SECOND 100 HOUR REHABILITATION COURSE TOPICS & OPERATIONAL DEFINITIONS (YEAR II)

The Following *Core Material Topic Areas* and *Operational Definitions* have been established by the American Chiropractic Rehab Board (ACRB) through a modified Delphi process incorporating nominal group methodology. Appendices include review of the Delphi process, learning objectives, test question distribution and test question examples.

This material is intended to serve: (1) postgraduate educational departments as the minimal criteria necessary for annual ACRB course re-certification; (2) as a guide for instructors in course preparation and test question submission to the ACRB; and (3) as study guide and reference resource for the candidate preparing for national examination.

This material builds upon the academic material and clinical skills from year I.

I) BASIC SCIENCE

1) Clinical biomechanics (lumbar spine: lifting & bending; upper quarter: prehension)

Injury risk in the lumbar spine has been shown to increase with exposure to lifting, whole body vibration, or sudden, unexpected movements or loads [1]. Back injury is usually a result of repetitive loading rather than a single, specific event. It is usually a result of "a history of excessive loading which gradually, but progressively, reduces the tissue failure tolerance." [2] "The ultimate failure of a tissue may result from accumulated trauma produced by either repeated application of load (and failure from tissue fatigue) or of a sustained load that is applied for a long duration (and failure from tissue deformation and strain). Hence, the injury process need not always be associated with very high magnitudes of loads but rather relatively low loads that are repeated or sustained (such as prolonged stretching, and sitting)." [2]

Any tissue may be injured after prolonged strain if exposed to sudden unexpected movements. According to Bogduk and Twomney "After prolonged strain ligaments, capsules, and IV discs of the lumbar spine may creep, and they may be liable to injury if sudden forces are unexpectedly applied during the vulnerable recovery phase." [3] In order to reduce injury risk a general rule is to train functional capacity to meet external demands [4].

Lumbar disc herniation occurs following repetitive end-range flexion loading. "Herniation is more consistently produced under many cycles of combined compression, flexion and torsional loading and tends to occur in younger specimens with no visible gross signs of "degeneration" [2]. Of interest is the fact that disc herniation occurs in younger individuals with less degeneration [5]. In contrast, facets "fail under shear loading and torsional loading and hyperextension." [2].

In rehabilitation, knowledge of mechanism of injury can be utilized to train individuals to handle potentially harmful forces better. McGill states, "evidence from tissue-specific injury generally supports the notion of a neutral spine (neutral lordosis) when performing loading tasks to minimize the risk of low back injury." [2]. "Avoiding spine end range of motion, during activity, can reduce the risk of several types of injury." [2]
Biomechanics of lifting involves understanding the dangers of creep after prolonged sitting or after sleeping. Also, the risk of injury if the spine is flexed or rotated or the lever arm is too long. Typical lifting advice includes co-contraction of back and abdominal muscles to stabilize the spine; maintain the lordosis; keep the object as close as possible so long as lordosis is maintained; avoid twisting; don't lift first thing in the morning or after sitting for a prolonged period of time [6].

Forward bending of the trunk involves the lumbo-pelvic rhythm. Movement is initiated in the hips and then occurs in the lumbar spine. At the end of trunk flexion the erector spine should relax as the spine hangs on it's ligaments. This is known as the "flexion relaxation phenomena". Shortened hamstrings can restrict hip flexion and result in lumbo-sacral hypermobility in

flexion. This is functionally a problem with respect to activities of daily living involving forward bending such as rising from or getting into a chair, performing sit-ups, squatting, lifting or reaching to the ground for any objects.

Prehension is a complex movement involving the scapulo-humeral rhythm (SHR). It is important due to its relationship to carrying, grasping, lifting, keyboarding, and overhead activities. The SHR refers to the combined motion which occurs in the glenohumeral (GH) and scapulothoracic (ST) joints during arm elevation [7,8]. The overall motion of the arm during elevation is 180 degrees. During the first 60 degrees ("setting phase") nearly all movement is in the GH joint. Over the last 120 degrees there is approximately an equal amount of GH as ST motion.

Of most importance is the "setting phase" during the first 60 degrees of arm elevation during which the glenoid fossa and the head of the humerus seek a position of maximum congruence. The typical dysfunction is related to excessive elevation of the scapulae during the "setting phase" [9].

1) Wilder DG, Aleksiev AR, Magnusson ML, Poper MH, et al. Muscular response to sudden load. Spine 1996;21 (22):2628-2639.
2) McGill SM ACSM Resourse Manual - 3rd Edition, Williams & Wilkins, 1998 (scheduled publication).
3) Bogduk N, Twomney L. Clinical Anatomy of the Lumbar Spine. Churchill Livingstone.
4) Liebenson C. Rehabilitation of the Spine. Williams and Wilkins, Baltimore, 1996 p15-17.
5) Adams MA, Hutton WC, Gradual disc prolapse. Spine 1985;10:524-531.
6)McGill S, Norman RW. Low back biomechanics in industry: The prevention of injury through safer lifting. In Grabiner M (ed): Current Issues in Biomechanics. Champaign, IL, Human Kinetics, 1993.
7) Michiels I, Greenstein J. Kinematics of shoulder abduction in the scapular plane. Clin Biomech 1995;10:137-143.
8) McQuade K, Wei Shun Hwa, Smidt GL. Effects of local muscle fatigue on three dimensional scapulohumeral rhythm. Clin Biomech 1995;10:144-148.
9) Babyar SR. Phys Ther 1996;76:226-238.

2) Principles of human locomotion (subtalar events, closed chain effects)

Gait is a complex locomotor function that involves muscles and joints primarily of the lower extremity kinetic chain.[1] There are 2 basic phases of gait - swing and stance. Stance phase is usually evaluated in light of mechanical events occurring at the subtalar joint which dramatically change from early, mid-stance to terminal stance or toe off.

Key concepts to learn about for an understanding of normal and abnormal gait mechanics are pronation, supination, windlass mechanism, rearfoot and forefoot varus or valgus, and tibial torsion. Kinesiologically speaking, the function of the gluteus medius during mid-stance and gluteus maximus during terminal stance (toe off) are considered to be of key importance. [2,3] Normal gait is dependent on adequate joint mobility especially in the 1st metatarsal/phalangeal (MTP)(dorsiflexion), ankle (dorsiflexion), knee (external rotation) and hip (extension) joints.[1]

Normalization of faulty foot/ankle proprioception is also considered crucial to optimization of gait mechanics.[4,5] Propriosensory balance training has been found to not only improve balance but to increase the strength of many different lower extremity muscles faster than with isotonic strength training.[4] Reaction speed of lower leg muscles such as the peronei has been discovered to successfully discriminate ankle instability from normal function.[5]

Since the pronated position of the subtalar joint is plantar flexion and adduction, a plantar grade ankle position or an internally rotated lower limb can predispose to hyperpronation. If the 1st MTP cannot dorsiflex at least 60 degrees, the peronei contraction cannot create sufficient tension in the plantar fascia to make the foot rigid for resupination. This process is called the windlass mechanism and is essential for a "high-gear" push off.

1) Michaud T. Foot Orthoses. Williams & Wilkins, Baltimore, 1993.
2) Bullock -Saxton JE, Janda V, Bullock MI. Reflex activation of gluteal muscles in walking. Spine 18:6;704-708, 1993.
3) Lewit K. Manipulation and rehabilitation. In Rehabilitation of the Spine: A Practitioner's Manual, Liebenson C (ed). Williams and Wilkins, Baltimore, 1995.
4) Balogun JA, Adesinasi CO, Marzouk DK. The effects of a wobble board exercise training program on static balance performance and strength of lower extremity muscles. Physiotherapy CAN 1992;44:23-30.
5) Konradsen L, Ravn JB. Ankle instability caused by prolonged peroneal reaction time. Acta Orthopaedica Scan 1990;61:388--390.

II) ASSESSMENT

3) Advanced assessment of motor control

Instability is defined as a poor control of movement around a joint's center of rotation [1,12]. This may include the concept that the center of force should be over a stable platform. Another factor in this definition is the speed of contraction of muscles required to achieve this stability. When a movement arc occurs with a broad or erratic center of rotation around a joint, or the center of mass cannot be maintained over a stable base of support injuries are more likely.[1-3] To accomplish this proximal stability is needed. For instance, if the scapulae moves superiorly in the early part of an arm raising activity (the "setting phase") this has been correlated with shoulder pain syndromes. [5] Similarly, when a forward head posture is present a greater incidence of headache can be predicted.[6,7] Lower back pain patients are distinguishable from non-sufferers by having poor control of A to P body sway on a balance board as well as by having an erratic sagital movement path after prolonged resisted trunk flexion/extension movements.[2,3]

Lower back pain patients have also been shown to have poor control of their center of force when going from 2 leg standing to 1 leg standing [3]. Knee stability has been shown to be improved by proprio-sensory training that increases the reaction speed of the hamstrings [7]. It has also been shown that a slow reaction speed of the peronei is correlated with ankle instability [8]. Slow speed of activation of the transverse abdominis during arm movements distinguishes LBP from non-LBP patients. [11]

Most low back injuries are due to end-range loading. Discs from repeated flexion, facets from repeated extension [9]. For this reason exercises involving co-contraction of antagonist muscles are recommended for training joint stability [9,10]. Increased joint stiffness has been demonstrated in the knee as a result of agonist/antagonist co-contraction [10].

