and techniques. Part Three, "Special Topics and Techniques for Therapists," is devoted to recent advances in the approach to treatment and rehabilitation, including oral speech and visual perception, electrodiagnosis, pain management, orthotics, and therapeutic recreation.

Special features of all three parts are evaluation tools and illustrated demonstrations of treatment plans. A glossary of specific physical therapy terminology should be of equal value to students and practitioners.

Since neurologically disabled clients frequently require orthopedic and cardiopulmonary intervention, we have provided a detailed index to Volume One, *Cardiopulmonary Physical Therapy*, and Volume Two, *Orthopedic and Sports Physical Therapy*. We encourage students and practitioners to use the foundation we offer in these three volumes to explore new frontiers in the practice of physical therapy and rehabilitation.

During the conceptualization and preparation of this manuscript, many individuals gave time, guidance, and emotional support. To all those people I extend my sincere appreciation. My specific thanks go to:

My many teachers, but especially Martha Trotter, Sarah Semans, Nancy Watts, and my father, who taught me to reach for the impossible and realize its actuality;

The founders of the various treatment methodologies, whose conceptual ideas and flexibility created the foundation for development of an integrated problem-oriented approach to treatment;

The numerous students, colleagues, and clients who taught me how to teach them;

All the contributors who gave time, thought, and part of their lives to actualize this book;

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My two sons, Jeb and Benjamin, whose love and patience during the conception, gestation, and birth of this book far exceeded their age;

Last, but certainly not least, my husband Gordon, who is the only one who truly knows what demands this book has made on me and everyone around me; yet his support has never dwindled.

Darcy Ann Umphred

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PART ONE

THEORETICAL FOUNDATIONS FOR CLINICAL PRACTICE

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| Chapter 1 | Conceptual model: a framework for clinical problem solving |
| 2 | Neuroanatomical correlation of reflexes, reactions, and behaviors with levels of central nervous system organization |
| 3 | Normal sequential behavioral and physiological changes throughout the developmental arc |
| 4 | Classification of common facilitatory and inhibitory treatment techniques |
| 5 | Psychosocial aspects and adjustment during various phases of a neurological disability |

1

DARCY ANN UMPHRED

Conceptual model: a framework for clinical problem solving

Although a physical therapist, occupational therapist, or other health professional may focus on a specific area of central nervous system (CNS) processing, a thorough understanding of the client as a total human being is critical for high-level professional performance. The purpose of this book is to orient the student and clinician to the understanding and treatment of a variety of common neurological disabilities by means of a problem-solving approach. A secondary objective is the development of a theoretical framework that justifies the use of techniques for facilitation, inhibition, and learning. Evaluation and treatment methodology incorporate all aspects of the client's CNS, including overt and nonapparent integration. The role of specific disciplines with regard to the treatment of sensory processing, gross to fine motor performance, perceptual cognitive processing, and emotional-affective growth has not been defined. In the area of neurological disabilities the overlap of basic knowledge and practical application of treatment techniques is so great that delineation of professional roles is often an administrative decision.

A problem-solving approach is used because it is logical and adaptable, and it is recommended by many professional studies.^{1,4,18,28} Part One lays the foundation of knowledge necessary to understand and implement a problem-oriented approach. Part Two deals with specific clinical problems, beginning with pediatrics and ending with senescence. In Part Two each author follows the same problem-solving format to enable the reader either to focus more easily on one specific neurological problem or to address the problem from a larger perspective. Authors vary in their use of specific cognitive strategies or methods of addressing a specific neurological deficit. A variety of strategies for examining clinical problems is presented to enable the reader to see variations on the

same theme and thus allow better adaptation to individual cases. Since clinicians tend to adapt learning devices to solve specific problems, many of the strategies used by one author apply to situations addressed by other authors. Readers are encouraged to use flexibility in selecting treatment with which they feel comfortable and to be creative when implementing any scheme. Part Three of the text focuses on clinical topics that might be appropriate for any one of the clinical problems discussed in Part Two.