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5) Babyar SR. Phys Ther 1996;76:226-238..
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7) Treleaven J, Jull G. Cephalgia 1994:14;273-279.
8) Konradsen L, Ravn JB. Ankle instability caused by prolonged peroneal reaction time. Acta Orthopaedica Scan 1990;61:388--390.
9) McGill SM. Low back exercises: prescription for the healthy back and when recovering from injury. ACSM Resource Manual - 3rd ed. Williams & Wilkins, Baltimore (sched 1997).
11) Hodges P, Richardson C. Spine 1996, Vol 21:2640-2650
12) Bogduk N Amevo B, Pearcy, M. Proceedings Instn Mech Engrs. 1995 Vol 209 pp177-183.

4) Upper quarter screen

The upper quarter includes the cervicothoracic, scapulothoracic, costotransverse, glenohumeral, acromioclavicular and stemoclavicular articulations, the associated soft tissue structures as well as the distal aspect of the upper extremity. The entire shoulder complex is the critical link to complete functional success of rehabilitation of the upper extremity and cervicothoracic spine. Most activities of daily living can still be performed despite the loss of glenohumeral motion, providing that mobility in the cervical spine and distal upper extremity joints are not impaired.

The evaluation of this region must include an orthopedic and neurological assessment. Postural analysis of the spine and shoulder girdle, motion palpation of each articulation within the shoulder girdle complex, upper quarter movement patterns (shoulder abduction, cervical flexion, and push-up. and observation of muscular tone and symmetry are all necessary components of the upper quarter screen. A Systems review must also be incorporated to establish if a viscerosomatic referral pattern exists.

- Sweeney T, Prentice C, Saal JA, Saal JS - Cervicothoracic Muscular Stabilization Techniques. Physical Medicine
- and Rehabilitation 4:2 June 1990
- Wilk K, Arrigo C An Integrated Approach to Upper Extremity Exercises. Orthop Phys Ther Clin North Am 1:2,
- Liebenson C - Rehabilitation of the Spine: A Practitioner's Manual. Williams and Wilkens, 1995
- Lewit K - Chain Reactions in Disturbed Function of the Motor System. Man Med 1987, 3:27-29

5) Evaluation of gait-

The lower extremity kinetic chain functions dynamically during gait. The foot is required to be both a mobile adapter during stance phase and a rigid lever during propulsion. The requirements of the subtalar region during these 2 distinct phases are mirrored in the entire kinetic chain.

For instance, in near terminal stance, in order to be able to propel the body forward, the following biomechanical events occur & their function should be observed:

- forward flexion of the swing leg
- external rotation of the thigh and lower leg of the stance leg
- supination of the forefoot
- 60 degrees plantar flexion of the 1st metatarsal joint
- contraction of the peronei
- 10 degrees of hip joint extension
- anterior pelvic tilting

The result of these events is a "high-gear" push off. With appropriate plantar flexion of the 1st MTP and early firing of the peronei, the slack is taken out of the plantar fascia enabling the force transmission system called the "windlass mechanism".

Unfortunately, gait is notoriously difficult to evaluate. Pronation is the easiest and most popular item to observe during gait. Excessive pronation or failure of supination at terminal stance would be a key assessment feature.

Other easily observable factors to look for during gait include stride length, knee hyperextension, external rotation of the stance limb, symetrical spinal rotation & arm swing, and pelvic mechanics.

1) Michaud T. Foot Orthoses. Williams & Wilkins, Baltimore, 1993.

6) Return to Work Outcomes (related to Dictionary of Occupational Title items)

Realistic end-points of care include:

- Pain Relief
- Elimination of Activity Intolerance/Limitation
- Return to Work
- Functional Restoration.

According to the AHCPR "The panel's overall intent was to change the paradigm of focusing care exclusively on the pain of low back problems to one of helping patients improve their activity tolerance." [1] "Back problems" were defined as activity intolerances due to back-related symptoms..." [1]

Activity Limitations are drawn from the Dictionary of Occupational Titles [2,3]. These are core functional characteristics that define the Demands of Employment [2]. Some examples are: lifting, carrying, standing, walking, kneeling, crouching, and balancing.

What tools are useful for identifying activity intolerances? Identification of patient's perception of their disability is one of the simplest methods. Various inexpensive tools can help capture this data: Spinal Function Sort;Hand Function Sort; Oswestry Low Back Pain Index; Neck Disability Index; Roland Morris Scale; and the Functional Assessment Screening Questionnaire.

1) Bigos S, Bowyer O, Braen G, et al. Acute low back problems in adults. Clinical Practice Guideline. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research, 1994.

2) U.S. Department of Labor, Employment and Training Administration: Dictionary of Occupational Titles, (4th Edition): Supplement. Washington, D.C.: U.S. Government Printing Office, 1986.

3) Fishbain DA, Khalil TM, Abdel-Moty A, et al. Physician limitation when assessing work capacity: a review. J Back Musculoskelet Rehabil 1995;5:107-113.

7) Quantifiable functional testing and disability questionnaires as they relate to activity intolerance (to include the role and appropriate timing of impairment rating).

According to AHCPR, "The panel suggested that the early goal of exercise programs is to prevent debilitation due to inactivity and then to improve activity tolerance to return patients to their highest level of functioning as soon as possible." (p 57) (1)

According to Hazard, there are 3 goals of care (2):

1) Reduction of **Pain**
2) Treatment of **Impairment**
3) Prevention of **Disability.**

According to Gatchel, "Function drives the treatment process." (3) According to Matheson, "Once healing has run it's course, functional goal setting must become the primary goal of the secondary treatment program." (4)

Questionnaires can be used to reliably and responsively measure disability or impairment. Examples include: *Spinal Function Sort;Hand Function Sort; Oswestry Low Back Pain Index; Neck Disability Index; Roland Morris Scale; and the Functional Assessment Screening Questionnaire.*

Functional capacity evaluations are also valuable in impairment assessment (5-11). Criteria include safety, responsiveness, reliability, normative data, cost effectiveness, time efficiency, and validity (7,8,10). Time efficient testing can take as little as 30 minutes (10,11). The validity is stronger, however, in longer evaluations taking 4 hours or even 2 days (5,6).

Physical capacity testing of specific muscles and joints is done to determine impairments which can then be:
1. Addressed in a prescriptive manner (treatment plan/rehabilitation prescription) and,
2.To address the issue of outcome assessment as gathering objective data which carries reliability, validity and normative data can be used to compare the initial baseline results to those gathered at follow-up.Hence, both assessment information as well as treatment protocols can be driven from the use of physical performance testing.

A number of low tech, reliable procedures have emerged.[12] They have normative data bases and good validity. Endurance can be assessed by the use of the repetitive squat, repetitive sit-up, repetitive arch-up and the static back endurance or, Sorenson's test[12] . Muscle length assessments are assessed by the Gastroenernius/Soleus, SLR, Modified Thomas (iliopsoas), knee flexion, and hip rotation tests.[13] Spinal ROM is gathered by use of dual inclinometers.(14, 15)4 Grip is assessed by the use of a Jamar grip dyrasmometer.(16) Isomachines/testing can add strength & endurance measurements to this evaluation for a variety of regions. Excellent reliability, normative data, and safety have been established. Cost effectiveness is an issue in the typical practice setting.

1) Bigos S, Bowyer O, Braen G, et al. Acute low back problems in adults. Clinical Practice Guideline. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research, 1994.

2) Hazard R. Occupational low back pain, The critical role of functional goal setting. APS Journal 1994;3(2):101-106.

3) Gaetchel RJ. Occupational low back pain disability, Why function need to "drive" the rehabilitation process. APS Journal 1 994;3(2):107-110.

4) Matheson L. Functional goal setting. APS Journal 1994;3(2):1111-114.

5) Mooney V, Matheson LN. Objective measurement of soft tissue injury: Feasibility study examiner's manual. Industrial Medical Council, State of California 1994.

6) Fishbain DA, Khalil TM, Abdel-Moty A, et al. Physician limitation when assessing work capacity: a review. J Back Musculoskelet Rehabil 1995;5:107-113.

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8) Matheson L. Basic requirements for utility in the assessment of physical disability. American Pain Society Journal 3:195, 1994.

9) Vernon H. Pain and disability questionnaires in chiropractic rehabilitation In Liebenson C Rehabilitation of the spine. Williams and Wilkins, Baltimore 1996.

10) Yeomans SG, Liebenson C. Quantitative functional capacity evaluation. Top Clin Chiro 1996;3(1):32-43.

1) Yeomans SG, Liebenson C. Quantitative functional capacity evaluation and chiropractic case management. Top Clin Chiro 1996;3(3):15-25.

12. Alaranta H, Hurri H, Heliovaara M, et al. Nonsynnnometric trunk performance tests: Reliability and normative data. Scand J Relmb Med 1994; 26:211-215.

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14.Gatchel 'U, Mayer TG, Capra P, et al. Quantification of lumbar fimction, Part 6: The use of psychological measures in guiding physical functional restoration. Spine 1986; 11:3641.

15.Mayer T, Gatchel 'U, Keeley 3, Mayer H, Richling D. A Male incumbent worker industrial database. Spine 1994; 19:762-76

16.Swanson AB, Matev ffi, de Groot Swanson G. The strength of the hand. Bull Prosthet Res Fall 1970;145-53.

8) Emerging classification systems of spinal disorders

Diagnostic triage is the goal of patient classification [1]. The 3 main categories of spinal disorders are red flags, nerve root pain, and mechanical pain. Thorough history & examination has excellent sensitivity & specificity for identifying the various red flags of serious disease [1,2]. These include:
tumor, infection, fracture, inflammatory disease, caudal equina syndrome, and serious neurological disease. Lab tests, imaging, & referral follow critical pathways related to each potential serious cause of spinal pain.

Nerve root disorders can also be diagnosed through history & examination which have excellent sensitivity & specificity. Imaging is only required if there is a progression in the neurological loss or a lack of progress over 4-6 weeks.

Nerve Root Compression

- Leg symptoms below the knee
- + nerve root tension signs (+ SLR or M,S, R exam)
- high sensitivity/specificity
- Imaging tests are unnecessary in 1st month

Non-Specific "Mechanical" Pain

- 85% of all cases
- Better or worse w/ certain postures or movements
- poor sensitivity/specificity of orthopedic tests
- Usually in lumbar, buttock or thigh

Mechanical back pain is considered non-specific and except with the use of double anaesthetic block techniques and discography, has not been able to be objectively demonstrated with regard to specific myofascial, facet, disc, or SI pain generators. This is changing, at least with regard to the disc as a pain generator, with further research into McKenzie methods of assessment of response to loading and other non-invasive methods [3,4] Similar procedures are required in the cervical spine.

Recent research is beginning to show promise for our ability to diagnose more than 20% of our patients, & thus avoid having to label them with non-specific pain. No correlation with physical examination tests (provocation tests, motion palpation, ROM, etc.) has yet emerged. Diagnostic blocks have been able to show that SI joints and zygapophysial joints are pain generators in chronic neck & low back pain sufferers [3] Bogduk reported that lumbar facet joint pain is responsible for between 15-40% of lower back pain. Internal disc disruption 39% and SI joints at least 13%. Conservatively that is 69% of low back patients for who a pain generator can be found.

13-30% of chronic LBP pts had relief of pain from diagnostic blocks of their SI joints [4]. Groin pain was suggestive of SI involvement. Tears of the ventral capsule of the SI joint were significantly correlated with pain relief on injection.

40-68% of chronic neck pain pts post whiplash got relief from posterior neck joint injections [5]. A double block was used to reduce false + rate. Pts had to have longer term relief with long acting block than w/ short acting block.

Erhard & Delitto have shown that pts could be reliably classified as having SI dysfunction and/or a McKenzie extension "bias" [6]. Matched, controlled treatment led to superior results than unmatched treatment thus demonstrating that generic treatment to patients classified as "non-specific" was inferior to treatment aimed at more specific classification of patients.

Just because no structural cause can be found in the vast majority of patients, the common assumption that there must be a psychogenic etiology is unjustified. Dworkin, states,"Pain report often occurs in the absence of pathophysiology or any discernible peripheral somatic changes. This finding implies the need to reexamine our limited understanding of pain, rather than leaping to the conclusion that such pains must be psychogenic." [7].

General

1) Waddell G, Feder G, McIntosh A, Lewis M, Hutchinson A. (1996) Low back pain evidence review. London: Royal College of Practitioners.
2) AHCPR
3) Donelson R, Aprill C, Medcalf R, Grant W. A prospective study of centralization of lumbar and referred pain: a predictor of symptomatic discs and annular competence. Spine 1997; 22(10):1115-1122.
4) Yrjama M, Tervonen O, Vanharanta H . Ultrasonic imaging of lumbar discs combined with vibration pain provocation compared with discography in the diagnosis of internal annular fissures in the lumbar spine. Spine. 1996; 21(5):571-575.
5) Bogduk N. Conference proceedings of the chiropractic centennial foundation, 1995).
6)Schwarzer AC, April CN, Bogduk N. The sacroiliac joint in chronic low back pain. Spine 1995:20;31-37
7) Barnsley L, Lord SM, Wallis BJ, Bogduk N. The prevalence of chronic cervical zygapophysial joint pain after whiplash. Spine1995:20;20-26.

8) Erhard RE, Delitto A. Relative effectiveness of an extension program and a combined program of manipulation and flexion and extension exercises in patients with acute low back syndrome. Phys Ther 1994; 74:1093-1100.

9) Dworkin, APS 1992

9) Introduction to Functional Capacity testing of whole body activities

Functional capacity refers to whole body limitations involving dictionary of occupational titles job descriptions like lifting, carrying, climbing, crouching, etc.. An example is lifting capacity. This is contrasted with physical capacity which involves isolated limitations of muscle or joint strength, endurance or flexibility. An example is trunk extension endurance.

A functional capacity evaluation typically takes from 2 hours to 2 days. It is usually performed by O.T.'s or P.T.'s. however, reliable and valid lifting and carrying capacity tests can be performed in just 20 minutes with a low-tech approach This is certainly within the grasp of a chiropractic rehabilitation specialist.

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- Contemporary concepts in spine care; spine rehabilitation - secondary and tertiary nonoperative care. Spine 2O:18;2O6O-2O64, 1995.
- Mooney V, Matheson LN. Objective ent of soft tissue injury: Feasibility study examiners manual. Industrial Medical Council, State of California 1994.
- Yeomans SC, Liebenson C. Quantitative functional capacity evaluation: The missing link to outcomes assessment. Top Clin ~Chiro *1996;* 3.32A3.
- Fishbain DA, Khalil TM, Abdel-Moty *A,* et al. Physician limitation when assessing work capacity: a review. J Back Musculoskelet Rehabil 1995;5:107-113.

10. Advanced issues in the objective measurement of soft tissue injury (Dictionary of Occupational Titles)

Outcomes management can be achieved by gathering both subjective information (questionnaires), as well as objective data (physical performance testing - see #7). The subjective tools include the:

1.general health questionnaires (SF-36);'
2.pain assessment scale (VAS - visual analogue scale, numerical pain scale); [2.3]
3.condition specific questionnaires (Oswestry, [4]. neck disability index, [6] headache questionnaire, [7] and others);
4.psychometric questionnaires (SCL-90-R, Beck's Depression Screen, ,
5.patient satisfaction questionnaires (Chiropractic Satisfaction questionnaire): [(10)]
6.disability prediction questionnaires (Vermont Q)[(11)]
The objective tools include the functional performance tests describe above (see #7). In addition, a soft tissue tenderness grading scheme has been described which can "objectify" palpation which is very useful.[(12)]

I.Goertz CMH. Measuring functional health status in the chiropractic office using self-report questionnaires. Top Clia Chiro 1994; 1(1): 51-59.

2.Von Kortfm, Deyo RA, Cherkin D, Barlow SF. Back pain in primary care: Outcomes at 1 year. Spine 1993; 18:855-862.

3.Dworkin SF, Von KorffM, Whitney WC, et al. Measurement of characteristic pain intensity in field research. Pain Suppl 1990; 5:8290.

4.Oswestry LBPDQ: Fai~ik 3, Davies 3, et al. The Gswestry Low Back Pain Disability Questionnaire. Physiother 1980; 66(18): 271-273.

5.Hudson~ook N, Tomes-Nicholson K. The revised Oswestry low back pain disability questionnaire. Thesis; AngloEuropean College of Chiropractic, 1988.

6.Vernon H, Mior S. The Neck Disability Index: A Study of Reliability and Validity. J Manip Phys Ther 1991;14(7):409.

7.Jacobson Gary P., Ramadan NM, et al., The Henry Ford Hospital headache disability inventory (HDI). Neurology l994;44:837~2.

8.Bernstein 'H, Jareinko ME, Hirkley BS. On the utility of the SCL-90-R with low-back pain patients. Spine I 994;J 9:4248.

9.Beck A. Depression: Clinical, experimental and theoretical aspects. New York: Haper & Row, 1967.

10.Coulter D, Hays RD, Danielson CD. The chiropractic satisfaction questionnaire. Top Clin Chiro 1994; l(4):4043.

11.Vermont Q. (Short form): Hazard RG, Haugh LD, Reid S, Preble JB, MacDonald L. Farly prediction of chronic disability after occupational low back injury. Spine 1996; 21:945-951.

12.Wolfe F, Smythe HA, Yunus MB, et al. The American College of Rheumatology 1990 criteria for the classification of fibromyalgia. Arthritis Rheum. 1990; 33:160-172.

11.McKenzie Assessment of Lumbar Spine

McKenzie assessment of the lumbar spine is based upon the history and clinical testing of provocative and palliative responses to spinal loading during lumbar motion and at end range. The assessment determines whether spinal complaints are amenable to mechanical therapy. Those amenable to mechanical therapy are classified as one of three syndromes: Postural, Dysfunction, or Derangement. This classification is based upon subjective and objective findings that occur during motion and end-range loading.

The behavior of spinal complaints amenable to mechanical therapy is distinguished from other causes.

- Butler, D: Mobilization of the Nervous system. Churchill Livingstone, Melbourne, 1991
- Cyriax J, Cyriax P. Illustrated manual of orthopedic medicine. London: Butterworths, 1993
- Jacob G, McKenzie R "Spinal Therapeutics Based on Responses to Loading, in *Rehabilitation* of the Spine, Craig Liebenson, ed., Williams & Wilkins, 1996
- McKenzie RA: The Lumbar Spine. Mechanical Diagnosis and Therapy, Spinal Publications, Wailanae, New Zealand, 1995.
- McKenzie RA: Treat Your Own Back, Spinal Publications. Waikanac, New Zealand, 1997

III Rehabilitation Treatment

12) McKenzie Management of Low Back Pain

If spinal complaints are assessed as being amenable to mechanical therapy, they are classified as one of three syndrome patterns, each of which is managed according to an individual specific exercise (preferred loading strategy"):

1.Postural syndrome -- requires postural re-education
2. Dysfunction syndrome -- requires remodeling of adaptively shortened tissue
3.Derangernent syndrome -- requires reduction of deranged disc material.