CONCEPTUAL MODEL FOR EVALUATING AND TREATING NEUROLOGICAL DISABILITIES Rationale for development of a model

Traditionally, both short-term and full-semester courses, as well as literature related to treatment of clients with CNS dysfunction, have been divided into units labeled according to a technique. Often, interrelation and integration among techniques have not been explored. As a result, clinical problem solving is impeded if not stopped when one approach fails, since there is little integration of theories and methods achieved in the learning process. Learning is a sequential process in which the learner combines new information with previously acquired knowledge and integrates the whole.^{7,17,22,23} Learning does not occur first by processing all information and then activating higher cognitive strategies. Rather processing of available information and integrating that content into higher thought processes occur in an elliptical fashion. New input is constantly being retrieved from the environment while higher thought processes are integrating the information already present. Throughout life the individual is taking in new information, processing it, and storing the content appropriately for retrieval when needed for higher cortical and integrative functioning.^{8,23}

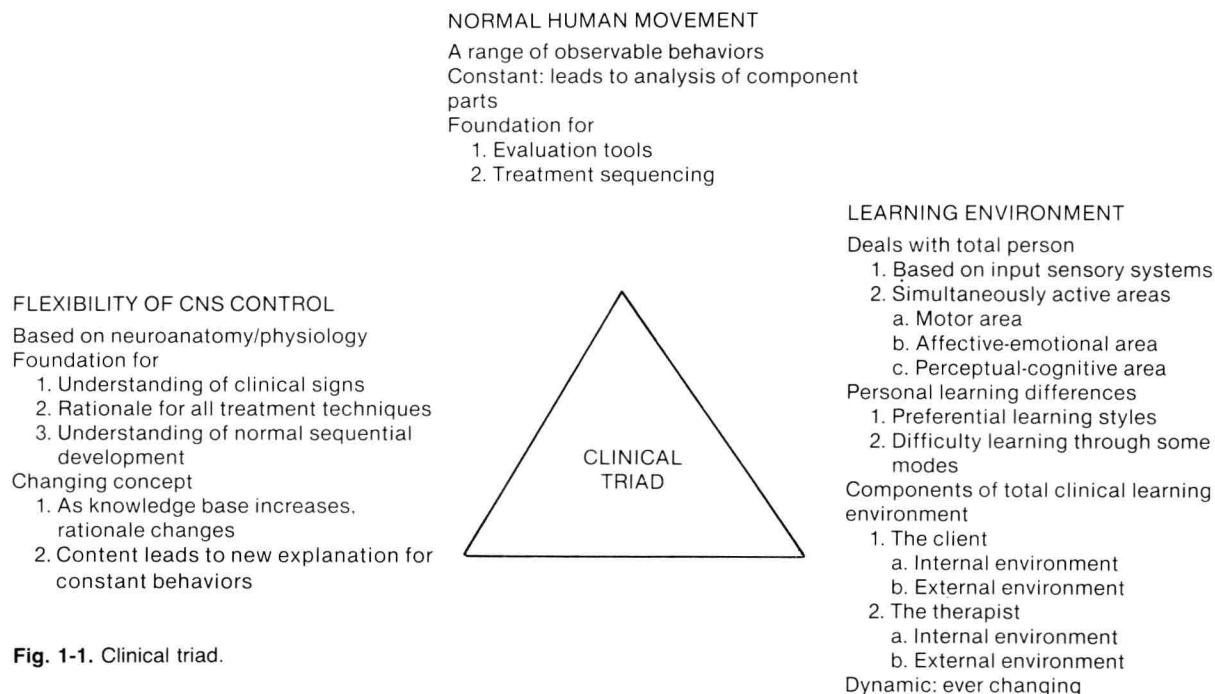


Fig. 1-1. Clinical triad.

It cannot be assumed that new information (input), when presented in fragmented units, will be integrated automatically with previously acquired information to become part of a functioning whole. This is especially true when identification of how those parts are linked to the total concept has not been made. Repetitive use of the sequencing pattern is necessary for memory. If the input (content) is totally new to the individual and thus no previously stored material is available for referencing, the new content is stored in fragmented units but meaning is not applied. To assume the individual could use this fragmented content in flexible higher symbolic thought would be analogous to assuming that first graders, on initial introduction to concepts of addition, are ready for college calculus. The problem of introducing fragmented information does have direct application to classroom learning and clinical performance. Clinicians may be bound to one specific treatment approach without the theoretical understanding of the step-by-step process, thus lacking the base for a change of direction when a treatment is ineffective. It is therefore difficult to adapt alternative treatment techniques to meet the individual needs of clients. A conceptual model that allows for integration of all treatment methods is one way to avoid this problem. It permits application of a variety of techniques because it is based on thorough understanding of the rationale or higher cognitive processing behind specific actions by the clinician and reactions by the client.

Widely known and accepted theorists, with the empirical support of clinicians treating individuals with CNS damage, have identified a need for an upgraded, integrated approach to education, especially with regard to text and reference books. It is hoped that this series will provide the background for such change. The conceptual model presented here is based on principles of neurophysiology, sequential peripheral and CNS development, and human interaction and learning. Such a conceptual framework gives therapists a foundation for future growth and change. Discussions of treatment strategies are also based on neurophysiological and developmental principles. Identification of clinical problems and development of treatment programs in terms of these concepts are the two major goals of each contributor.

The clinical triad: components of the conceptual model

The majority of techniques dealing with treatment of clients with CNS damage incorporate principles of neurophysiology and normal sequential development as an evaluation and treatment tool. Both areas therefore must be included within the conceptual model. Of considerable significance also is the client-therapist interaction, which is labeled the *learning environment*. This may be the critical link between clinical success or failure. Fig. 1-1 illustrates the model as a conceptual triad. All aspects occur simultaneously, yet each component has unique characteristics

Table 1-1. Categories of evaluation forms based on developmental sequencing

Type	Data recorded
Reflex testing	Presence or absence of specific reflexes and reaction related to levels of CNS integration
Gross to fine motor assessment	
Age related	Presence or absence of a variety of behaviors consistent with a specific age. Often based on first 2 years of life
Sequentially based on difficulty of task	The ability of the client to hold a position, go into a position, or move in and out of a position. Usually sequenced from horizontal to vertical, using functional activities such as rolling, sitting, coming to stand, and walking
Activities of daily living (ADL)	Ability of the client to carry out normal daily activities. Ability to perform early test items that lay foundation for performance of more difficult tasks
Perceptual-motor assessment	
Age related	The ability of the client to carry out a variety of motor tasks related to the age norm of the test item. Often items are age normed through childhood
Sequentially based on difficulty of task	The ability of the client to carry out a complex motor plan with each sequential step in a category of items based on the previous motor plan (therapist usually assuming the client can perform many items listed above under gross to fine motor assessment)

and influences the clinical performance of the therapist. Although each component is explored separately in the following pages, the reader should retain the image of the entire model. This approach should help develop a gestalt—that is, picture of the client as a total human being even though a specific aspect of therapy may be the focus. When the client is not viewed as a whole being, the therapist often misses critical response patterns such as movement in another body part, a grimace, or an autonomic response. These responses may be the key to successful goal attainment or client-therapist rapport.

**Concept of normal sequential development:
a range of observable behaviors**

Normal sequential development may also be referred to as normal human movement within a range of behavior. Human beings exhibit certain movement patterns that may vary in tonal characteristics, aspects of the specific movement sequences, and even the sequential nature of development. Yet the range of acceptable behavior does have limitations, and variations beyond those boundaries is recognizable by most people. A 5-year-old child may ask why a little girl walks on her toes with her legs stuck together. If questioned, that same 5-year-old may be able to break down the specific aspects of the movement that seem unacceptable. From birth a sighted individual has observed normal human movement. Because the range of behaviors identified as normal has been established, the concept behind normal human movement can be considered a constant. This concept does provide flexibility in analysis of normal movement and its sequential development. Some

children choose creeping as a primary mode of horizontal movement while others may scoot. Both forms of movement are normal for a young child. In both cases each child would have had to develop normal postural tone in the head and trunk in order to carry out the activity in a normal fashion. Thus the sequential nature of development of that tone would be the constant and therefore a usable sequential treatment process for habilitation or rehabilitation. This constant also means that certain stages of development or maturation of the CNS precede others. One can feel confident that no infant will be born, jump out of the womb, walk over to the doctor and shake hands, or say 'Hi' to mom and dad. Instead the infant must integrate the sequences of rolling and head control. These progressions lay the foundation for development of normal motor control, and each sequence takes time for mastery and CNS maturity.