Recommendations for management of complaints not amenable to mechanical therapy are also considered. The employment of Cyriax (for SI joint and hip), Butler (for adherent nerve root), and strength conditioning principles to McKenzie management of low back is considered. The psychosocial impact of spinal treatment style is stressed. Includes demonstration and practical participation to develop treatment management skills.

- Butler, D: Mobilization of the Nervous system. Churchill Livingstone, Melbourne, 1991
- Cyriax J, Cyriax P. Illustrated manual of orthopedic medicine. London: Butterworths, 1993
- Jacob G, McKenzie R "Spinal Therapeutics Based on Responses to Loading, in *Rehabilitation* of the Spine, Craig Liebenson, ed., Williams & Wilkins, 1996
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- McKenzie RA: Treat Your Own Back, Spinal Publications. Waikanac, New Zealand, 1997

13) Open closed chain/functional movement (upper & lower extremity functional-whole body exercises

Open chain and closed chain exercises have certain characteristics that are necessary for the development of strength motor skills:-

1.The behavior of the distal segment.
2.The degrees of freedom of the joints and number of axes involved.
3.The types of muscular contractions that can be achieved.
4.The movement may be isolated, complex, functional or non-functional.
5.Facilitation of proprioceptive feedback and feedforward mechanisms, hence coordination can be enhanced.
6.Core, proximal and distal joint stability can be utilized to improve function.
7.Different muscle groups or isolated muscles of a complex muscular chain may be exercised.
8.Both gross and fine motor skills can be trained.

COMPARISONS:

	OPEN CHAIN	CLOSE CHAIN
End segment	Free	Fixed
Axis of motion	distal to joint	proximal and distal
Muscle action	concentric	concentric eccentric, isometric
Movement	isolated	Integrated
Load	artificial	physiological
Velocity	Variable	Variable
Stabilization	often artificial	Synergist cocontraction
Planes	often limited	often 3 dimensional
variability	limited	unlimited

Both types of exercise are essential for rehabilitation. The rehabilitation stage and the degree of tissue healing will determine the use and combination ratio of these two types of exercise.

- Enoka, R.M. Neuromechanical basis of kinesiolgy. Human Kinetics$_1$ 1988.
- Gray, G. Chain Reaction, course manual. Wynn marketing, 1992.
  McConaill, M.A., Basmajian, J.V Muscles and movement: a basis forhuman kinesiology. William and Wilkins, 1969.
- Balke. B.. The Fitness Handbook. Wellness Bookshelf, 1995.

14) Advanced issues in the principles & protocols of Strength Training (including weights stacks/free weights). [See also topic #16, first hundred hours]

Again, these movements must attain 75 percent of pain free motion prior to graduating to dynamic or rotational movements.[3] Each exercise must be performed specifically and in, as close to perfect posture as possible, combining normal gait and biomechanics into the joint movements. For example: Knee extension should be performed with dorsiflexion and slight inversion and knee flexion should be performed in planterflexion and slight eversion.[2] This will ensure that the synergistic as well as the major muscle groups are targeted, increasing stability allowing for accommodation and restoration of proper functional movement of the joint complex.

Endurance training at 25-40% of patients MVC should precede strength training at greater than 90% of the In order to properly, and adequately address the principles of strength training one must consider the principles of hypertrophy, the importance of quality of movement and the biomechanical indicators for safety during performance of such programs. The concentric and eccentric, antagonist and agonist, and the force and lever arm relationships are in need of addressing in order to allow for safe and appropriate strength training programs. Eccentric and concentric relationships are for stability and protection of the musculotendinous unit and ultimately the joint, and has been documented to be approximately 1.3:1[1][2] Antagonist to agonist relationships are for the stability of joint, allowing appropriate biomechanics through a pain free range of motion, diminishing postural plastic deformation and other viscous changes, and has been documented to be approximately 3:4 to 4:5.[2][3]

Appropriate performance of a specific exercise is dependent upon the posture during the lift and proper set up between patient and machine(weight stack and free weights). Accepted limitations in reference to lever arm and contact of body part in question is that the farther away from the joint being exercised is the contact point of resistance, the more joint stress is produced. For example: Contact pad placement for the exercise Knee Extension, at the Tibial Tuberosity will allow 60-90 degrees of movement without significant joint stress, 30~0 degrees with placement at mid tibia, and 20-30 degrees with placement at the distal tibia.[2]

Exercise protocols for strength training indicate that proprioceptive and postural training be successfully completed or in the process, prior to performing the actual strength movements of the joints in question.[5] Once a strength program is initiated$_1$ flexion and extension of the joint must be performed, pain free through 75 percent of normal range of motion prior to performing adduction, abduction, or lateral flexion. patients MVC.(5) In order to protect joints and avoid reinforcing muscle imbalances, proper form must be maintained during strength training to ensure agonist isolation [4]

1) Biemborn D, Morrissey Mc.A review of the literature related to trunk muscle performance. Spine 1988; 13(6) 655~0
2) Mcconnal McConnal Seminars: Patellar Femoral Syndrome, Santa Monica GA, 1992
3) Sa ha, AK: Mechanisms of shoulder movements and a plea for the recognition of "zero" position of the glenohumeral joint. din Orthop 73: 3-10
4) Janda V. "Evaluation of Muscular Imbalance", 1996, pp97-1 12
5) Jordan A et al: Cervicobrachio syndrome, neck muscle function: effects of rehabilitation, J Musculoskeletal Pain, 1: 283-8, 1993
6) Rutherford O. (Craig Liebensen to fill in reference at Delphi mtg)

15)Advanced issues in the principles and protocols in endurance training. [See also topic #17 of first hundred hours.]

In order to properly, and adequately address the principles of endurance training one must consider the principles of aerobic and anaerobic training, the energy systems required to perform such types of exercise, and the importance of target heart rate and the biomechanical and physiological indicators for safety during performance of such programs.

Endurance training utilizes the anaerobic energy sources for its energy source, and is dependant upon the amount of force applied, the quickness and the number of repetitions performed in a specific amount of time. Building one's endurance depends on the sport specific or activity specific principle.[1][2] This indicates that in order to increase ones individual endurance, one must train in the appropriate percentage of aerobic and anaerobic cycles, as related to the targeted outcome. Ultimately this

includes interval training, Fart-leck training, Zero effect, Pyramid, and many other lactic acid stimulating and glycogen utilizing activities.[3]

Safety is increased by utilizing girth of the areas trained, resting heart rate, soreness and range of motion as a guide to increasing participation or advancement in the program.[4] For example. Should the quadriceps circumference be greater than 1 centimeter larger than originally measured prior to the last session, than no intense strength or endurance training will shall be allowed.

Endurance training at 25-40% of patients MVC should precede strength training at greater than 90% of the patients MVC.(5) In order to protect joints and avoid reinforcing muscle imbalances, proper form must be maintained during strength training to ensure agonist isolation (6)

1)American college of Sports Medicine's Guidelines for Exercising Testing and Prescription Fifth Edition, Williams and Wilkins, 1995

2)Hornberg, J. Exercise Physiology Guidelines. Rehabilitation Guidelines for chiropractic, chiropractic Rehabilitation Association, 1992, ppl 1-18

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5) Jordan A et al: Cervicobrachio syndrome, neck muscle function: effects of rehabilitation, J Musculoskeletal Pain, 1: 283-8, 1993

6) Janda V. "Evaluation of Muscular Imbalance", 1996, pp97-1 12

16)Advanced issues in the principles and protocols of flexibility training (including active stretching). [See also topic #18 & #29 of first hundred hours.]

In order to properly, and adequately address the principles of flexibility training one must consider the principles of nerve and muscle biology, the effects of stretch on the muscle, and the importance of functional and biomechanical quality during this type of training, to enhance safety.

Basic neurological principles include Post Contraction Inhibition where muscle contraction is closely followed by proportional relaxation of the same muscle, and Reciprocal Inhibition where the contraction of a gien muscle inhibits the contraction of it's antagonist.[1] The indication for therapeutic muscle stretching are :decreased range of motion, pain from contractile tissue, reduced healing capacity and prevention of atrophy. [1]

Types of Stretching being utilized on a regular basis in practice are:

- Static Stretch(SS)
- Contract Relax(GR)
- Hold Relax(HR)
- Repeated Contractions(RC)
- Hold Relax Active Motion(HRA)
- Rythmic Stabilization(RS)
- Slow Reversal(SR)
- Quick Reversal(QR)
- Slow Reversal Hold Relax(SRHR)
- Agonist Contract Relax(ACR)
- Reciprocal inhibition(RI)
- Postisometric Relaxation(PR)
- Contract Relax Antagonist Contract(CRAC)
- Postfacilitation Stretch (PS)(2)

Contraindication for Therapeutic Muscle Stretch (TMS) include lack of stability, vascular compromise, inflammation or infection, excessive pain and lack of compliance from patient. [3]

There are many types of stretching techniques utilizing the above basic principles. Contract Relax(CR) Antagonist Contraction(AC) has been found to be the most appropriate for pain and inflammation reduction when performed after cryotherapy to the area. Range of motion benefit is best attained by performing cryotherapy followed by three static stretches followed by active range of motion.[4][5]

Active, or active resistive exercises in the appropriate posture(see *#14)* can aid in the painfree attainment of stretch in a tight or hypertonic muscle. Flexibility and appropriate muscle length relationships are essential to joint stability and proprioception, thus aiding in muscle strength balance.