Two very important aspects of the clinical problem solving process emerge. First, the evaluation of motor function is based on principles of sequential development. Second, rehabilitation treatment strategies become clear when the therapist observes human development from birth to aging.

Evaluation. Four categories of evaluation are used when focusing on a neurological deficit (Table 1-1).

Reflex testing. Fiorentino¹¹ has developed a reflex test that can be used on both children and adults. This form of evaluation is based on the hypothesized level of integration of reflexes and reactions within the CNS. Although the exact location of processing of many of these responses has not been identified, the behavioral aspect of the

stimulus-response pattern has been recorded for decades.²¹ This reflex test is easy to administer. A therapist selects a spatial position such as supine, elicits the stimulus, and records whether the response is present or absent and the degree of obligatory behavior. Once the assessment is completed, translating the results into meaningful information often creates a barrier for clinicians. If a client has an obligatory asymmetrical tonic neck reflex (ATNR), then many activities of daily living (ADL) are severely hampered. Understanding how these reflexes and reactions assist or hinder normal activities is the key to determining whether reflex testing provides adequate evaluation data for a therapist. Fiorentino¹² discusses reflexes and their important clinical link to the analysis of CNS deficits in children. This link is also critical when looking at the adult CNS. Chapters 2 through 4 give more in-depth explanation in this area.

Motor assessment. Thousands of evaluation procedures for motor assessment are used throughout the United States. Some have been standardized while others were developed to meet specific clinical needs. Although some of these evaluations may incorporate gross motor, fine motor, or a combination of both movement patterns, they generally focus on one of two types of developmental sequencing. The first is age related, and the second is based sequentially on the difficulty of the task. Both types focus on early movement sequences observed in humans.

Age-related motor assessment. Gesell and Amatruda¹⁴ recorded many test items still used on age-related assessment forms. As researchers have improved their skills in assessment and children have accomplished tasks at earlier ages, the specific age norms for test items have changed.⁹ Yet the concept has remained stable, and its popularity as an instrument for evaluating small children still persists. As with reflex testing, problems can develop in the interpretation of test results. A combination of reflex testing and age-related behavioral responses are often used with the neonate.⁶ Understanding the tonal characteristic of in utero gestational ages seems critical when evaluating a premature or high-risk infant. This area of assessment is relatively new, and literature available is sparse. Clinicians interested in this general area are referred to Chapter 6 for additional information.

Sequential task motor assessment. The second type of motor assessment based on the sequential difficulty of the task is more frequently used with older children and adults. Semans and others²⁶ distinctly illustrate this area of motor assessment. Their evaluation form has two sequential components. The *first* is the scoring key, which begins by having the therapist position the client in the test posture. The client is asked to hold the position and then asked to independently assume the position. If the therapist

is unable to position the client in any of the test postures, the client is not asked to attempt independent position. The sequence of tests, starting with a totally flexed position, is based on the difficulty of holding or obtaining progressive test postures in a specific spatial plane. The nature of the test items within each spatial position gives the clinician the *second* sequential component within the evaluation form. For example, the following three items are used to evaluate supine positioning. Test position 1 is used to evaluate total flexion. Position 2 is used to evaluate flexion of one limb while the body remains extended. In posture 3 the therapist places the client's neck in flexion while the body and limbs remain extended.

The sequential nature of decreasing the amount of flexion in the supine position while asking for isolated flexor patterns has an inherent developmental base. If a client has excessive tone in the supine position, usually that tone will have a strong extensor component because of the influence of the tonic labyrinthine reflex (TLR). Taking the client out of total extension and placing the body in a total flexion pattern have strong inhibitory effects on the extension. Therefore a client can more easily comply with the request to hold a whole flexion pattern than to hold one body part in flexion while other parts remain extended.