Muscle relaxation is a prerequsite for improving the resting length of contractile tissues. Stretch is often unnecessary if relaxation spontaneously achieves a release and lengthening response in the tissue. Stretch may actually shorten muscles by facilitating contraction via the stretch reflex. (6)

(1)Etnyre BR, Abraham LD: H Reflex changes during static stretching and two variations of proprioceptive neuromuscular facilitation techiques. Electroenceph. clinical Neurophusiology. 1 986;63: 174-178 (
2) Muhlemann D, Cimino JA: Therapeutic Muscle Stretching. In Functional Soft Tissue Examination and Treatment by Manual Methods: The Extremities by Warren 1. Hammer. Aspen Publishers, Inc., Gaithersburg, MD, 1991
(3)Janda V, Schmid H: Muscles Fucntion Testing. Butterworths. London, 1983
(4)Knight KL, Londeree BR: comparison of blood flow and the ankle of uninjured subjects during therapeutic application of heat, cold, and exercise. Medicine and Science in Sports and Exercise, Vol.12, No.1, Spring 1980
(5)Roy S, Irvin R: Sports Medicine Prevention, Evaluation, Management, and Rehabilitation. Englewood cliffs, Prentice - Hall, 1983.
(6).Liebenson CS, ed. Rehabilitation of the Spine: A Practitioner's Manual. Baltimore: Williams and Wilkens, 1996.

IV) MANAGEMENT TOPICS

17) Cervical (condition specific: i.e. whiplash, headache, disc, myofascial)

A. Introduction:

The topic of cervical management includes a general coverage of pain and other symptoms arising from the cervical spine. This includes pain generators and how to identify them on examination, e.g. myofascial trigger points, zygapophyseal joint dysfunction, internal disc disruption and radiculopathy. The functional examination is discussed in the context of the types of dysfunction that be are commonly seen in the cervical spine patient, including the examination of cervical flexion, shoulder abduction (scapulohumeral rhythm), push up, hip extension, sit-to-stand, and swallowing movement pattern as well as the stepping test, and tests for cervical kinesthetic awareness. It also includes the principles of diagnosis, treatment, rehabilitation and overall management of the cervical spine patient.

The management strategies that are utilized are based on the pain generator(s) and the dysfunction that is found. The initial approach is geared toward decreasing the pain of the primary generators. This includes manipulation for the zygapophyseal joints, ischemic compression, postisometric relaxation and physical agents for myofascial trigger points, McKenzie exercises for the intervertebral disc, and manipulation, McKenzie, traction and physical agents for radiculopathy. As quickly as possible, shift toward addressing the primary dysfunction(s) occurs, again with the strategy depending on the type of dysfunction that is present. This includes prop riosensory retraining in the presence of indication for the need for this method (e.g. positive stepping test, faulty hip extension movement pattern, faulty one leg stand or squat, faulty eye-head-neck coordination), cervical stabilization in the presence of instability (e.g. faulty cervical flexion, faulty scapulohumeral rhythm, faulty posture) and strength training in those isolated cases that require it.

Isotesting studies show cervical spine muscular capacity deficiencies similar to the low back and may frequently effect the posterior muscles for both acute and chronic patients. The following is most relevant:

- decreased strength overall
- altered extensor to flexor ratio
- (extensors should be >20% stronger)

Contrasting studies show anterior muscle weakness[12-14]. Decreased strength and endurance in neck flexion has been correlated with both neck pain and headache.[12-14]

1.McKenzie RA. The Cervical and Thoracic Spine: Mechanical Diagnosis and Therapy. Waikanae, New Zealand,Spinal Publications, 1990.
2.Lebenson CS, ed. Rehabilitation of the Spine: A Practitioner's Manual. Baltimore: Williams and Wilkens, 1996.
3.Saal 3A, Saal 35. nonoperative treatment of cervical intervertebral disc with radiculopathy. Spine 1996; 21:1877-1883.
4.Jull G, Bogduk N, Marsland A. The accuracy of manual diagnosis for cervical zygapophyseal joint pain syndromes, Med JAust 1988; 148:233-236.
5.Janda V. Muscles and motor control in cervicogenic disorders: assessment and management. Tn: Grant R., ed. Physical Therapy of the Cervical and Thoracic Spine. New York: Churchill Livingstone, 1994:195-216.
6.Revel M, Andre-Deshays C, Minguet M. Cervicocephalic kinesthetic sensibility in patients with cervical pain.Arch Phys Med Rehabil 1991; 72; 288-291.
7.Gordon CR, Fletcher WA, Jones GM, Block EW. Is the stepping test a specific indicator of vestibulospinal function. Neurology 1995; 45:2035-2037.

8.Murphy DR. The sternocleidomastoid muscle: Clinical considerations in the causation of head and face pain. Cbiro Tech 1995; 7(1):12-17.
9.Murphy DR, ed. Conservative Management of Cervical Spine Syndromes.
10.Revel M, Minguet M, Gergoy P et al. Changes in cervicocephalic kinesthesia after a proprioceptive rehabilitation program in patients with neck pain: a randomized controlled trial. Arch Phys Med Rehabil 1994; 75:895-899.
11. Jordan A et al: Cervicobrachio syndrome, neck muscle function: effects of rehabilitation, J Musculoskeletal Pain, 1: 283-8, 1993
12.Watson DH, Trott PH. Cervical headache: An investigation of natural head posture and upper cervical flexormuscle performance. Cephalalgia 1993; 13:272-284.
13.Treleavan J, Jull 0, Atkinson L. Cervical museuloskeletal dysfunction in post~concussion headache. Cephalalgia 1994; 14:273-279.
14.Barton PM, Hayes KC. Neck flexor muscle strength, and relaxation times in normal subjects and subjects with unilateral neck pain and headache. Arch Phys Med Rehabil 1996; 77:68O~87.

B. Whiplash:

In the acute stage, the primary focus is on identifying pain generators and reducing the generation of pain as quickly as possible. Introduction of early movement is often possible, and should be encouraged. McKenzie protocols are helpful here [1]. Rapid transition to more active forms of care should be sought [2] to minimize the development of scar tissue and the establishment of faulty movement patterns. How soon this transition occurs will depend upon the severity of the injury and other clinical factors. Goals should set with regard to return to work and other ADL's as quickly as possible. The rehabilitation phase should focus on normalizing cervical reflex and coordination function focusing particularly on eye-head-neck coordination [3] and propriosensory [4] and stabilization function [5]. It should also be focused on normalizing any faulty movement patterns that may have been detected, particularly cervical flexion, shoulder abduction (scapulohumeral rhythm), breathing and hip extension.

In their monograph on whiplash associated disorders, Spitzer, et al state clearly that encouragement for activation is essential in the management of whiplash. Rest should be recommended cautiously and should not last more than 4 day. Manipulation is useful in the acute stages for the purpose of preparing the patient for more active approaches and long-term repeated manipulation is discouraged. Continued complaints and residual disability after 45 days justifies vigorous clinical intervention and mandatory interdisciplinary consultation.

1.Murphy DR. The passive/active care continuum: A model for the treatment of spine related disorders. J 3. Neuromusculoskel Sys 1996; 4(1)1-7.
2.Fitz-Ritson D. The chiropractic management and rehabilitation of cervical trauma. J Manipulative Physical Ther 1990; 13:17-25.
3.Fitz-Ritson D. Phasic exercises for cervical rehabilitation after "whiplash" trauma. J Manipulative Physical Ther 1995 18(1)21-24.
4.Spitzer WO, Skovron ML, Salmi LR, Cassidy Jr), et al. Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining "whiplash" and its management. Spine 1995; 20(85):25-735.
5.Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. Appleton Lange (scheduled publication 1998)

C. Vertigo:

Treatment depends entirely on diagnosis

1. Meniere's disease - manipulation and myofascial therapy for any related joint and/or muscle for ENT co-management.

2. Benign paroxysmal positional vertigo - manipulation and myofascial therapy for any related joint and/or muscle dysfunction, along with home recommendation for labyrinthine stimulation exercises performed at home.

3. Cervicogenic vertigo - this is usually posttraumatic and management should follow the outline for whiplash, with particular emphasis on improving joint and muscle function in the upper cervical spine and normalizing eye-head-neck and propriosensory function

4. Cervical disequilibrium - manipulation and myofascial therapy with particular emphasis on the upper cervical spine

1.K&lburg M, Magnusson M, Malinstrom EM, et al. Postural and symptomatic improvement after physiotherapy inpatients with dizziness of suspected cervical origin. Arch Phys Ed Rehab 1996; 77:874-882.
2.Jacobson GP, Newman CW. The development of the dizziness handicap inventory. Arch otolaryngol Head Neck Surg 1990; 1 l6:424~27.
3.Lewit K. Manipulative Therapy in the Rehabilitation of the Motor System. Boston: Butterworths, 1985.
4.Hulse M. Disequilibrium, caused by a functional disturbance of the upper cervical spine. Clinical aspects and differential diagnosis. Man Med 1983; 1:18-23.
5.Fitz-Ritson D. Assessment of cervicogenic *vertigo. J* Manipulative Physiol Ther 1991; 14(3):193-l 98.
6.Murphy DR, ed. Conservative Management of Cervical Spine Syndromes.

D. Headache:

The conceptual foundation of the diagnosis and management approach is based on the known pathophysiological mechanisms behind tension and migraine headache. This understanding has evolved into the concept of the tension headache-migraine headache continuum [1]. Treatment will often involve co-management with neurologist of other professional providing biochemical treatment depending where along the pathophysiology continuum the patient lies. This is determined via history and examination.

Treatment will be focused Initially on decreasing the generation of pain by those structures that has been identified as the primary pain generators [2,3]). This will be combined with correction of relevant joint and/or muscle dysfunctions [4,~,6]. Special attention will be placed on the detection and correction of faulty cervical flexion, shoulder abduction (scapulohumeral rhythm), hip extension, sit-to-stand and swallowing patterns.

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2.Travell JG, Simons DG. Myofascial Pain and Dysfunction: The Trigger Point Manual. Vol.1.1983 Williams and Wilkens, Baltimore.

3.Murphy DR, ed. Conservative Management of Cervical Spine Syndromes.

4.Watson DH, Trott PH. Cervical headache: An investigation of natural head posture and upper cervical flexor muscle performance. Cephalalgia 1993; 13:272-284.

5.Treleavan J, Jull 0, Atkinson L. Cervical musculoskeletal dysfunction in post~concussion headache. Cephalalgia 1994; 14:273-279.

6.Barton PM, Hayes KC. Neck flexor muscle strength, and relaxation times in normal subjects and subjects with unilateral neck pain and headache. Arch Phys Med Rehabil 1996; 77:68O~87.

18) Thoracic (condition specific: i.e. thoracic outlet syndrome, myofascial)

A. Introduction:

The topic of thoracic spine management includes a general coverage of pain and other symptoms arising from or involving the thoracic spine. This includes pain generators and how to identify them on examination, e.g. myofascial trigger points, zygapophyseal joint dysfunction, internal disc disruption and radiculopathy. The functional examination is discussed in the context of the types of dysfunction that be are commonly seen in the thoracic spine patient, including the examination of faulty movement patterns [1], particularly shoulder abduction (scapulohumeral rhythm), push up and breathing [2].

It also includes the principles of diagnosis, treatment, rehabilitation and overall management of the thoracic spine patient.

The management strategies that are utilized are based on the pain generator(s) and the dysfunction that is found. The initial approach is geared toward decreasing the pain of the primary generators. This includes manipulation for zygapophyseal joint dysfunction [1], ischemic compression, postisometric relaxation and physical agents for myofascial trigger points [2] and McKenzie exercises for intervertebral disc disruption [3]. As quickly as possible, shift toward addressing the primary dysfunction(s) occurs [4], again with the strategy depending on the type of dysfunction that is present. This includes manipulation, postisometric relaxation, postfacilitation stretch and cervicothoracic stabilization [5] and strength training [6] in those isolated cases that require it.

1. Lewit K. Manipulative Therapy in the Rehabilitation of the Locomotor System. Boston: Butterworth-Heinemann, 1991.
2. Janda V. Muscles and motor control in cervicogenic disorders: assessment and management. In: Grant R., ed. Physical Therapy of the
3. Mennel JM. Joint Pain. Boston: Little Brown, 1964.
4. Travell JG, Simons DG. Myofascial Pain and Dysfunction: The Trigger Point Manual. Vol. 1. 1983 Williams and Wilkens, Baltimore.
5. McKenzie RA. The Cervical and Thoracic Spine: Mechanical Diagnosis and Therapy. Waikanae, New Zealand, Spinal Publications, 1990.
6. Liebenson CS, ed. Rehabilitation of the Spine: A Practitioner's Manual. Baltimore: Williams and Wilkens, 1996.
7. Saal JA, Saal JS. Non-operative treatment of cervical intervertebral disc with radiculopathy. Spine 1996; 21:1877-1883.
8. Jordan A, Ostergaard K. Rehabilitation of neck/shoulder patients in primary health care clinics. J Manipulative Physiol Ther 1996; 19(1):32-35.

B Thoracic Outlet Syndrome:

The primary focus with this condition should first be identifying those tissues that are creating the neurovascular compression that is producing the symptoms. Close attention should be paid to excessive tension in the scalenes and pectoralis minor [1] and to hypomobility of the first rib [2,3]. Next, focus should be placed on those faulty patterns and/or lifestyle habits that produced the compressive dysfunction breathing [5] and "Gothic Shoulders" posture [6]. Treatment and rehabilitation should be geared toward improving , particularly shoulder abduction (scapulohumeral rhythm), push up [4], function in the areas involved [7].

1. Travell JG, Simons DG. Myofascial Pain and Dysfunction: The Trigger Point Manual. Vol. 1. 1983 Williams and Wilkens, Baltimore.
2. Lindgren KA, Leino E. Subluxation of the first rib: a possible thoracic outlet syndrome mechanism. Arch Phys Med Rehabil 1988; 68:692-695.

3. Lindgren KA, Leino E, Manninen H. Cervical rotation lateral flexion test in brachialgia. Arch Phys Med Rehabil 1992; 72:735-737.
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5. Lewit K. Manipulative Therapy in the Rehabilitation of the Locomotor System. Boston: Butterworth-Heinemann, 1991.
6. Swift TR, Nichols FT. The droopy shoulder syndrome. Neurology 1984; 34:212-215.
7. Murphy DR. Cervical radiculopathy and pseudiradicular syndromes. In: Murphy DR, ed. Conservative Management of Cervical Spine Syndromes.

19) Lumbar (condition specific - i.e. disc, facet, sacro-iliac, myofascial)

A. General treatment parameters:

Pain and disability should be distinguished. Most costs are due to disability, not pain. Pain comes and goes with a high recurrence rate in all cultures. Disability, is a uniquely western, modern epidemic. The primary goal of care is to prevent activity intolerences due to pain. (4)

The majority of patients recover. The majority do not. Health care resources are most concentrated on the chronic pain patient. More efficient utilization would result from earlier, aggressive treatment of subacute patients who have outlasted the natural history. (5)

Acute patients require diagnostic triage to rule out sinister causes of back pain, reassurance, activity modification advice, and simple pain relief approaches. Over the counter pain medication and/or manipulation are recommended for pain.

History and physical examination has excellent sensitivity and specificity for identifying red flags on sinister disease. Xray evaluation is usually unnecessary in the initial evaluation of low back problems. (1,4).

Expensive diagnostic work-ups for subacute pain patients should be replaced with aggressive conservative care focusing on rehabilitation and adhering to biopsychosocial principles. (5)

B. Treatment Interventions:

The effects of different interventions for nerve root and mechanical back pain have been evaluated (1). The highest rated statements receive 3 stars.

Acute LBP

- Manipulation speeds recovery for acutes ***
- -- 30% improvement w/in the 1st month.
- The risks of manipulation for low back pain are very low, provided...it is carried out by a trained therapist or practitioner. **
- McKenzie speeds recovery for acutes **
- Bed Rest for > 2 days slows recovery for acutes ***
- Advice on Staying Active leads to less chronic disability ***
- Graded Reactivation combined with behavioral pain management leads to less chronic disability ***
- NSAIDs effectively reduce simple back ache...can have serious adverse effects... ***
- Muscle relaxants effectively reduce acute back pain. ***
- Muscle relaxants have significant adverse effects...even after relatively short courses (i.e. one week.) **

Chronic LBP

-
- Some evidence points to the value of time-limited manipulation. (6)
- Exercise programs and physical reconditioning can improve pain and functional levels in chronics **

Nerve Root Syndromes

- Bed rest for > 2 days slows recovery for nerve root patients ***
- Stabilization training effective for nerve root & failed back surgery (not ranked) (2,3)
- Epidural injections are effective for nerve root **
-

C. Typical activity modification advice would include:

- Limit prolonged unsupported sitting (< 20 minutes)
- Limit heavy lifting

- Limit bending or twisting while lifting

D. Alternative symptomatic procedures to be considered when treatment has plateaued include [1]:

- muscle relaxants
- antidepressants
- injections
- supports
- biofeedback
- acupuncture
-

1)Waddell G, Feder G, McIntosh A, Lewis M, Hutchinson A. (1996) Low back pain evidence review. London: Royal College of General Practitioners.)

2) Saal JA, Saal JS: Nonoperative treatment of herniated lumbar intervertebral disc with radiculopathy. Spine 1989;14:431-437.

3) Timm KE. A randomized-control study of active and passive treatments for chronic low back pain following L5 laminectomy. JOSPT 1994;20:276-286.

(4) AHCPR ref -- find and drop in

(5) Waddell G, The Back Pain Revolution, Churchill Livingstone, Scheduled Publication 1998.

(6) Triano, J. Get Ref

20) Upper extremity (application of rehabilitation principles to common orthopedic conditions) -

In order to appropriately manage upper extremity injuries, the practitioner must have a sound grasp on the orthopedic tests related to the upper extremity, the common complications and cause and effect relationships associated with the upper quarter exam, and biomechanics.