Sequential task motor evaluation tests clients in all spatial positions. In addition to assessing motor skills, a therapist can extract important clinical information regarding the function of the client's CNS. Range of motion (ROM), reflex testing, auditory processing, sequential perceptual processing, and motor planning are but a few of the areas from which the therapist can gain vital clinical data. Results of testing also can help direct the therapist in selecting additional tests. For example, detection of persistent reflexes may suggest that a reflex test would be appropriate. On the other hand, detection of certain perceptual problems, such as auditory or temporal sequencing of a motor plan, may direct the therapist to specific perceptual tests. Many motor assessment tests also give clues to a sequential treatment plan. These methods proceed from easy to complex, often incorporating reflex integration and progression of the client from horizontal activities to vertical activities such as kneeling and walking.

Activities of daily living tests. ADL evaluations are frequently used in adult testing, for example, following stroke or trauma. Forms for testing vary from clinic to clinic in specific tasks, number of test items, and emphasis on gross or fine motor skills required, but the formats have many consistent features. Categories are sequenced from basic motor skills, such as bed mobility, to complex motor plans, such as dressing.

The items within each category progress from simple to complex. Early ADL evaluations were designed through

trial and error. Therapists realized that clients needed bed mobility skills such as rolling, moving in bed, reaching for objects, and rising to a sitting position before they were ready to achieve tasks such as transfers. Transfer skills normally precede walking activities. Achieving functional sitting and trunk stability is critical for addition of more complex upper extremity and trunk skills, such as dressing and eating. Thus the sequential design of these tests developed through the success to failure ratio of the client's achievements.

Determining the reason a client cannot achieve bed mobility, including moving in bed, rolling, and coming to sit patterns, can be an important question. This individual might first need to modify and control some reflexes before attaining success. For example, if a client with head trauma were dominated by ATNR and TLR, then rolling over and general bed mobility would be prevented. Depending on the movement patterns the client used to come to a sitting position, the two reflexes could also prevent that integrated motion. The ATNR would prevent the client from using a prone to crawling to side sitting to long sitting pattern because as the head turned, the arm closest to the skull would flex and be unable to support weight. The same problem would exist if a client used a side lying, partial rotation, coming to sitting pattern. The TLR would on the other hand, stop the client from using a symmetrical supine to sit pattern, which requires neck and abdominal flexion in a supine position. These same and additional reflexes could hamper transfers and disrupt more complex motor plans to be used as part of the ADL assessment. In addition rotatory and postural skills used in bed mobility are foundation skills for transfers. Without these skills more complex activities such as transfers or dressing are impossible. Thus ADL forms have a developmental base. Reflex testing and motor assessment data can be extracted from the results of an ADL test. Similarly, after evaluating a client with a reflex test or motor assessment, a clinician should be able to deduce the majority of test item results on an ADL checklist.

Perceptual motor assessment. Psychologists and educators have developed tests that are frequently used by therapists evaluating both children and adults.^{3,13,25,30} The results not only provide data regarding gross and fine motor functioning but also focus on many specific perceptual and cognitive skills. A clear understanding of the normal development of higher-order processing and of CNS damage is vital in planning successful treatment of any client with a neurological deficit. Ayers² has been a principal leader in theory and implementation of perceptual-cognitive sequencing related to both physical and occupational therapy settings. Her research emphasis has been in the area of learning disabilities, but her concepts and treatment sequences have far-reaching implications. As with the other forms of evaluation, interpretation of the results in

each category is the most challenging aspect. Because of the complexity of higher-order problems encountered in this form of evaluation, interpretation of the reasons why a client may not be able to perform a specific test item may be overlooked. This interpretation and integration problem is significantly influenced by the medical-model approach to evaluation, in which a clinician identifies problem areas, evaluates only those problems, and then treats them. If instead therapists evaluate systems, they can then determine what perceptual strategies are functioning when the client performs successfully on a test item. Once analysis of intact systems and their component parts has been made, specific deficits in those systems can be identified and approached.