The shoulder girdle is a very dynamic structure, often associated with overuse injuries and abnormal biomechanical states often leading to the chronic injury. Full functional capacity of the shoulder girdle involves the synchronization of the Scapula Thoracic Glenohumeral, Acromial Clavicular and Sternoclavicular joints. Each play a particular role in the shoulders stability and function.[1]

Cervicothoracic compromise and thoracic outlet syndromes are often associated with long standing upper extremity disease processes. Particular attention must be directed toward scapular stabilization, rotator cuff internal and external rotation muscular balance(see #14), biomechanics and proprioception.[2][3]

Appropriate treatment of the upper Quarter requires appropriate orthopedic and functional evaluation, proprioceptive training, muscular strength and balance, endurance and functional flexibility. [6][7]

Active treatment protocols include, but are not limited to joint mobilization, functional reinforcement, proprioceptive reinforcement and appropriate rehabilitation protocols(see #14-16).

The ultimate goal of upper extremity rehabilitation is to obtain and then maintain proper muscular balance to allow for normal integrated function. The critical concept in upper extremity rehab is to establish central stability to allow for optimal distal mobility. Cervicothoracic stabilization, Scapulothoracic and Scapulouhumeral rhythm must be present before optimal upper extremity motion can occur [8-12] . Restoration of Scapulothoracic and Scapulohumeral rhythm is accomplished by improving muscular balance, endurance and coordination.

If the dynamic stabilizers of the shoulder girdle (primarily the rotator cuff, biceps brachii and serratus anterior) are well coordinated and balanced, the function of the ligaments, capsule and labral mechanism will improve. This is accomplished through the concept of dynamic ligament tension. This allows for optimal humeral head to glenoid fossa congruency to be present. Cervicothoracic and Scapulothoracic postural faults (forward drawn head carriage, protracted shoulder girdle and accentuated cervicothoracic kyphosis) are commonly observed in upper extremity disorders and will disrupt this humeral head to glenoid tossa relationship[8,9]. Postural education is the foundation of maximizing coordinated function of the upper quarter.

1)Saha, AK: Mechanisms of shoulder movements and a plea for the recognition of "zero" position of the glenohumeral joint. din Orthop 173: 3-10 1983

2)Panjabi MM, White M,: clinical Biomechanics of the Spine, Philideiphia, Lippencott company, 1978

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5)Guffy GJ: Rehabilitating Shoulder Dysfunction: The importance of Scapular Stabilization. 1991 Whal and Associates

6)American college of Sports Medicine~s Guidelines for Exercising Testing and Prescription Fifth Edition, Williams and Wilkins, 1995

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8) Liebenson C - Rehabilitation of the Spine: A Practitioner's Manual. Williams and Wilkens, *1995*
9) Wilk K, Arrigo C - Current Concepts in Rehabilitation of the Athletic Shoulder. JOSPT I 8:1 July 1993
10) Souza T - Sports Injuries of the Shoulder, Churchill Livingstone 1994
11) Sweeney T, Prentice C, Saal JA, Saal is - Cervicothoracic Muscular Stabilization Techniques. Physical Medicine and Rehabilitation 4:2 June 1990
12) Jobe F, Moynes D, Brewster C 1987 - Rehabilitation of Shoulder Joint Instabilities. Orthop Clin North Am 18:3 July

21) Lower extremity (application of rehabilitation principles to common orthopedic conditions)

A. In order to appropriately manage lower extremity injuries, the practitioner must have a sound grasp on the orthopedic tests related to the lower extremity, the common complications and cause and effect relationships associated with the lower quarter exam, and biomechanics of gait.

Due to constant gravitation forces and rotational functional movements, the lower extremity is constantly taxed biomechanically. Normal gait patterns dictate that rotational stress and gravitational loading be accommodated for by specific muscle balance, proprioception and coordinated movement patterns.[1][2]

Plastic deformation from constant low force loading to the arches leads to overpronation, causing internal derangement of the tibia and torsional stresses at the knee.[3] Any alteration from the normal chain of events during gait causes abnormal biomechanics which leads to repetitive trauma in the form of tendonitis, patellar femoral syndrome, and eventually crepitus at the knee. This chronic abnormal stimulation will cause an increase in muscle imbalance of the inner and outer quadricep muscle and the quad and hamstring in relation to one another. This muscle imbalance will cause valgus deformity inducing medial collater and meniscus trauma, ultimately leading to hip and sacroiliac compensation and instability.[4][5] Appropriate muscle balance and proprioceptive training are essential to the stability of the lower extremity.. As noticed with strength training only quality movements are beneficial to the chronic abnormally postured lower extremity. The importance of the VMO to knee joint stability is minor[6] in relation to the balance of the Quad *I* Ham ratio, which should follow normal strength factors. (see #14)

Active treatment of either the acute or chronically injured lower extremity includes but is not limited to specific joint mobilization, proprioceptive stimulation, functional and proprioceptive reinforcement, and appropriate rehabilitation protocols.

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22) Management of common sports and industrial injuries

Most common sports and industrial injuries occur in the soft-tissues of the extremities and result from acute trauma or repetitive strain. The goal of care is to control pain and inflammation in the acute phase and restore normal neuromusculoskeletal function in the subacute and remodeling phases. A critical component in the rehabilitation is to fully integrate the extremity back into its role as a key link in the entire locomotor system.

Essential to this process is an understanding of the physiology of the acute inflammatory, proliferative healing and remodeling phases of tissue repair. Appropriate use of passive therapies during the acute phase inclusive of modalities, joint mobilization, and modification of activities of daily living and orthopedic appliances to prevent further injury is key to a prompt recovery. Less reliance on passive approaches in lieu of active protocols should be initiated as quickly as is clinically prudent.

The goal of active rehabilitation is to restore preinjury function to the injury site inclusive of strength, endurance, flexibility, agility and coordination. As these goals are achieved, the extremity needs to be reintegrated back into its role in the locomotor system by using full-body stabilization, proprioception and sensorimotor retraining techniques. The steps to recovery should include joint mobilization, muscle relaxation and lengthening, increase speed of muscle contraction, improved control of movement, task specific training and mass movement conditioning. Strategies to achieve these objectives include knowledge of isometric, isotonic dynamic, isotonic variable and isokinetic strength training, open verses closed chain exercises, post-isometric relaxation techniques, home stretching exercises, scapular and lumbopelvic stabilization exercises and the use of wobble/rocker boards and balance sandals protocols.

Fundamental to optimal implementation of rehabilitation techniques for common sports and industrial injuries is an understanding of the functional mechanics of gait, prehension and throwing.

- Bob Warkins chapter in Craig's Book

23) Post-surgical spine

Spine rehabilitation principles are similar in the post-surgical and pre-surgical patient. The goals are to restore function. Obviously, *a* period of rest is required post-surgically. Walking can be encouraged almost immediately. Exercises sbould begin in the functional training range (FTR). This is defined as the painless range in which movements can be performed in a coordinated way. Usually the FTR is narrow at first as
the patient exhibits various mechanical sensitivities such as to gravity loading. The patient first learns to produce and then control movements, particularly at the lumbosacral junction.

Exercises which minimize the mass movement in the lumbar spine are emphasized. Sensory-motor training on rocker boards is an example. Non-weight bearing exercises emphasizing isometric trunk muscle activity and isotonic arm or leg movements are also used early in the program. Traction assistance can be added as an aid to reducing mechanical sensitivity. Supine, prone or quadruped exercises are all appropriate in the first few weeks. Recumbent or aquatic aerobic activities should also be used. Weight bearing exercise should be limited to walking at first.

Activity modifications should include limiting prolonged unsupported sitting to less than 20 minutes; limit heavy lifting; and limit bending or twisting while lifting. Ice may be encouraged for pain relief

Manipulation should be targeted to improve extension mobility in the lumbar spine and preventing end-range flexion load on the lower lumbar segments. Post-isometric relaxation or muscle energy procedures may be advisable at first. Hamstring tension should be relaxed and quadriceps, guteal and trunk extensor endurance be facilitated. It is important to train the coordination of stabilizer muscles such as the transverse abdominus and multifidus.

Stabilization exercises combined with McKenzie protocols were successful in a large randomized, controlled clinical trial for failed back surgery (laminectomies) patients (Timm). Hides, et al found that stabilization exercises were successful in restoring the size of atrophied multi fidus musculature. By combining *advice* about postural control with *manipulation* to expand the FTR and *exercise* to improve load handling ability, a post-surgical patient can be successfully rehabilitated.

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24)Multidisciplinary (tertiary care/biobehavorial)

According to a recent North American Spine Society consensus paper on rehabilitation, tertiary care facilities are defined as being interdisciplinary; having a large, behavioral component; and utilizing ongoing outcome assessment [1]. They should be considered for referral in patients who have remained symptomatic for 4-6 months and have failed treatment efforts which included a trial of manipulation, rehabilitation, psycho1ogical referral & alternative Symptomatic procedures. This Constitutes about 8% of the pain population.

Tertiary care centers typically have a large behavioral component. Teaching appropriate coping strategies is considered essential for chronic pain management. The focus is on reduction of activity intolerences/disabilities, increasing exercises tolerance/quota, learning self-treatment strategies, reducing medication dependent, and stress reduction.

According to Nass, "Many patients who do not respond to non-operative treatment within 4-6 mos have a history of significant psychosocial disorders, limited compliance and inhibition of physical function as evidenced by pain sensitivity,. nonorganic signs, and demonstrated deficiencies in physical and functional capacity testing. [1].

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Appendix A:

LEARNING OBJECTIVES FOR THE SECOND 100-HOUR REHABILITATION CERTIFICATION COURSE

Participants who attain a certificate for the second 100-hours of postgraduate study in rehabilitation should demonstrate mastery of the following:

1. Have attained and be able to demonstrate proficiency in the rehabilitation of post-surgical and complicated nonsurgical spinal cases (this will include functional assessment, treatment planning, appropriate triage, assessment of biomechanical residuals, deficits & limitations.

2. Have attained and be able to demonstrate proficiency in the rehabilitation of extremity disorders.

3. Have attained and be able to demonstrate advanced clinical proficiency in the rehabilitation of specific clinical disorders (e.g. TOS, disc syndrome, etc.)

4. Have attained and be able to demonstrate advanced clinical proficiency in the rehabilitation of management specific conditions (e.g. sports & industrial disorders).

5.Have attained competency in the psychomotor skills specific to the variety of evaluation and management procedures outlined in the core curriculum.

SECOND

Appendix B

~~FIRST~~ 100 HOUR REHABILITATION COURSE TOPICS & TEST QUESTION DISTRIBUTION

Core material for the first 100 hours of rehab course work consists of the following topics. The American Chiropractic Rehab Board (ACRB) maintains multiple examinations for this course. Among the examinations, the distribution of test questions from each topic area averages:

Ave #	
	I) Basic Science
5	1) Clinical biomechanics (lumbar spine: lifting, bending. Lower extremity: gait. Upper quarter: prehension
5	2) Principles of human locomotion (subtalar events, closed chain effects)
	II) Assessment
5	3) Advanced assessment of motor control
5	4) Upper quarter screen
4	5) Evaluation of gait
3	6) Return to work outcomes (related to Dictionary of Occupation Titles items)
5	7) Quantifiable functional testing and disability questionnaires as they relate to activity 3 intolerance (to include the role and appropriate timing of impairment rating)
3	8) Emerging classification systems of spinal disorders
5	9) Introduction to functional capacity testing of whole body activities
5	10) Advanced issues in the objective measurement of soft tissue injury (Dictionary of Occupational Titles)
2	11) McKenzie assessment of the lumbar spine
	III) Rehabilitation Treatment
4	12) Lumbar McKenzie protocols
4	13) Open and closed chain upper & lower extremity/whole body exercise in functional 5 movement
5	14) Advanced issues in the principles & protocols of strength training, including weight stacks/free weights
2	15) Advanced issues in the principles & protocols of endurance training
4	16) Advanced issues in the principles & protocols of flexibility training (including active stretching)
	IV) Management Topics
5	17) Cervical (condition specific - i.e. whiplash, headache, disc)
5	18) Thoracic (condition specific - i.e. thoracic outlet syndrome)
5	19) Lumbar (condition specific - i.e. disc, facet, sacro-iliac)
5	20) Upper extremity (application of rehabilitation principles to common orthopedic conditions)
5	21) Lower extremity (application of rehabilitation principles to common orthopedic conditions)
3	22) Advanced management of common sports & industrial injuries
3	23) Post-surgical spine
3	24) Multidisciplinary (tertiary care/biobehavorial)

Appendix C

Sample Test Questions

Delphi Topic # 2
Key C
Subtalar supination is associated with:
A. a lowered medial arch and an unlocked midtarsal joint
B. loose-packing of the midtarsal and intertarsal joints
C. a raised arch, a locked midtarsal joint, and foot stability
D. palpation of the talar head just posterior to the navicular tuberosity

Delphi Topic # 3
Key D
Which of the following muscles do [not] commonly substitute for an inhibited gluteus medius?
(A) Tensor fascia lata
(B) Quadratus lumborum
(C) Piriformis
(D) Iliocostalis lumborum

Delphi Topic # 4
Key A
When there is hypertonicity of the left sternocleidomastoideus muscle, the typical head presentation is:
(A) anterior translation with right rotation
(B) anterior translation with left rotation
(C) extension with no rotation
(D) extension with left rotation

Delphi Topic #5
Key A
Which of the following phases of gait is the lower extremity kinetic chain considered to be closed?
(A) Stance
(B) Toe-off
(C) Heel strike
(D) Swing

Delphi Topic #8
Key C
The Oswestry low back disability questionnaire includes which of the following categories of functional assessment?
(A) Running
(B) Squatting
(C) Lifting
(D) Climbing

Delphi Topic #9
Key B
Lifting danger is minimized by all the following except:
(A) maintaining the normal lordosis
(B) lifting after sitting relaxed for 20 minutes
(C) not lifting immediately after rising from bed
(D) avoiding twisting

Delphi Topic # 11
Key C
Status: A
McKenzie's "three syndrome" classification system of spinal disorders is based on:
(A) static palpation findings and biomechanical analysis of imaging studies
(B) motion palpation findings and leg length testing
(C) mechanical and symptomatic responses to loading
(D) symptomatic, but [not] mechanical responses to loading

Delphi Topic #15
Key D
The Harvard method is used for which of the following?
(A) To test muscle strength
(B) To test flexibility
(C) To test muscle endurance
(D) To test aerobic capacity

Delphi Topic #16
Key C
Flexibility training:
(A) emphasizes static stretching
(B) emphasizes ballistic stretching
(C) emphasizes post-isometric relaxation techniques
(D) is contra-indicated in the low back pain patient

Delphi Topic #19
Key D
The best time to lift objects is:
(A) in the morning
(B) after resting in a chair for 30 minutes
(C) after stretching into forward flexion
(D) after performing extension exercises

Delphi Topic #20
Key D
During early rehabilitation of the shoulder, which of the following should be addressed first?
(A) Strength with resistance tubing
(B) Plyometric power with mediball throwing

(C) Endurance with high repetitions
(D) Improve glenohumeral congruency with weight shifts or cuff co-contractions

Delphi Topic #22
Key C
Status: A
During throwing mechanics, which phase requires plyometric power?
(A) Wind-up
(B) Cocking
(C) Acceleration
(D) Follow through

Appendix D:

TOPIC & REPORTING AREAS

Successful completion of the ACRB examination is attained with a minimum score of 70%. If this level is not achieved, to facilitate further study, the testing agency will report to the candidate the relative scores of Delphi topic areas. For purposes of reporting, the 24 Delphi topic areas are combined into 15 "reporting areas" as follows:

Content Areas	Reporting Areas
1, 8	1
2, 5	2
3	3
4	4
6, 10	5
7, 9	6
11, 12	7
13	8
14	9
15, 16	10
17, 18	11
19	12
20, 21	13
22	14
23, 24	15

Appendix E

DELPHI PROCESS

Began in 1994 when it was suggested that a Delphi process be utilized to achieve concensus on the educational requirements for chiropractic rehabilitation.

On May 13, 1995, the first Delphi meeting on Chiropractic rehabilitaiton was held in Dallas, Texas under the direction of John J. Triano, DC. Representatives of all chiropractic College offering post-graduate study in rehabilitaiton were invited to attend. Participants included 11chiropractors including representatives from NWCC, CMCC, WSCC, LACC, Palmer, NYCC, Parker, and Cleveland-KC. At this meeting the concensus process was outlined with agreement on the following future steps:

- create matrix of rehabilitation course information taught from syllabi & outlines
- meet to prioritize matrix by nominal group process
- Contact Subject Matter Experts (SME) for content information
- Create operational definitions of Delphi items
- Incorporate multidisciplinary SME suggestions into Delphi process
- Establish knowledge, skills, and attitudes necessary to be a rehabilitation specialist in chiropractic
- Publish a candidates guide of the minimum competencies required for the Diplomat status

Following this meeting, syllabi & outlines were collected from all colleges teaching rehab as well as other related educational programs (i.e. CARF, APTA specialty council, NSC curriculum).

At the July 3, 1995 (Washington D.C. Centennial) meeting:

- Was attended by representatives of NWCC, CMCC, WSCC, LACC, Palmer, and Cleve/Parker.
- Matrix presented & Matrix items voted on by nominal group process resulting in Delphi topics for each of the three 100 hundred hour programs
- Agreement from all participants to invite SME's to flush out definitions, references & a key outline for each Delphi topic.
- Agreement to meet again as soon as SME material was collated.

Following the July 3, 1995 meeting , SME material began flowing in throughout the rest of 1995 and early 1996. The Delphi topics were forwarded to the newly established ACRB on December 13, 1995 at the request of ACA Rehab Council President in order to facilitate implementation of the Delphi topics into the testing process. On December 30, 1995 confirmation was received from the the ACRB president that his board recommended the Delphi committee proceed with Delphi work.

After additional SME input, it was determined by that SME material was sufficient to allow for collation of the material and the next Delphi meeting was scheduled. At this meeting:

- Representatives from NWCC, CMCC, WSCC, LACC, Palmer, Parker, Cleveland-KC, and ACRB attended.
- Delphi items were moved, merged, added or deleted.
- Learning objectives were established for each of the three years.

- Operational Definitions with references were assigned to Delphi committee members with ACRB liaison appointed facilitator. Selected references based upon representative literature from indexed-peer reviewed sources.

Since the meeting:

- Input was received and sent back to each member for review
- Input and critque of input was collated into the document
- To ensure fairness in the process, the document was sent for approval to rehab board members (Diplomates of the ACRB) and the chairperson of college rehab programs.

At the current time (December, 1996), all rehab course instructors have been requested to review the document. Their input will be included in the proceedings of the next Delphi meeting later in 1997.