All four categories of evaluation are based on human development. Each clinician should use whichever form or combination of forms is the most conducive to his or her learning styles. There is no "best form"; each has both benefits and problems. One of the characteristics of a highly skilled therapist is the ability to extract essential information from a variety of sources. The skilled therapist looks beyond the obvious interpretations for subtle clues to CNS dysfunctions.

Treatment sequences

Developmental sequence. The concept of using normal sequential development as a treatment strategy is commonly accepted by therapists treating children. The use of this approach with adults has produced conflicting results. The real controversy over developmental sequencing may relate more to the manner in which the activity is introduced rather than to the activity itself. If the therapist presents rolling as a childlike activity and expects the adult to get on a mat and roll like a child, the client may perceive this activity as inappropriate for his or her level of development. If instead the client is approached with an explanation of trunk rotation as critical for transfer skills and is told that one way to work on rotation is by rolling, then the activity will be better accepted.

Sequential development as a tool for treatment is enhanced as a therapeutic intervention with the realization that behavioral changes result from therapy. Once a goal or behavior has been established, then the component parts necessary for attaining that goal can be identified. A thorough analysis should be made of any activity and its component parts—with the understanding that each component part may have its own development sequence.

Table 1-2 illustrates a developmental sequence activity testing scheme. It also provides a form for the therapist to use in recording key elements, with the first entry filled in as an example. The first activity focuses on a horizontal movement—rolling—an important component of independent bed mobility. Knowledge of developmental patterns makes us realize that humans roll by leading either with

Table 1-2. Concept of sequential development as a treatment progression

Movement patterns	Reflex reaction to assist	Reflex reaction to prevent	Necessary perceptual concepts	Treatment sequences
ACTIVITY: HORIZONTAL MOVEMENT—ROLLING				
1. Start at head				
a. Head flexion with rotation or head extension with rotation	Neck righting	Tonic labyrinthine reflex	Limited at this level if therapist elicits response manually	Modify reflexes preventing behavior
b. UE, trunk and LE follow in appropriate sequential progress	Optic and labyrinthine righting	Asymmetrical tonic neck reflex	Complex if therapist expects client to perform from either auditory or visual cues	Elicit neck righting via any number of treatment techniques Use facilitatory or inhibitory techniques when appropriate, according to desired neurophysiological response
2. Start at LE				
a. Supine to prone: LE: flexion, adduction, internal rotation, followed by trunk and head in appropriate progression				
b. Prone to supine: LE: extension, abduction, external rotation, followed by trunk and head in appropriate progression				

Comments: When would you facilitate neck righting versus body on body on head righting and vice versa? *Why?* When would you facilitate one coming-up-to-sitting activity versus another, and *why?*

UE, Upper extremity. LE, lower extremity.

the head or the lower extremity. Therefore two alternative sites for facilitating rolling are identified, and methods for achieving head or lower extremity movement are established. The behavior is then broken into its component parts. Identifying (1) appropriate movement patterns, reflexes, and reactions that assist or prevent the desired movement and (2) perceptual concepts necessary for adequate performance of the task give important clues to appropriate treatment strategies. Understanding the movement sequences, as well as multiple factors that may assist or prevent attaining the desired movement, allows the therapist flexibility in designing a treatment plan. Thus the therapist might work on appropriate patterns while the client is in a horizontal position or might help the client break the movement into components, approaching them from a sitting, kneeling, or half-kneeling position. Creating an environment conducive to client satisfaction and supportive of client needs

can of course be considered at any time.

The second activity introduced in Table 1-2—coming to sitting from a supine position—is more complex than rolling. Three different patterns are presented in the order observed during normal child development. A child first rolls from a supine to a prone position. From a prone position the child pushes to a four point position, rotates to a side-sitting position, and then to a full-sitting position. The child then progresses to a partial rotation pattern and finally into the more complex adult sitting patterns by the fifth to sixth year. Children and adults with neurological deficits may find that for them this three-stage sequence does not progress from simple to complex. Abnormal reflex activity can dominate and severely hamper successful accomplishment of one or all methods. Analysis of each of the component movements determines which pattern is most beneficial for each client. Although a developmentally higher method may be easier, each sequence of the